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Future of Health

Shifting Australia's focus from illness treatment to health and wellbeing management

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CSIRO FUTURES

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ACKNOWLEDGEMENT

CSIRO acknowledges the Traditional Owners of the lands that we live and work on across Australia and pays its respect to Elders past and present. CSIRO recognises that Aboriginal and Torres Strait Islander peoples have made and will continue to make extraordinary contributions to all aspects of Australian life including culture, economy, and science.

We are grateful for the time and input of external partners and stakeholders who contributed to the project through interviews, the workshop, and written feedback.

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THIS REPORT

The aim of this report is to help shape future investments in the health system by providing a vision for how Australia can shift from a focus around illness treatment to one of health and wellbeing management over the next 15 years. The primary audience consists of Australian governments, private health insurers, and private health solution providers. To inform the report, CSIRO consulted a range of industry stakeholders, including those representing the views of consumers, health professionals, other service providers, technology companies, private health insurers, government, and research.



Foreword

Can Australia be the healthiest country in the world? Well, I'll admit it's a moonshot – it will take many different people working together in bold new innovative ways – but moonshots are nothing new for CSIRO, including the original moonshot back in '69.

We have a long and proud history of solving seemingly impossible problems with science: partnering with government, industry, the research sector, and the community to invent and deliver the moonshots. From delivering the flu vaccine to diets for total wellbeing to developing technology to grow the perfect citrus fruit, CSIRO brings together leaders in their fields across the country to deliver on complex and innovative visions. But as pressure on our healthcare system increases, costs escalate, and healthy choices compete with busier lives, we need a new approach to our nation's health and wellbeing.

Our Future of Health report takes a whole-of-system view of health in Australia and provides a vision for future technologies and disruptions shaping the sector. Australia starts from a strong position to realise this vision, with a high-quality healthcare system, a robust medical research community and strong international linkages to other healthcare systems. But we need a fundamental shift in our paradigm of healthcare from treatment to prevention – we believe this shift will both reduce the financial burden on healthcare and improve quality of life for all Australians.

CSIRO plays a leading role in achieving this vision, translating our world-class science into practical real world outcomes. In true 'Team Australia' style, we are partnering with universities, industry and government to build capabilities in traditional and emerging health fields. Everything we do, we do with deep consultation and in partnership with doctors, nurses, researchers, patients and communities – so that when the solutions are ready they are tried, true and trusted.

At CSIRO, our health experts are strengthened by being part of the national science agency – home to agricultural researchers who are among the oldest genetics groups in the country, and data scientists who form the nation's largest digital research network. Recognising the rise in pandemics originating in animals, our biosecurity experts work with national and international human and animal health organisations as part of a global One Health network. They operate one of only six high-containment animal research centres in the world, our Australian Animal Health Laboratory (AAHL).



We've also grown our student and postdoctoral population by 30 per cent, and will have invested $200 million or more over this five year period in breakthrough research of the future in areas we call Future Science Platforms (FSP), planting seeds now for our future. Precision Health, one of our FSPs, is a multi-year investment focused on solving complex health-related problems. By focusing on the power of big data, including clinical, laboratory, and genetic data, the Precision Health platform is working to create novel health solutions. Our work on Synthetic Biology, another FSP, offers the potential to print vaccines one DNA letter at a time, to address chronic diseases like leukaemia.

This Future of Health report outlines enablers required for a sector-wide shift from illness treatment to health and wellbeing management over the next 15 years. It provides the foundations for creating a more efficient and resilient healthcare system and calls for a new, more diverse approach to collaboration to improve our healthcare system as a whole.

Together we can create a healthier future for Australia. At CSIRO, it's in our DNA not just to deliver the national missions, but to deliver national benefit and improve the life of every single Australian. That's the real moonshot, no one left behind.

Dr Larry Marshall
CSIRO Chief Executive

Technical foreword

Health remains a challenging area of activity. Challenges exist around system demands, financial needs, complex workforce requirements and changing consumer demands. Modern medicine has been built on a rigorous system of critically testing new ideas, with an inquisitive workforce not inclined to rest on the status quo. It could be said that disruption has been occurring in the healthcare setting since the incorporation of modern scientific methods into the care system.

In preparing for the development of this report it was considered that a 10 to 15 year horizon would be taken. In doing this it was clear that the extensive work done by others in the areas of immediate concern such as the changing age demographic and financial modelling be acknowledged.

With this in mind, we focused our attention on solutions for encouraging healthcare developments, consumer empowerment, and emerging technologies. Advances that have already shown some type of possibility are included in aspirational consumer narratives to demonstrate a realistic approach to prediction. This assumption is justified as the lead time for new developments in health to go from trial phase to standard practice can take over 15 years.

In foresighting the possibilities of health in 10 to 15 years' time, and what we can do to get there, we reviewed a wide range of literature and engaged with individuals and organisations across the health sector. This included conducting interviews with over 30 organisations from all sides of the field; including government, health insurers, educators, researchers, and professional bodies. Importantly, we also consulted consumer and sector representative groups. To test preliminary insights and further unpack complex health sector issues and solutions, we also developed an expert review panel consisting of healthcare providers, government, and research. This process is one that follows an expert consensus style, with those from the expert review panel acknowledged at the end of the document.



The complexity of the healthcare system is such that a large number of factors need to be considered and addressed for change to occur. Some of these include the need for safety, quality, and clinical effectiveness of healthcare solutions. Cost efficiency is a strong driver along with finance models and payment systems. Underpinning the move to a digitally supported healthcare system of the future is the need for infrastructure improvement, rigorous data science, and attention to integration with workflow and interface parity. The list goes on with legal, regulatory, ethical, and policy drivers playing key roles in implementation of new technologies. Perhaps the most crucial factor for the incorporation of any new procedure, technology, or process in healthcare is the acceptance by the health workforce.

The intent of this report is to not only provide an enjoyable and challenging read, but one that generates discussion and dialogue as we head into a very exciting future for health and care.

Dr Rob Grenfell
Director, CSIRO Health and Biosecurity



Executive summary

By shifting focus away from illness treatment and towards the management of health and wellbeing, the Australian healthcare sector has the opportunity to improve the health outcomes of all Australians and ensure sustainability of the healthcare system.

Australians rank amongst the healthiest in the world, largely due to the high standard of living, education, and healthcare accessibility.[1,2] Compared to other Organisation for Economic Co-operation and Development (OECD) member countries, Australia has the fourth lowest rate of Disability-Adjusted Life Years[3] and one of the lowest rates of smoking among people aged 15 and over.[4] Australia's health system is also one of the most efficient and equitable in the world, ranking fifth of 163 countries on Bloomberg's 2017 Healthiest Country Index.[5]

Governments have played a significant role in this success, with Australia's positive health outcomes correlated with the introduction of Medicare, the Pharmaceutical Benefits Scheme, and coordinated and community-wide initiatives around immunisation, road safety, and tobacco control. Other initiatives include the National Health Reform agenda; the National Health Agreement; the Medicare Benefits Schedule Review; the Medical Research Future Fund that is providing $784 million over 4 years to address national research priorities in a cohesive and coordinated way; and publications such as Innovation and Science Australia's 2030 Strategic Plan.

FIGURE 1: IMPERATIVE FOR CHANGE

However, the nation's strong health outcomes hide a few alarming facts:

Australians spend on average 11 years in ill health the highest among OECD countries.[6]





63% (over 11 million) of adult Australians are considered overweight or obese.[7]

There is a 10-year life expectancy gap between the health of non-Indigenous Australians and Aboriginal and Torres Strait Islander peoples.[8]





60% of 15-74 year olds have low levels of health literacy.[9]

The majority of Australians do not consume the recommended number of serves from any of the five food groups.[10]



1 The Organisation for Economic Co-operation and Development (OECD) 2017, *Health at a Glance 2017: OECD Indicators*, viewed 5 June 2018, http://www.oecd.org/health/health-systems/health-at-a-glance-19991312.htm

2 The Commonwealth Fund 2017, *Mirror, Mirror 2017:International Comparison Reflects Flaws and Opportunities for Better U.S. Health Care*, viewed 19 April 2018, http://www.commonwealthfund.org/~/media/files/publications/fund-report/2017/jul/schneider_mirror_mirror_2017.pdf

3 According to the WHO, one Disability-Adjusted Life Year can be thought of as one lost year of 'healthy' life. The sum of these DALYs across the population, or the burden of disease, can be thought of as a measurement of the gap between current health status and an ideal health situation where the entire population lives to an advanced aged, free of disease and disability.

4 AIHW 2018, *Australia's health 2018*. Australia's health series no. 16. AUS 221. Canberra: AIHW.

5 Lu, W & DelGiudice, V 2017, *Italy's Struggling Economy Has World's Healthiest People*, *Bloomberg Markets*, viewed 22 March 2018, https://www.bloomberg.com/news/articles/2017-03-20/italy-s-struggling-economy-has-world-s-healthiest-people

6 Productivity Commission (PC) 2017, *Shifting the Dial: 5 Year Productivity Review,* Inquiry Report No. 84, Canberra

7 Australian Bureau of Statistics (ABS) 2015, *2014-15 National Health Survey*, viewed 5 June 2018, http://www.abs.gov.au/ausstats/abs@.nsf/PrimaryMainFeatures/4364.0.55.001

8 Australian Institute of Health and Welfare (AIHW) 2015, *The health and welfare of Australia's Aboriginal and Torres Strait Islander peoples 2015*, Cat.no. IHW 147. Canberra: AIHW.

9 ABS 2006, *Health Literacy,* Australia, 2006, 4233.0. ABS, Canberra. The ABS define health literacy as the knowledge and skills needed to understand and use information relating to health issues such as drugs and alcohol, disease prevention and treatment, safety and accident prevention, first aid, emergencies and staying healthy.

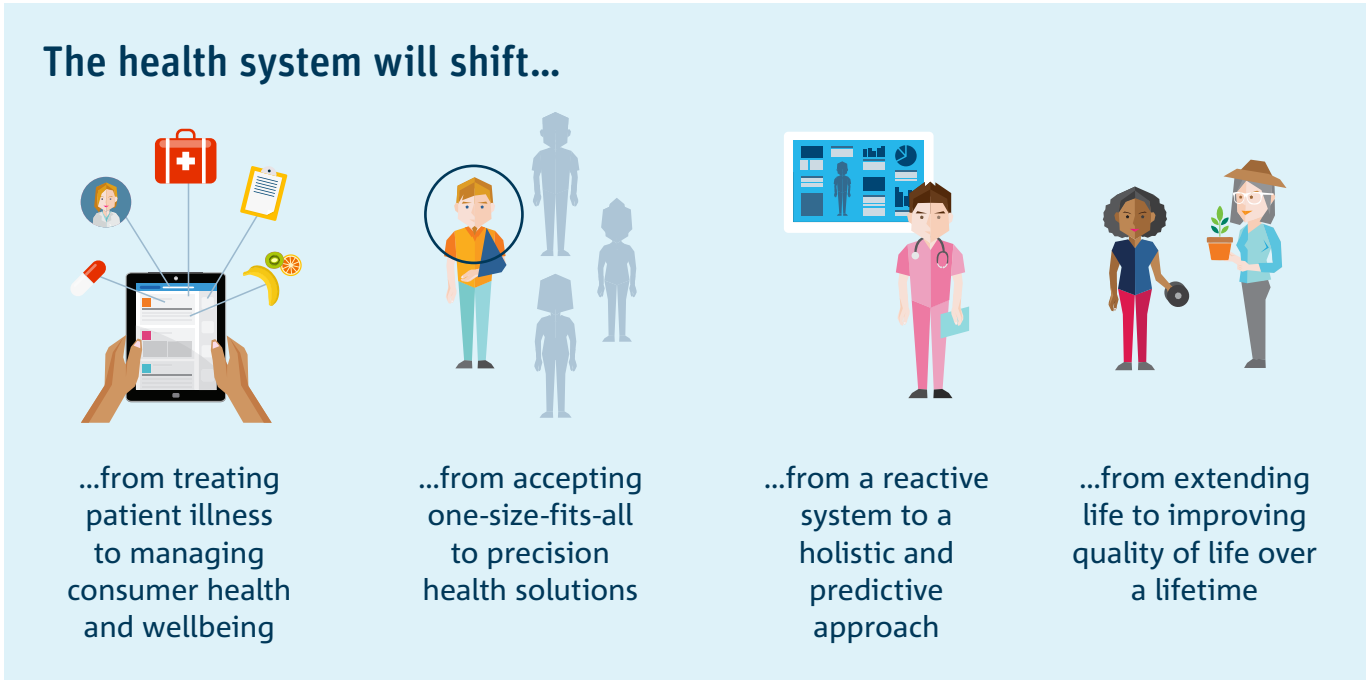
10 AIHW 2018, *Australia's health 2018*. Australia's health series no. 16. AUS 221. Canberra: AIHW.

To help address these issues and facilitate improved health and wellbeing outcomes for all Australians, CSIRO has undertaken a highly consultative process to develop this report which aims to shape future investments in the health system. Specifically, by providing an industry informed vision for how Australia's health sector can shift from a focus around illness treatment to one of health and wellbeing management over the next 15 years (Figure 2). This report was informed by the views of over 30 organisations from all sides of health, including government, health insurers, educators, researchers, and professional bodies.

While the health sector will always be required to deliver a degree of illness treatment, improvements to health outcomes can arise through a shift in focus towards cost-effective and evidence-backed preventative, precision-based, and digitally enabled health and wellbeing solutions.

This shift has already commenced in the increasingly gobal sector of healthcare.[11,12] How Australia navigates this shift over the next 15 years will significantly impact the health of the population and the success of Australian healthcare organisations both domestically and abroad.

FIGURE 2: A SHIFT IN FOCUS FOR AUSTRALIA'S HEALTH SYSTEM



11 National Health Services (NHS), *Integrated Care,* viewed 25 June 2018, https://www.england.nhs.uk/integratedcare/

12 World Health Organisation (WHO) 2016, *Framework on integrated, people-centred health services* viewed 26 June 2018, http://apps.who.int/gb/ebwha/pdf_files/WHA69/A69_39-en.pdf

Balancing continued efforts around long-term challenges such as sustainable health financing and the management of chronic disease with enhanced efforts around emerging challenges will help to successfully navigate the shift towards precision, preventative, and holistic health and wellbeing management.

FIGURE 3: EXISTING AND EMERGING CHALLENGES



CHANGING NATIONAL HEALTH PROFILE

There will be a continued and increasing need to support the ageing population and better manage chronic disease and mental health and wellbeing. However, these needs will compete for resources and investment with the emerging impacts of biosecurity issues, climate change, an increase in neurodegenerative disorders, and a changing spectrum of cancers as the common cancers become more survivable.



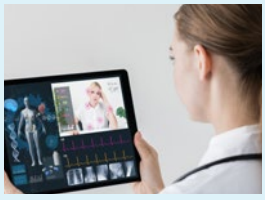
INEQUITY IN ACCESS AND EXPERIENCE

Realising substantial improvements in national health outcomes will require providing access to quality health services for all Australians and shifting away from a one-size-fits-all service model.



CONSUMER BEHAVIOUR AND TRUST

Consumers are demanding more from their healthcare experiences and embracing new technology for low-risk decision making relating to their health.



ADJUSTING TO AN INCREASINGLY DIGITAL WORLD

Trust in data sharing, digital and health literacy, data ownership, system interoperability, and Australia's current digital infrastructure present as key barriers to a more integrated and data-enabled health system.



FRAGMENTED AND INFLEXIBLE HEALTH SYSTEMS

Barriers to an integrated health services model include multiple and complex funding arrangements, siloed data streams, ever-evolving regulatory requirements, and dated infrastructure.



UNSUSTAINABLE FINANCING

Healthcare costs and the dependency ratio continue to rise, placing significant financial pressure on all stakeholders. Some solutions are gaining traction, however require significant changes to financing structures, cultures, and expensive initial outlays.

Long-term and multifaceted planning around behavioural change and policies that target holistic health and wellbeing management can help enable the shift.

Digital technologies could assist many of the necessary changes – complementing the role of health professionals and providing consumers with greater autonomy in their health and wellbeing management. Many of the digital platforms and tools required already exist but are not heavily utilised. The sector will need to consider how to facilitate greater uptake of novel and effective health solutions; how to provide health professionals and organisations with the necessary support required to successfully navigate change; what system changes are required to securely unlock value from the growing volume of personal health information; and how to divest away from obsolete or lower value health solutions.

Balancing these efforts with the continued need for face-to-face interactions and humanity in health will help to ensure Australians receive the most suitable care for their situation. With clinical care only accounting for 20% of the factors influencing an individual's length and quality of life, focussing on the remaining 80% – the role that healthy behaviours, social and economic support, and the physical environment play in impacting health outcomes – is critical.[13]

Based on extensive desktop research and stakeholder consultation, enabling themes and actions were identified to achieve the shift towards precision, preventative, and holistic health and wellbeing management (Table 1).

13 Hood, C,M, Gennuso, K,P, Swain, G,R, and Catlin, B,B, 2016, County Health Rankings, *American journal of preventive medicine*, vol. *50*, no. 2, pp.129-135.

TABLE 1: ENABLING THEMES AND ACTIONS FOR AUSTRALIA'S HEALTH SYSTEM SHIFT

THEME	ENABLER	SUMMARY OF POTENTIAL ENABLING ACTIONS
Empowering consumers	**Addressing information asymmetry**	Develop robust consumer rating tools, symptom checker applications (apps), and publically available information sources for market rates of common health services.
	Expanding telehealth services and improving consumer controlled devices	Encourage the provision of telehealth services across additional health service types and regions, ensure new mobile health (mHealth) offerings pair output and interpretation with actionable recommendations, and incentivise the uptake of in-home and wearable technology to support preventative behaviours.
Addressing health inequity	**Providing community-tailored solutions for digital and health literacy**	Develop tools and initiatives that target health issues faced by Australians experiencing inequitable health outcomes, including community-tailored early childhood education programs, improved access to healthy foods, and incentives for engagement in personal health and wellbeing.
	Maintaining and strengthening Aboriginal and Torres Strait Islander health	Co-create health and wellbeing solutions by bringing together industry and research with key Aboriginal and Torres Strait Islander influencers in the region to develop health initiatives that consider the diverse demographics and population attributes of each community.
Unlocking the value of digitised data	**Facilitating electronic health record (EHR) engagement**	Ensure EHRs involve clear value communication, are easy to use, have Key Performance Indicators (KPI) around usage, are securely interconnected (within the health sector as well as other related sectors), and are accompanied by education and training programs.
	Ensuring interoperability	Invest in digital infrastructure and ensure Australian representation in international discussions around the global harmonisation of interoperability standards.
	Creating trust in digital tools	Improve healthcare networks and infrastructure such that all new systems and upgrades are secure by design, improve communication to all stakeholders around how data will be handled, and ensure data sharing guidelines account for ethical and cultural diversity.
Supporting integrated and precision health solutions	**Accelerating the move to integrated care**	Improve the stratification and triage of consumers, expand the number of integrated care sites, encourage the sharing of infrastructure, and develop consortiums to tackle issues around data management and easing the consumer journey.
	Moving to models of value-based care	Improve understanding of clinical variation to more effectively implement outcomes-based funding models, which include the incorporation of patient-reported experiences and outcomes that can be shared through a national outcomes database.
	Improving the quality of predictive analytics	Invest in diagnostic and health management tools that integrate medical data with data from an individual's environment, lifestyle, and internal biology. Ethical implications of increased predictive capabilities must also be considered.
	Preparing the future health professional	Shift education and training focus away from detailed textbook knowledge and towards learning from new and high quality evidence, digital health literacy, interpersonal skills, and a greater understanding of equity, diversity, population health, and ethics.
Integrating with the global sector	**Improving international collaboration**	Identify areas of competitive strength for investment and pursuit of global excellence, enhance national coordination, and collaborate with global technology companies and international research groups.
	Improving pathways to market for novel health management solutions	Explore more efficient ways of conducting clinical trials and develop partnerships between research, industry, and regulators that help inform regulators early of complex emerging health solutions and to test regulatory classifications and pathways for new technologies.

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1 Imperative for change

Shifting focus from treating one disease at a time to managing the overall health of individuals and populations can assist in building long-term adaptability into the health system and further improving the health outcomes of all Australians.

Australian citizens rank amongst the healthiest in the world, largely due to the high standard of living, education, and healthcare accessibility.[14,15] Australia's health system is also one of the most efficient and equitable in the world, ranking fifth of 163 countries on Bloomberg's 2017 Healthiest Country Index.[16] The health sector is supported by comparative strengths in medical research and education, as well as a thriving industry involved in the development and distribution of health and medical technologies, pharmaceuticals, and biotechnology. The government has played a significant role in this success, with Australia's positive health outcomes correlated with the introduction of the Pharmaceutical Benefits Scheme, Medicare, and coordinated and community-wide initiatives around immunisation, road safety, and tobacco control.

Unfortunately, Australia's global rank and positive activities hide a few alarming facts (Figure 4). While Australians have an enviable average life-span, high quality of life and access to quality healthcare are not available for all. According to self-reporting, 50% of Australians have at least one of eight[17] surveyed chronic conditions.[18] These conditions often occur concurrently with another primary disease or disorder and share many common risk factors.

Moving away from a design that specialises in the treatment of single and acute illnesses and towards one that supports the health and wellbeing management of individuals from birth will help improve health outcomes for all Australians. As will improving the ability of the health system to continually adapt to the population's ever-evolving needs. For example, as solutions for cardiovascular diseases, common cancers, and neurodegenerative diseases are developed, more focus will be placed on emerging threats such as rare cancers and the risk of infectious disease outbreaks.

The transition to a more holistic, preventative, and consumer empowered health system presents as a substantial and challenging shift for Australia. This shift will require a change in how consumers share their personal data and how they trust next generation medical platforms; it will require the modification of existing business models, which may damage short-term profitability; and it will require alignment to the current federal structure which sees nine different governments (federal and state levels) each with different sets of priorities and responsibilities.

How Australia navigates the shift over the next 15 years will significantly impact the health and wellbeing of the population and the success of Australian healthcare organisations. Healthcare solutions that provide improved consumer care with greater cost efficiency are constantly emerging, and Australia must act now to prepare itself to realise the benefits they provide and ensure new clinically validated technologies are incorporated through timely, safe, and quality assured frameworks.

14 The Organisation for Economic Co-operation and Development (OECD) 2017, *Health at a Glance 2017: OECD Indicators*, viewed 5 June 2018, http://www.oecd.org/health/health-systems/health-at-a-glance-19991312.htm

15 The Commonwealth Fund 2017, *Mirror, Mirror 2017:International Comparison Reflects Flaws and Opportunities for Better U.S. Health Care*, viewed 19 April 2018, http://www.commonwealthfund.org/~/media/files/publications/fund-report/2017/jul/schneider_mirror_mirror_2017.pdf

16 Lu, W & DelGiudice, V 2017, *Italy's Struggling Economy Has World's Healthiest People*, *Bloomberg Markets*, viewed 22 March 2018, https://www.bloomberg.com/news/articles/2017-03-20/italy-s-struggling-economy-has-world-s-healthiest-people

17 Arthritis, asthma, back problems, cancer, chronic obstructive pulmonary disease, cardiovascular disease, diabetes mellitus, or a mental or behavioural condition.

18 AIHW 2016, *Australia's health 2016*, Australia's health no. 15. Cat. no. AUS 199. Canberra: AIHW.

FIGURE 4: IMPERATIVE FOR CHANGE

Despite ranking the 5th most efficient and equitable health system in the world, Australia's health sector needs improving.



Australian's spend on average 11 years in ill health the highest among OECD countries.[19]



Over 11 million (63%) of adult Australians are considered overweight or obese.[20]



There is a 10-year life expectancy gap between the health of Aboriginal and Torres Strait Islander peoples and non-Indigenous Australians.[21]



60% of 15-74 year olds have low levels of health literacy.[22]



The majority of Australians do not consume the recommended number of serves from any of the five food groups.[23]

19 Productivity Commission (PC) 2017, *Shifting the Dial: 5 Year Productivity Review,* Inquiry Report No. 84, Canberra
20 ABS 2015, *2014-15 National Health Survey*, viewed 5 June 2018, http://www.abs.gov.au/ausstats/abs@.nsf/PrimaryMainFeatures/4364.0.55.001
21 AIHW 2015, *The health and welfare of Australia's Aboriginal and Torres Strait Islander peoples 2015*, Cat.no. IHW 147.Canberra: AIHW.
22 ABS 2006, *Health Literacy,* Australia, 2006, 4233.0. ABS, Canberra. The ABS define health literacy as the knowledge and skills needed to understand and use information relating to health issues such as drugs and alcohol, disease prevention and treatment, safety and accident prevention, first aid, emergencies and staying healthy.
23 AIHW 2018, *Australia's health 2018*. Australia's health series no. 16. AUS 221. Canberra: AIHW.



2 Existing and emerging challenges

Australia's health sector faces constantly changing requirements and is typically slow to adapt to drivers of change. The nation will face its own unique set of challenges over the next 15 years, however many will overlap with those of other countries, especially as the sector becomes more global.

Preparing for both existing and emerging challenges will help Australia's health sector maintain its strong reputation and facilitate a shift in focus towards greater health and wellbeing management. Existing challenges around sustainable financing and the ageing population have been present for years, and will continue to require attention for years to come. However, as the quality of clinical data around equity, data management, and future health profiles improves, associated challenges will come into focus and compete for investment.

A deeper consideration of all challenges presented in this chapter will help governments, industry, and researchers understand the highest priority needs that will best prepare Australia for a healthy future – including business models, industries, cultures, and skills.

2.1 Changing national health profile

There will be a continued and increasing need to support the ageing population and better manage chronic disease and mental health and wellbeing. However, these needs will compete for resources and investment with the emerging impacts of biosecurity issues, climate change, an increase in neurodegenerative disorders, and a changing spectrum of cancers as the common cancers become more survivable.

EXISTING HEALTH AND WELLBEING ISSUES

- **Ageing** – An ageing Australian population has been the primary factor behind a growth in demand for health services over the past five years.[24] In 2015–16, there were more Australians aged 45 or older than under 30 – the first time since federation.[25] By 2056, it is projected that 22% of Australians will be 65 or over.[26] As this demographic continues to grow, discussions and decision making will need to move away from treating the elderly as a single cohort with the same needs and wants – growth in size breeds growth in diversity.
- **Chronic disease** – The ageing population, coupled with increasingly sedentary lifestyles, changing diets and rising obesity rates have caused an increase in the incidence of chronic disease globally. As technology continues to make life easier – from commuting to manual labour – Australians risk becoming even more sedentary unless a greater focus on total wellbeing is achieved. Managing obesity alone costs the nation more than $5 billion a year in healthcare costs, welfare expenditure and lost income taxes, and leads to other illnesses, both physical and mental in nature.[27] The impacts of chronic disease are compounded for many Australians with 5.3 million Australians living with two or more of the eight chronic conditions surveyed by the National Health Survey in 2015.[28]
- **Mental health** – Mental health issues make up 12% of Australia's burden of disease – equating to $60 billion annually.[29,30] Mental health conditions will continue to require additional support as demand grows through improvements in diagnosis and a greater societal focus is placed on holistic wellbeing. Demand growth will also result if the growing number of elderly and chronically impeded continue to find it difficult to obtain meaningful employment or experience a high quality of life.

Mental health issues make up 12% of Australia's burden of disease – equating to $60 billion annually.

While the world will have better management and treatment options for some diseases (e.g. genetic disorders, common cancers, and cardiovascular disease), many existing health problems will persist over the next 15 years. Efforts to combat these existing health issues will need to be balanced with an array of emerging health issues.

24 Richardson, A 2017, IBIS World Industry Report Q8601, *Aged Care Residential Services in Australia*
25 ABS 2018, Australian Demographic Statistics 2017,cat.no. 3101.0, Australian Bureau of Statistics, Canberra.
26 AIHW 2017, *Older Australians at a glance*, https://www.aihw.gov.au/reports/older-people/older-australia-at-a-glance/contents/demographics-of-older-australians/australia-s-changing-age-and-gender-profile
27 Duckett, S, Swerissen, H & Wiltshire, T 2016, A *sugary drinks tax: recovering the community costs of obesity*, Grattan Institute
28 AIHW 2016, *Australia's health 2016*, Australia's health no. 15. Cat. no. AUS 199. Canberra: AIHW
29 AIHW 2016, *Australian Burden of Disease Study: Impact and causes of illness and death in Australia 2011, Australian Burden of Disease Study*, series no.3. BOD 4. Canberra: AIHW.
30 National Mental Health Commission 2016, *Economics of Mental Health in Australia,* viewed 29 May 2018, http://www.mentalhealthcommission.gov.au/media-centre/news/economics-of-mental-health-in-australia.aspx

EMERGING HEALTH AND WELLBEING ISSUES

- **Neurodegenerative disorders** – 50 million people worldwide are living with dementia and this figure is predicted to double in 20 years.[31] In Australia, the cost of dementia alone has been valued at over $14 billion annually.[32] However, emerging biomarker and imaging technologies that identify early indicators of these diseases, and allow for early intervention, have the potential to rapidly curb growth beyond the next 15 years.
- **Rare and less common (RLC) cancers** – Common cancers continue to experience reductions in mortality, however, this has not been the case for RLC cancers where diagnosis remains slow and treatment availability is limited.[33] As the management of more common cancers continues to improve, the associated increasing lifespans will see more individuals develop RLC cancers such as pancreatic and renal.[34]
- **Biosecurity concerns** – As globalisation and migration continue to increase the flow of people, livestock, and plants across Australia's borders, the risk of a significant biosecurity event grows. In addition to the negative impacts this could have on determinants of health like employment, viral strains carried by birds or livestock, or biothreat events, could bring a wave of infectious disease. These events would be particularly harmful in the likely context of a future where anti-microbial resistance has reached a point that leaves the nation critically vulnerable to such events. Relatively little is known about infectious diseases like Ebola, Middle East Respiratory Syndrome (MERS) and the Hendra Virus, and while detection will become easier in the future, Australia's health system will need to become better informed and prepared to manage outbreaks.[35]
- **Effects of environmental change**[36,37] – As the impacts of climate change and urbanisation become more severe, so will their impact on public health. Changing weather patterns will impact the growth of crops for food and result in vectors of tropical diseases moving south. Hotter temperatures will cause more heat stroke, dehydration, and a higher incidence of cardiovascular, respiratory, and cerebrovascular disease. Worsening air quality will result in an increase in allergy triggers, asthma attacks, and other respiratory issues. High-density living could result in poorer housing conditions, environmental pollution and degradation, faster spread of disease, and negative impacts on water supply and sanitation. In addition, more frequent severe weather events will disrupt food production and increase population displacement, injuries, and deaths.

As the impacts of climate change and urbanisation become more severe, so will their impact on public health.

31 Deloitte UK Centre for Health Solutions 2017, *The Future awakens: Life sciences and health care predictions 2022*, viewed 22 March 2017, https://www2.deloitte. com/uk/en/pages/life-sciences-and-healthcare/articles/healthcare-andlife-sciences-predictions.html

32 Brown, L, Hansnata, E and La, HA 2017, Economic cost of dementia in Australia 2016-2056, *Alzheimer's Australia, Canberra: Institute for Governance and Policy Analysis, University of Canberra*.

33 Rare Cancers Australia 2018, *Research,* viewed 29 May 2018, https://www.rarecancers.org.au/page/14/research

34 Rare Cancers Australia 2017, *Rare solutions: a time to act*, viewed 19 April 2018, https://engonetrca2.blob.core.windows.net/assets/uploads/files/2017%20Rare%20Solutions%20Report_%20FINAL%20DIGITAL%20VERSION.pdf

35 Commonwealth Scientific and Industrial Research Organisation (CSIRO) Futures 2014, CSIRO, *Australia's Biosecurity Future – Preparing for future, biological challenges*, viewed 20 April 2018, https://publications.csiro.au/rpr/download?pid=csiro:EP146693&dsid=DS4

36 Bell, J et al 2017, *Changes in extreme events and the potential impacts on human health,* Journal of the Air & Waste Management Association, *vol. 68*, no. 4.

37 AIHW 2018, *Australia's health 2018*. Australia's health series no. 16. AUS 221. Canberra: AIHW.

2.2 Inequity in access and experience

Realising substantial improvements in national health outcomes will require providing access to quality health services for all Australians and shifting from a one-size-fits-all service model.

Despite Australia's universal health system enabling comprehensive health cover for most Australians, the health needs of certain demographics remain unmet. Inequities exist across a range of social, economic, and cultural measures and cost Australia almost $230 billion a year – more than mental illness and obesity.[38]

The population groups most likely to be faced with health inequity include Aboriginal and Torres Strait Islander peoples, homeless people, those affected by chronic mental illness or disability (and their carers), unemployed people or those with insecure low-paid employment, people living in remote areas, and some immigrant groups.[39] For example, low socioeconomic status is associated with higher morbidity, mortality rates, and health risk behaviours (e.g. smoking and poor nutrition). The AIHW estimate that mortality from a selection of leading causes of death in Australia is 29% higher in the lowest socioeconomic group than in the highest socioeconomic group.[40]

Of particular concern are the significant differences between the health of non-Indigenous Australians and Aboriginal and Torres Strait Islander peoples – which include a 10-year life expectancy gap.[41] Aboriginal and Torres Strait Islander peoples also have higher child mortality, higher rates of chronic disease, and higher rates of hospitalisation.[42]

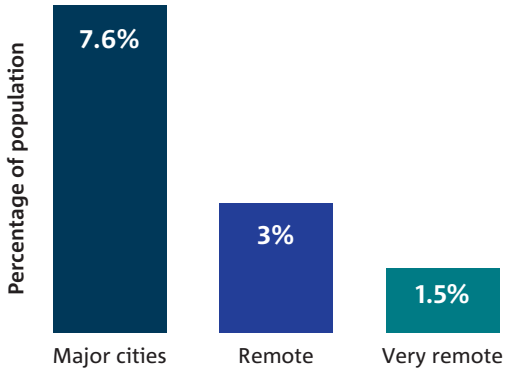
There are also significant disparities in health between populations living in rural and urban areas.

Approximately 30% of the Australian population live outside major cities and face significantly poorer health outcomes compared to those living in urban areas.[43] This is largely due to having greater health risk factors (including higher blood pressure and lower levels of exercise) and poorer access to and use of health services than people living in major cities.

Australians living in rural and remote areas tend to have lower life expectancy, poorer mental health outcomes, and higher rates of disease and injury.[44]

Of the rural population, almost 11% face limited healthcare-provider density due to a lack of infrastructure developments and physicians (who prefer to work in urban centres).[45] Further, while the prevalence of mental disorders is similar across all regions, individuals living in very remote areas access the Medical Benefit Schedule (MBS) for mental health services less than 20% the rate of those in major cities (Figure 5).

FIGURE 5: UTILISATION OF MBS MENTAL HEALTH ITEM NUMBERS BY REGION (2011–12)[46]



38 Lateral Economics 2017, Herald/Age – Lateral Economics (HALE) Index, December.
39 Public Health Australia (PHA) 2012, Health Inequalities Policy
40 AIHW 2016, *Australia's health 2016*, Australia's health series no. 15. Cat. no. AUS 199. Canberra: AIHW.
41 AIHW 2017, *Deaths in Australia*, viewed 22 March 2018, https://www.aihw.gov.au/reports/life-expectancy-death/deaths-in-australia/contents/life-expectancy
42 Australian Indigenous HealthInfoNet 2016, *Summary of Aboriginal and Torres Strait Islander health status 2016*, https://healthinfonet.ecu.edu.au/healthinfonet/getContent.php?linkid=590827&title=Summary+of+Aboriginal+and+Torres+Strait+Islander+health+status+2016
43 ABS 2011, *Health outside major cities*, Australian Social Trends, March 2011. Cat no. 41020.0. Canberra: (ABS).
44 AIHW 2016, *Rural and Remote health: Australia's health 2016*, viewed 29 May 2018, https://www.aihw.gov.au/getmedia/6d6c9331-5abf-49ca-827b-e1df177ab0d3/ah16-5-11-rural-remote-health.pdf.aspx
45 Frost & Sullivan 2015, Analysis of Mobile Health Market in Australia
46 The Centre for International Economics 2015, The Royal Flying Doctor Service: Flexible and responsive primary healthcare in rural and remote Australia, Canberra: Centre for International Economics.

2.3 Consumer behaviour and trust

Consumers are demanding more from their healthcare experiences and embracing new technology for low-risk decision making relating to their health.

Highly engaged consumers are demanding faster, cheaper, more personalised, and preventative health solutions that are delivered with high quality customer service.[47] They are also demanding greater convenience – services delivered when they want it, where they want it, and with the ability to control both. While 73% of Australians want access to health services online, only 6% manage to find an online health source they trust.[48] In contrast, there are also Australian communities with more urgent needs such as access to reliable internet and health clinics.

These demands are driving the creation of new and often decentralised digital health offerings, which are becoming increasingly pervasive and accessible to consumers.[49] However with slow uptake by many health professionals and the broader systems they operate in, patient data will continue to be underutilised as its true value can only be realised when integrated with a broader set of patient and population information and converted into actionable recommendations.

While 73% of Australians want access to health services online, only 6% manage to find an online health source they trust.

With a growing amount of information available online, consumers are entering clinics more informed and with preconceived diagnoses and preferred treatment options. In some instances, consumers may avoid professional face-to-face support entirely if they deem the self-collected information sufficient. This presents dangers as most consumers are not well equipped to translate this information into knowledge, and in many cases the information identified is non-clinical and potentially inaccurate, resulting in individual's misdiagnosing and mistreating themselves.

It is important that consumers are enabled to make informed choices as they are increasingly able to take greater responsibility for their own health.

Also driven by a desire for greater information is the growth in online purchasing of direct-to-consumer tests (e.g. genetic tests) sourced from international suppliers (domestic supply of genetic tests is prohibited unless a health professional is involved in the return of results to the patient). Such tests are difficult to regulate, and so their quality and performance vary significantly. Again, this can result in a misunderstanding of one's health. The investigation of novel methods of quality performance is essential to provide a safe setting for the progression to a consumer driven healthcare system.

47 KPMG 2018, *Healthcare reimagined,* viewed 30 May 2018, https://assets.kpmg.com/content/dam/kpmg/au/pdf/2018/healthcare-reimagined-report-2018.pdf

48 Australian Digital Health Agency (ADHA) 2017, *Safe seamless and secure: evolving health and care to meet the needs of modern Australia, Australia's National Digital Health Strategy*, viewed 15 April 2018, https://www.digitalhealth.gov.au/about-the-agency/publications/australias-national-digital-health-strategy/ADHA-strategy-doc-(2ndAug).pdf

49 GlaxoSmithKline Pharmaceuticals Ltd. (GSK) 2017, *Digital healthcare attitudes in Australia,* viewed 30 May 2018, http://au.gsk.com/en-au/behind-the-science/everyday-health/digital-healthcare-attitudes-in-australia/

50 *The Growing Value of Digital Health: Evidence and Impact on Human Health and the Healthcare System*

51 Norman, C,D, and Skinner, HA, 2006, eHEALS: the eHealth literacy scale. *Journal of medical Internet research*, vol. *8*, no.4.

52 ABS 2006, Health Literacy, Australia, 2006, 4233.0. ABS, Canberra. The ABS define health literacy as the knowledge and skills needed to understand and use information relating to health issues such as drugs and alcohol, disease prevention and treatment, safety and accident prevention, first aid, emergencies and staying healthy.

53 ICT literacy is defined as the ability of individuals to use ICT appropriately to access, manage, integrate and evaluate information, develop new understandings, and communicate with others in order to participate effectively in society.

54 Australian Curriculum Assessment and Reporting Authority (ACARA) 2011, National Assessment Program – ICT Literacy Years 6 & 10 Report, viewed 7 June 2018, https://www.nap.edu.au/_resources/NAP_ICTL_2011_Public_Report_Final.pdf

2.4 Adjusting to an increasingly digital world

Trust in data sharing, digital and health literacy, data ownership, system interoperability, and Australia's current digital infrastructure present as key barriers to a more integrated and data-enabled health system.

Technology companies are introducing new levels of competition to the healthcare market. There were approximately 318,000 mobile health apps as at 2017[50] – presenting an increasing opportunity for consumers to manage their own health. However, many remain unregulated despite making health claims and have no accountability for the health outcomes they may lead to. Further, organisations like IBM, Amazon, and Google, as well as a wide range of smaller start-ups, are flooding the healthcare market with new and effective digital health solutions.

With a seemingly unlimited array of apps, Artificial Intelligence (AI) platforms, bots, virtual reality and augmented reality applications, and robots, consumers and service providers in all sectors have entered an era where digital literacy is a prerequisite for receiving and delivering the best support. Digital health literacy – the ability to seek, find, understand, and appraise health information from electronic sources and apply the knowledge gained to addressing or solving a health problem – is also becoming more important.[51]

Despite these trends, almost 60% of Australians aged 15–74 have a health literacy level that is considered inadequate.[52] This challenge is compounded by a lack of digital literacy, with approximately 40% of Year 6 and 10 students failing to meet a proficient standard of ICT literacy.[53,54] For those who have difficulty correctly using digital health tools (as a result of digital literacy level or design issues) or lack the ability to appropriately interpret data outputs, there is a risk that digital health platforms could lead to misdiagnosis or ineffective health management when greater power is given to the consumer. This risk, combined with a desire to maintain current practices and a lack of effective incentives to do otherwise, is resulting in many health professionals resisting uptake of digital health platforms.

Almost 60% of Australians aged 15–74 have a health literacy level that is considered inadequate.

Australian consumers generally adopt new technologies faster than businesses or government.[55] However, many consumers still have concerns around the privacy, integrity, and management of personal medical data.[56] In the wrong hands, this information can lead to identity fraud or interfering with digital health implants. As more data is created and exchanged through apps and medical devices, improvements to data storage, standardisation, access, ownership, integrity, interoperability, and security need to be central concerns for the sector if users are to overcome trust issues.[57]

A Ponemon Institute study found that 90% of healthcare organisations have experienced a data breach in the past two years.[58]

Finally, for Australia to effectively transition to a digitised health sector, the nation requires significant upgrades to digital infrastructure, with poor network coverage in rural areas and difficulties in accessing high speed and consistent internet in some metropolitan regions.[59]

55 PC 2016, *Digital Disruption: What do governments need to do?,* Commission Research Paper, Canberra.
56 CSIRO Futures 2018, *Cyber Security: A roadmap to enable growth opportunities for Australia*, Canberra, Australia.
57 Frost & Sullivan 2016, *Top Trends in Health IT from HIMSS16*, Mountain View
58 Ponemon Institute 2016, *Sixth Annual Benchmark Study on Privacy & Security of Healthcare Data*, viewed 19 April 2018, https://www.ponemon.org/library/sixth-annual-benchmark-study-on-privacy-security-of-healthcare-data-1
59 PC 2016, *Digital Disruption: What do governments need to do?,* Commission Research Paper, Canberra.

2.5 Fragmented and inflexible health systems

Barriers to an integrated health services model include multiple and complex funding arrangements, siloed data streams, ever-evolving regulatory requirements and dated infrastructure.

With split federal and state level control, and both private and public health sectors, Australia's health services are fragmented. These fragmented services have resulted in fragmented data collection – which is highly detrimental to continuity of care between providers and can lead to adverse health outcomes.[60]

Federal, state, and private health systems all use different methods for data collection and management, creating silos of information across Australia's health system as well as between countries. A survey conducted by Australia's Digital Health Agency (ADHA) found that over 65% of respondents thought the Australian healthcare system was difficult to navigate, and only 10% currently access personal health information on their smart phone despite 50% wanting to.[61]

Less than 20% of Australian general practitioners (GPs) were always told when a patient was seen in an emergency department compared with 68% in the Netherlands, 56% in New Zealand and 49% in the United Kingdom.[62]

Attempts have been made to link systems through My Health Record. While the program has had limited adoption to date, improvements may arise from the recent move to an opt-out model, with more data increasing the potential value. All initiatives designed to link existing and emerging sources of health data will need to carefully consider data privacy, access, and handling arrangements, as well as the communication of these protocols to all relevant stakeholders.

Regulators are also facing challenges, with a step change increase in the number of health solutions (e.g. digital health solutions and precision medicines) seeking approval. Current global best practice approval processes need to be more adaptive in order to keep pace with the ever evolving complexity of emerging technologies, software based health solutions, and combination therapeutics. Regulatory approval classifications and processes face ongoing design challenges as they attempt to deliver the same level of safety and maintain public confidence and trust, while facilitating a less onerous, more adaptive, and faster route to market for Australian innovations.

Finally, as the health services in greatest demand and their associated best practice solutions continue to change, Australia's health service infrastructure will become dated faster than ever before. Already, many of the operating theatres (and equipment) in existing hospitals lay idle for long periods each day, with poor scheduling and clinics that lack the flexibility to perform multiple functions resulting in cost inefficiencies due to unutilised space and out-dated technologies.[63,64]

60 Srinivasan, U, Rao, S, Ramachandran, D & Jonas, D 2016, *Flying Blind: Australian Consumers and Digital Health*, Volume 1: Australian Health Data Series, Health Market Quality Research Program, CMCRC, Sydney.
61 ADHA 2017, *Safe, seamless and secure: evolving health and care to meet the needs of modern Australia, Australia's National Digital Health Strategy*, viewed 15 April 2018, https://www.digitalhealth.gov.au/about-the-agency/publications/australias-national-digital-health-strategy
62 PC 2017, *Shifting the Dial: 5 Year Productivity Review, Inquiry Report.*
63 Victorian Government 2016, *Victorian Auditor- General's Report: Efficiency and Effectiveness of Hospital Services: Emergency Care.*
64 Queensland Audit Office 2016, *Queensland Public Hospital Operating theatre efficiency* .

2.6 Unsustainable financing

Healthcare costs and the dependency ratio continue to rise, placing significant financial pressure on all stakeholders. While some solutions are gaining traction, they require significant changes to financing structures, cultures, and expensive initial outlays.

Sustainable health financing is a challenge globally. For many years, increasing demand, funding constraints and expensive new technologies, medical services, and pharmaceuticals have seen both public and private health systems experience rising costs and falling margins. In 2015-16, Australia spent around $170 billion (10.3% of GDP) on health, with government expenditure accounting for $115 billion of this figure.[65]

Looking ahead, these cost pressures will continue as Australia's ageing population and incidence of chronic disease grow, further increasing the dependency ratio[66] and restricting investment in updating outdated infrastructure and legacy technologies.[67] A shift towards precision medicine will also bring financing pressures, with the cost of development being spread across fewer consumers.[68] Without intervention, Australian governments will need to double spending on healthcare per capita by 2054–55 in order to finance their current level of responsibility.[69]

Governments will increasingly be challenged by finding a balance between their fiscal responsibilities of the current system and investing in innovation. While changing to more preventative models of care and incorporating associated digital platforms can provide cost efficiencies, they also require large up-front investments in planning, capital investments, and training. These shifts are challenged further by the short-term nature of political cycles and therefore thinking; pressure on for-profit providers to maintain margins for their shareholders and operate under viable business models; and the need to coordinate the numerous levels of government, payers, and providers.

While Australia's out of pocket expenses (19.0% of health spending) are near the OECD average (23.0%), they rank higher than many key comparator countries, including the United Kingdom (15.1%), New Zealand (13.6%), US (11.0%), and France (9.8%).[70] If governments and private insurers are unable to identify cost-efficient solutions, consumers risk facing further increases. This could cause additional negative health outcomes for families under financial distress as they are forced to make trade-offs between which family members receive support, what foods they can afford and how much they put towards other determinants of health.

Finally, as the population continues to experience increases in life expectancy, personal savings will be stretched over a longer retirement if older Australians are not able to find or participate in employment. This will make it more difficult to finance the additional health and lifestyle related expenses associated with this life stage which may also lead to increases in stress related health issues.

65 AIHW 2018, *Australia's health 2018*. Australia's health series no. 16. AUS 221. Canberra: AIHW.
66 The dependency ratio is a measure showing the number of dependents, aged zero to 14 and over the age of 65, to the total population, aged 15 to 64.
67 Deloitte 2017, *2018 Global health care outlook l The evolution of smart health care*, viewed 22 March 2018, https://www2.deloitte.com/global/en/pages/life-sciences-and-healthcare/articles/global-health-care-sector-outlook.html
68 Williamson, R., et al 2018, The Future of Precision Medicine in Australia, Report for the Australian Council of Learned Academies.
69 Australian Treasury 2015, *2015 intergenerational report: Australia in 2055*, Australian Treasury, Canberra, pp. 62.
70 OECD 2018, *Health spending*, viewed 5 September 2018, https://data.oecd.org/healthres/health-spending.htm

3 A vision for Australian health

Value will be rewarded over volume, consumers will be empowered and viewed as a valuable health resource, humanity and relationships will be essential elements of care, and technology will be used to decrease costs and increase access to care.

This chapter presents an aspirational vision for Australia's health sector in 15 years' time. The vision is presented in the form of consumer narratives which describe elements of Australia's health system that could be realised if some of the challenges discussed in the previous section were mitigated.

Under this vision, the greatest shift to occur will be one of perspective – where the health sector is no longer predominantly viewed as something consumers engage with when sick, but instead a series of integrated activities designed to sustain good health. This shift will drive most other changes in the sector.

There will be a broader appreciation of the roles that meaningful employment, social equity, stress levels, education, nutrition, exercise, and environment play in managing health. This means that improvements in Australian health outcomes will be delivered by a system that combines the value of a range of industries. Mergers, acquisitions and collaborations will bring together medical and allied health providers with technology companies, research organisations, not for profits, supermarkets, gyms, and consumer-generated information to combine their pooled data and resources for more comprehensive and integrated services.

FIGURE 6: A SHIFT IN FOCUS FOR AUSTRALIA'S HEALTH SYSTEM

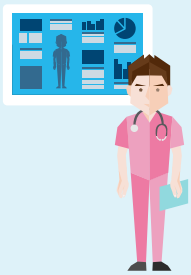
The health system will shift...



...from treating patient illness to managing consumer health and wellbeing



...from accepting one-size-fits-all to precision health solutions



...from a reactive system to a holistic and predictive approach



...from extending life to improving quality of life over a lifetime

Healthy and highly engaged



Zoe and Priya

Priya and her wife Zoe are healthy, highly engaged, and technologically savvy health consumers. They exercise and spend time in the natural environment daily, check-in with their health management plans weekly and consider the environmental sustainability ratings of their healthcare providers and solutions. Zoe is pregnant with their first child.

HEALTH MANAGEMENT PLANS

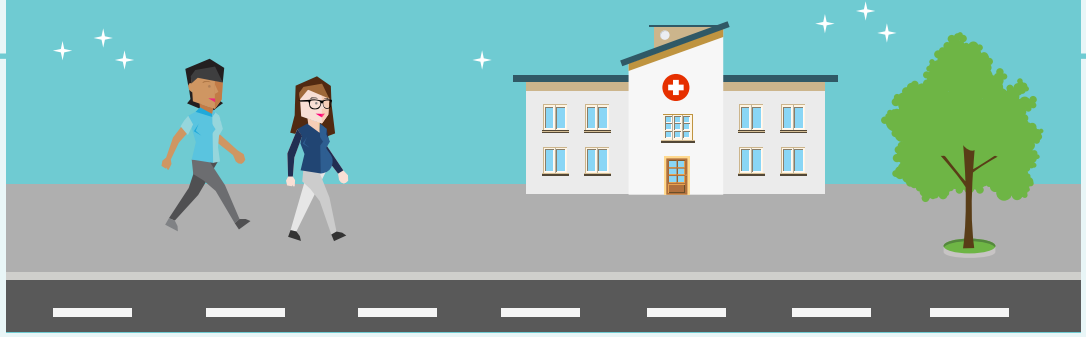
Developed by their private insurer in partnership with healthcare providers and governments, these mobile platforms offer self-care tools and data management and transfer. Combining personal and population data helps insurers provide more appropriate coverage, information about health risks, and better match consumers with management solutions.





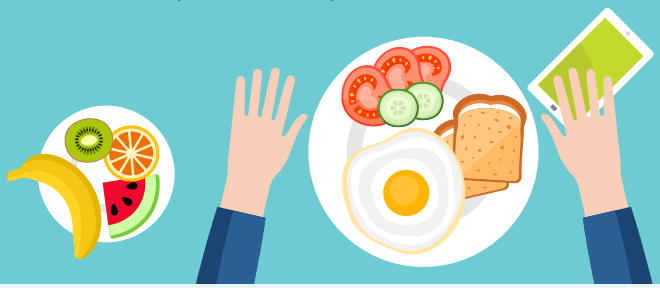
PRENATAL GENETIC SCREENING

After arriving home from work, Priya and Zoe decide to walk to their local health clinic after being notified through an app that their clinician is running 15 minutes late. They are there for their prenatal screen; a test that has replaced newborn screens and tests for over 1,000 disorders where early intervention can lead to improved outcomes.



EVIDENCE-BASED HEALTH APPS

Zoe starts her day with a breakfast that is tailor-made for the nutritional requirements of both herself and her baby. The app recommends foods based on genetic, biological and environmental data collected by sensors inbuilt in her home and wearable devices as well as Zoe's personal taste preferences.





ONLINE PHARMACY

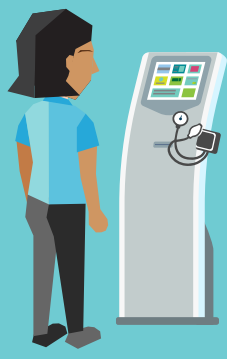
Zoe has her medication for morning sickness and evidence based nutraceuticals delivered to her home through an online pharmacy – the latter being subsidised by her private health insurer.

AUTOMATED AND SECURE DATA SHARING

The results indicate no readings outside of the personalised standard ranges and are automatically sent through to both her electronic health record and mobile health management tool. Only Priya has access to this secure and confidential data, however she chooses to share it electronically with her GP.

WORKPLACE HEALTH SCREENING

During her lunchbreak, Priya decides to visit her company's evidence based health screening station which measures basic health metrics, including blood pressure, cholesterol, iron, blood oxygen levels and white blood cell count.





INCREASED RESPONSIBILITY OF NURSES

These tests and the initial consultation are performed by a nurse, with GPs now focussing on consumers with more complex conditions.

CONSUMER RATING TOOLS

After the appointment, the couple jump online to rate the service experience. This helps to continually improve care and helps other consumers identify the best performing health professionals.



Passive engagement



Dale

Dale is in his mid-50s and a single father to three young boys. He has a low income and is receiving financial support from the government. Stressed and tired from working long hours and fighting off debt, Dale frequently eats unhealthy foods and lives a sedentary lifestyle.

INTEGRATED CARE TEAM

At the IPU, Dale is able to speak to a counsellor who, along with his broader care team (including a nutritionist, general practitioner, and personal trainer) develop a plan to manage Dale's overall health and wellbeing. The plan draws on health and lifestyle data from his environment, genome, and smart phone.



GENOMIC SCREENING

The care team notes that Dale hasn't had a routine health check in years. His care team run a full check-up, including blood tests and genomic screening, which is covered by Medicare since Dale had not previously had his genome sequenced.

PERSONALISED MEDICINE

Dale is prescribed cholesterol medication that has been designed specifically for his genetic information and the population stratification group that Dale belongs to, ensuring high efficacy and low risk of adverse side effects. Dale and his IPU will be alerted through an app if he fails to re-fill his prescription as planned.



SUBSIDIES FOR HEALTHY EATING

Dale's care team are also concerned about his diet and the food he provides for his children. With genetic and dietary risk factors for type-2 diabetes identified, they decide the family meet the criteria for receiving a government subsidised healthy diet that contains nutritious, healthy, and palatable foods aimed at lowering these risks. This is delivered weekly to their home along with simple recipes and instructions for storage.



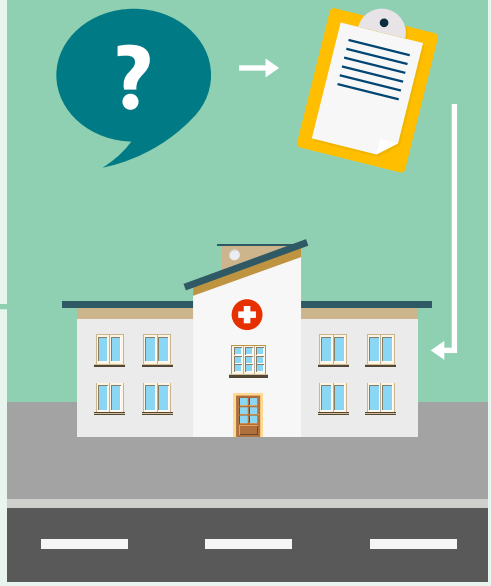
ONLINE MENTAL HEALTH SCREENING

While scrolling through his social media, Dale receives a pop-up message asking about his mental health. The complex algorithms in the social media app have detected digital behaviour markers linked to depression for a month now and prompt him to complete an online test to determine the level of severity.



PAIRING MONITORING WITH ACTION

The test confirms that Dale has a high probability of experiencing issues with his mental health and facilitates the booking of an appointment at his local Integrated Practice Unit (IPU) to discuss the issue and develop a management plan. The test results allow the IPU to prioritise his appointment, provide his care team with valuable insights and reduce the amount of sensitive information Dale needs to repeat for multiple clinicians.



PREVENTATIVE HEALTH

On the way to his medical appointment, Dale's car detects that his stress levels are higher than normal through its facial monitoring system but notes that he is still fit to drive. The car also monitors drowsiness and blood alcohol level detected through his breath.





VIRTUAL COUNSELLOR

Part of Dale's health management plan involves the use of a virtual counsellor chatbot app which provides ongoing monitoring of phone use behaviour and more regular check-ups between face-to-face visits with his IPU. The data is fed back to his care team with his permission.



Chronic Care

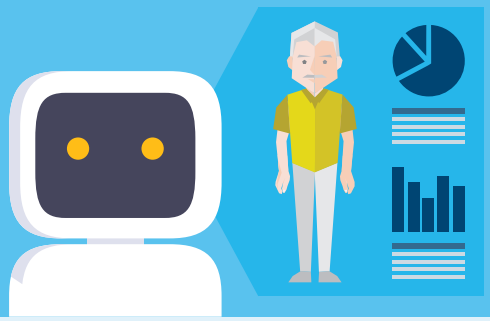


Diego

Diego, 85, has been experiencing progressively worse symptoms of Alzheimer's for the past five years. Last year, he and his family decided to fit out his home with a sensor monitoring and support system. Diego now enjoys the freedom and independence enabled by his smart home and appreciates the ability to largely self-manage his condition over time with the support of his care team.

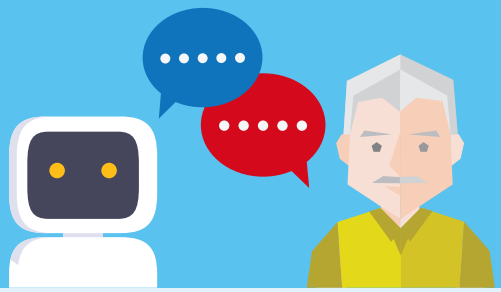
VIRTUAL COGNITIVE BEHAVIOURAL THERAPY

After a quick assessment of his emotional state, Tom performs cognitive behavioural therapy to promote Diego's mental wellbeing.



VOICE MONITORING

Once dressed, Tom asks Diego how he is feeling this morning, monitoring the tone and pace of his speech to highlight any variances. The analysis helps track the severity and progression of Diego's Alzheimer's symptoms.



SOCIAL INCLUSION

Now ready for the day ahead, Tom reminds Diego that he is scheduled to speak to his son today. Tom brings up an image of Diego's son before providing him with a summary of the last conversation they had.



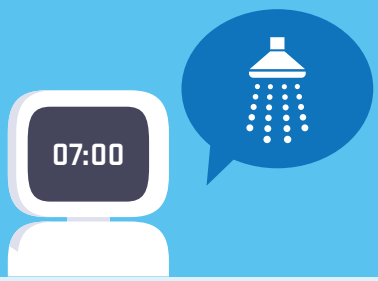
COMMUNITY SUPPORT

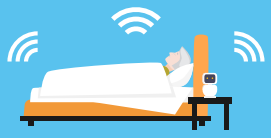
Following on from the call, Diego maintains social inclusion by interacting with a student volunteer who has arrived to help him with exercises designed to manage his chronic pain. Diego also volunteers at the local school – providing meaningful engagement for all involved parties.



VIRTUAL ASSISTANT

Diego starts his day with a wakeup call from Tom – his virtual assistant. After outlining Diego's agenda for the day, Tom reminds him that it's time for his morning shower.





SENSORS

Diego's bedsheets have been monitoring his cardiopulmonary function while he was asleep.
He then moves freely to the bathroom, guided by sensors that warn him of hazards which could cause slips and falls.

RISK RATINGS FOR PRIVATE HEALTH INSURANCE

Diego's smart home system has lowered his risk rating; allowing him to lower his health insurance premiums.



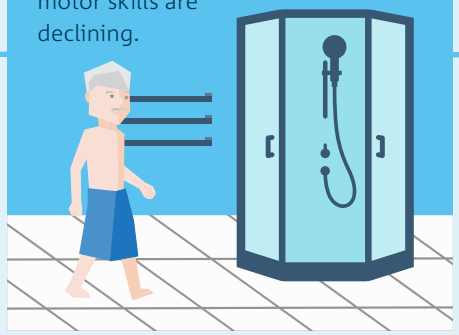
ARTIFICIAL INTELLIGENCE BACKED DIAGNOSTICS

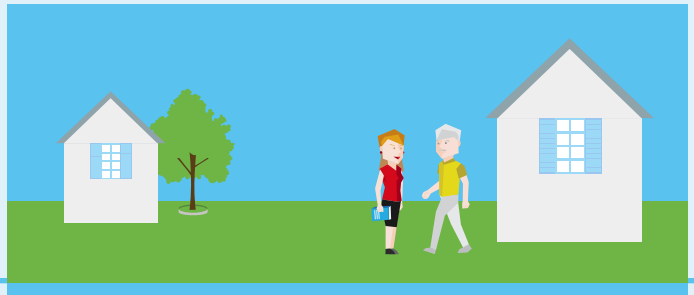
Diego routinely uses a point-of-care imaging device to check his eyesight as well as his skin for early detection of skin cancer. The device compares his input with that of thousands of other images, including his own, to pick-up any concerning changes.



SMART SHOWER

The shower doors open and close automatically, with voice activation software allowing Diego to set his preferred temperature now that his motor skills are declining.





GOVERNMENT BACKED BEHAVIOUR CHANGE INITIATIVES

Thanks to the government's recent smart homes initiative, a service consultant visits Diego regularly to ensure he is comfortable using the technology within his home and that it is tailored to his needs.

INTEGRATED CARE

When Diego's care team arrive for their fortnightly visit, they draw on the daily activity and sensor output summaries that have been sent automatically to provide Diego with tailored and efficient support. This real time monitoring also allows his care team to detect variations in Diego's health earlier and avoid hospitalisations.



Accidents happen



Layla

At age 28, avid cyclist Layla has a high-speed crash while training for an upcoming amateur race. She has been knocked unconscious and suffers serious abrasions to her arms.

SHAREABLE IMAGING

Layla shares an electronic version of her neuronal scan and x-ray with her family to explain the extent of her injuries.



ARTIFICIAL INTELLIGENCE DECISION SUPPORT

It is determined that Layla requires treatment for her serious skin damage. Layla is presented with three options for treatment by her care team which are confirmed as suitable options by the hospital's AI engine.

PATIENT-CENTRIC CARE

Layla speaks virtually with a plastic surgeon overseas, an expert in the field, in order to make an informed decision about the skin treatment options presented. Her care team also provide a range of surgeons for Layla to choose from and publicly available post-operative success rates of each.



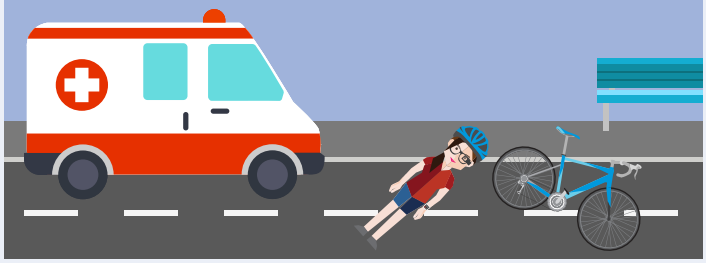
3D PRINTED SKIN

Layla opts for a 3D printed skin patch which offers the fastest healing time. It involves a lipid outer layer to prevent moisture loss, an artificial silk nano fibre layer with antimicrobial properties, and a final sponge layer of artificial silk containing cell binding signals that promote healing.



AUTOMATED AMBULANCE CALL

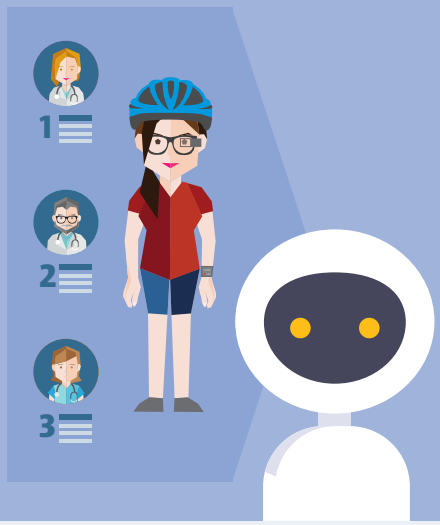
The combined information collected from sensors in Layla's cycling helmet, glasses, and heart monitor prompt an automated call from her personal device to check she is okay. Unconscious, she misses the two minute response cut-off which triggers an ambulance to be called and shares her electronic health record with the incoming paramedics.



MINIATURISED DIAGNOSTICS

The paramedics are concerned Layla might be suffering from internal bleeding and perform a neuronal scan in the ambulance on the way to hospital. She is cleared of any significant cerebral damage.





DIGITAL RECORDS

Once conscious and at hospital, Layla avoids filling out any forms thanks to her electronic medical record and data from her wearable device. Safety and quality regulations ensure some of this information is verified verbally by her care coordinator.



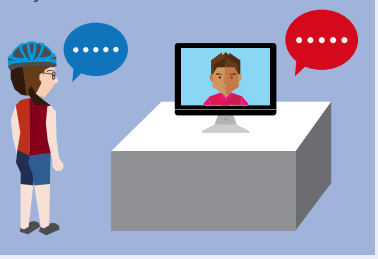
VIRTUAL ASSISTANT

As Layla awaits surgery, she consults with the hospital's virtual assistant to ask questions about the procedure, as well as expected recovery times and other last minute queries to settle her mind. The hospital collects and analyses key patient queries to ensure the most appropriate information is available to future patients.



TELEHEALTH

Post-surgery, Layla is working on making a speedy recovery through the use of her virtual physiotherapist which guides her through daily exercises and monitors her progress. Layla discusses the output data with her physiotherapist fortnightly through telehealth consults where they also video call other members of her care team as required.



4 Enabling the shift

To achieve the vision described in the previous chapter, Australia's health system will need to make a number of shifts (Figure 7). Digital technologies could assist many of these changes – complementing the role of health professionals and providing consumers with greater autonomy in their health and wellbeing management – but are only one element of addressing Australia's health system challenges. The transition will require long-term and multifaceted planning and policies targeting holistic health and wellbeing management, and providing health professionals and organisations with the necessary support required to successfully navigate these shifts. These efforts should utilise a range of tools including regulation, education programs, funding models, workforce development, infrastructure investments, and research that involves cross-industry collaborations to generate long-term behavioural change. Similar approaches have proven extremely successful in Australia for tobacco use, skin cancer, and road safety, with more work still to be done regarding alcohol use, diets, and activity levels.

FIGURE 7: ENABLING THE SHIFT

The health system will shift focus...



...from treating patient illness to managing consumer health and wellbeing



...from accepting one-size-fits-all to precision health solutions

Five enabling themes

Each enabling theme is designed to assist in Australia's health system shift, with the aim of making continual improvements to Australia's overall health outcomes

Empowering consumers

Consumers are an underutilised resource in the health sector. Consumers can be empowered to better prevent illness and manage their health via increased information access and consumer focussed health solutions.

Addressing health inequity

Supporting groups that have inequitable health outcomes to move up the health curve will provide greater social and economic returns than just extending the lifespan of those most advantaged.

Government, industry, researchers and the community must collaborate to create the **value** inherent in this shift

Improved health outcomes and equity for all Australians.

Greater system efficiencies that flatten the cost curve of health financing.

With clinical care only accounting for 20% of the factors influencing an individual's length and quality of life, focussing on the remaining 80% – the role that healthy behaviours, social and economic support, and the physical environment play in impacting health outcomes – is critical.[71]

This chapter highlights a selection of enablers and actions that arose through consultation with key health sector stakeholders, including those representing the views of consumers, health professionals, other service providers, technology companies, private health insurers, government, and research.



...from a reactive system to a holistic and predictive approach



...from extending life to improving quality of life over a lifetime

Unlocking the value of digitised data

Behavioural change is needed by all health stakeholders to ensure the growing volume of personal health data is securely shared, collated, analysed, interpreted, and paired with action for improved health and wellbeing.

Supporting integrated and precision health solutions

Greater systems integration and precision health solutions must be underpinned by improved predictive analytics, an outcomes-based mindset, and a new set of skills for health professionals.

Integrating with the global sector

Improved global integration will help the sector connect and contribute to world leading health and management solutions and encourage the development of novel and globally exportable solutions in Australia.

More impactful and profitable business models.

Creation of new industries based on precision and preventative health.

More sustainable and environmentally friendly healthcare practices.

More productive workers leading to increased job satisfaction and improved work-life balance.

71 Hood, C,M, Gennuso, K,P, Swain, G,R, and Catlin, B,B, 2016, County Health Rankings. *American journal of preventive medicine*, vol. *50*, no. 2, pp.129-135.



4.1 Empowering consumers

Consumers are an underutilised resource in the health sector. Consumers can be empowered to better prevent illness and manage their health via increased information access and consumer focussed health solutions.

ADDRESSING INFORMATION ASYMMETRY

Unlike other consumer markets, it is difficult for consumers to assess quality when it comes to healthcare. Individuals know little about their treatment needs and yet many are becoming increasingly responsible for their own healthcare. Addressing the existing information asymmetry will be critical to empowering consumers to make informed decisions and lower barriers to engaging in one's health and wellbeing.

With consumer-led online forums already emerging to share insights on their experiences, it will be important for industry, government, and research to ensure evidence-backed platforms exist to provide a more controlled and trustworthy method of consumer rating for healthcare experiences. Platforms like WhiteCoat[72] partly address this need but more is needed.

While there is evidence that suggests a correlation between good bedside manner and better clinical outcomes,[73] consumers are typically not in a position to provide accurate information relating to the medical quality of the services received. As such, consumer comments around clinical practice must be excluded. Expanding these tools to include a wider array of objective data about the clinician and the facility would greatly increase their value. For example, incorporating information on readmission rates, complication rates, or drawing on insights from clinical quality registries.[74] If transparently communicated, incorporating patient-reported outcome measures could also be valuable.

These tools will have a far greater benefit if health professionals are also engaged in the review of patient-reported experiences. Evidence suggests that having performance information about industry peers can help elevate industry performance.[75] Further, having consumers complete required data entry in collaboration with their health professional would facilitate important discussions and provide real-time and contextualised insights for both parties.

Addressing issues around price transparency is another area that will help consumers make more informed decisions. Tools or standardised practices that raise consumer awareness of out-of-pocket expenses and market rates will assist individuals in choosing the best provider for their situation. The most common healthcare services would be the logical starting place for improving price transparency, such as dental check-ups, optical services, physiotherapy, and chiropractic treatment.

These tools could be developed by a range of stakeholders, but ultimately require collaboration with healthcare providers to ensure their most effective execution. Banks and insurance companies are well placed to explore these offerings given they benefit from connecting individuals with the best providers for them and are also independent relative to other service providers.

Potential enabling actions

- Develop consumer rating tools that incorporate clinician and facility outcome data.
- Develop more robust symptom checker apps which direct people to evidence backed courses of action.
- Develop tools or information sources for listing market rates for common health services.

72 Whitecoat 2018, viewed 12 June 2018, https://www.whitecoat.com.au/

73 Kelley, J,M, Kraft-Todd, G, Schapira, L, Kossowsky, J and Riess, H, 2014, The influence of the patient-clinician relationship on healthcare outcomes: a systematic review and meta-analysis of randomized controlled trials. *PloS one*, vol. *9* no. 4, pp.e94207.

74 Australian Commission on Safety and Quality in Health Care 2018, *National arrangements for clinical quality registries*, viewed on 30 July 2018, https://www.safetyandquality.gov.au/our-work/information-strategy/clinical-quality-registries/

75 Emmert, M, Meszmer, N and Sander, U, 2016, Do health care providers use online patient ratings to improve the quality of care?, *Journal of Medical Internet Research,* vol. 2016, no. 9, pp.1-14.

CASE STUDY

Peer to peer health

PatientsLikeMe is a free website where people can share their health data with others.[76] The service is targeted at those suffering from chronic disease and helps to promote behaviour change and self-care by tracking progress and allowing consumers to compare themselves to others. This health data is also aggregated and shared with industry to provide better healthcare solutions. Research indicates that PatientsLikeMe has been able to improve disease management and health outcomes through improved disease knowledge and self-management.[77]

EXPANDING TELEHEALTH SERVICES AND IMPROVING CONSUMER CONTROLLED DEVICES

Telehealth encompasses the use of telecommunication techniques for providing mobile health, teleconsultation and medical and health education over a distance.[78] The digitisation of the consumer-provider interaction through telehealth services can drive efficiency, lower health system expenditure, improve continuity of care, and increase consumer engagement and customisation. Telehealth services can also provide consumers access to specialist care irrespective of geography or mobility.

Video consultations can also lead to a reduction in hospitalisations, reduced patient transport costs and shorter waiting lists.[79] While video consultations are often discussed in the context of improved access for remote and regional areas of Australia, these services can also improve access to care and health outcomes in urban areas. Consumers across geographies are increasingly seeking more remote interaction with their healthcare providers, 24/7 access, and health platforms that can assist in self-monitoring health.[80]

A UK study found that 2-3 telehealth consultations can be completed in the same time it takes to do one 10 minute face-to-face consultation, with a 95% satisfaction rate.[81]

Aside from efficiency benefits, health professionals can also use telehealth services to facilitate continued medical education, engage with peers, and improve the triage of care by using the service for simpler or lower severity cases. The latter benefit allows health professionals to spend more face-to-face time with higher needs consumers.

Mobile health and self-monitoring devices also hold great potential, with health professionals being able to guide consumers through data interpretation and health management response options over the phone, video or through the platform itself. Australia's first large-scale telehealth clinical trial was conducted by CSIRO and indicated the return on investment of a home telemonitoring initiative on a national scale would be in the order of five to one. The trial findings included a 53% reduction in hospital admissions, a 76% reduction in length of hospital stay, and a reduced patient mortality rate of over 40%.[82]

76 PatientsLikeMe, viewed 23 May 2018,https://www.patientslikeme.com/
77 Wicks, P, Massagli, M, Frost, J, Brownstein, C, Okun, S, Vaughan, T, Bradley, R and Heywood, J 2010, Sharing health data for better outcomes on PatientsLikeMe,' *Journal of medical Internet research*, vol.12, no.2.
78 Department of Health 2015, *Telehealth,* viewed 8 June 2018, http://www.health.gov.au/internet/main/publishing.nsf/content/e-health-telehealth
79 Australian Digital Health Agency 2017, *Framework for Action: How Australia will deliver the benefits of digitally enabled health and care,* viewed 16 July 2018, https://conversation.digitalhealth.gov.au/sites/default/files/framework_for_action_-_july_2018.pdf
80 Frost & Sullivan 2015, Market Trend: Technologies to Reduce Health System Fragmentation in Australia
81 econsult 2017, *Why econsult*, viewed 18 April 2016, https://econsult.net/why-econsult/
82 Celler, B et al 2016, *Home monitoring of chronic disease for aged care,* CSIRO, Australian e-Heath Research Centre.

However, continual monitoring and assessment can also create psychosocial risks and hypochondria for consumers, leading to unnecessary consultation requests and alarm fatigue for all involved stakeholders. It is essential that intelligent monitoring systems securely and anonymously combine all relevant data-streams but alert consumers and health professionals only to outlier data, i.e. when action should be taken.[83]

While many mHealth and self-monitoring tools can be operated by consumers, the greatest value and safest outcomes arise when health professionals engage with the outputs and provide interpretation and advice. At present, only 27% of GPs use telehealth services.[84] To facilitate greater adoption of these tools by health professionals, greater empirical evidence is required to demonstrate that new digital health solutions provide more accurate and effective health management than a health professional alone – and in some applications, in direct comparison to a health professional. A stronger government push towards value-based care may also support an increase in the use of telehealth solutions as practices seek to provide the highest level of care while increasing efficiency through digital technology (see Moving to models of value-based care).

Potential enabling actions

- Upskill healthcare professionals to be competent users of telehealth platforms; with applications incorporated seamlessly into care pathways.
- Extend remit of reimbursement arrangements for telehealth service provision to encourage roll-out across more health services in both remote and urban communities.
- Grow the base of empirical evidence demonstrating the accuracy and effectiveness of mHealth and self-monitoring devices.
- Incentivise the uptake of in-home and wearable technologies that offer a more effective and cost-efficient approach to health management or encourage preventative behaviours.
- Ensure new mHealth offerings focus on communicating outliers rather than all data, and pair output and interpretation with advice around behavioural change and actionable recommendations for both consumers and health professionals.
- Develop mHealth offerings that involve the setting of goals and feedback on progress to facilitate higher levels of consumer behaviour change.

83 The Economist 2017, *A Prescription for the future: How hospitals could be rebuilt, better than before*, viewed 22 March 2018, https://www.economist.com/news/international/21720278-technology-could-revolutionise-way-they-work-how-hospitals-could-be-rebuilt-better

84 Royal Australia College of General Practioners (RACGP) 2017, *Views and attitudes towards technological innovation in general practice,* viewed 29 May 2018, https://www.racgp.org.au/download/Documents/e-health/2017/RACGP-Technology-Survey-2017-Results.pdf

4.2 Addressing health inequity

Supporting groups that have inequitable health outcomes to move up the health curve will provide greater social and economic returns than just extending the lifespan of those most advantaged.

The social and economic benefits of improving equity for Australians has been estimated to include:[85]

500,000 Australians avoiding suffering a chronic illness

170,000 extra Australians entering the workforce, with $8 billion in extra earnings

Annual savings of **$4 billion** in welfare support payments

60,000 fewer people admitted to hospital annually, with hospital expenditure savings of $2.3 billion

5.5 million fewer Medicare services each year, with annual savings of $273 million

5.3 million fewer Pharmaceutical Benefit Scheme scripts filled each year, with annual savings of $184.5 million.

PROVIDING COMMUNITY-TAILORED SOLUTIONS FOR DIGITAL AND HEALTH LITERACY

Digital and health literacy are fast becoming prerequisites for receiving and delivering the best health support. These skills allow consumers to make more informed health decisions and take greater control over lifestyle factors and health management plans. However, communities with inequitable health outcomes often possess lower levels of digital and health literacy. This is due to a range of factors, which may include financial disadvantage, geographic isolation, disability, education, mental health issues, and cultural or language differences.[86]

Each of these groups experience different types of inequity, however in all cases, these factors can have a cyclical relationship with poor learned behaviours and low health literacy. It is important to design health services that consider these differences and address the specific needs of these populations in order to develop effective health management solutions.

For groups experiencing inequitable access to face-to-face support – be it through geographic isolation or cultural factors – digital solutions can act as a supplementary support tool. Mobile phones are often the digital platform of choice for many Australians, with Australia having the second highest smartphone penetration globally (77%).[87] However, most health apps in the market are designed for the masses and their underlying algorithms can be biased by incomplete training data that does not reflect minority groups.[88] Ensuring the design of these tools considers contextual information specific to the demographic it is applied to is essential. More broadly, ensuring appropriate diversity in all research input data – be it algorithm training data or clinical trial participants – is important in ensuring end products can provide effective outcomes for a broader range of consumers.

85 National Centre for Social and Economic Modelling 2012, *The cost of inaction on the social determinants of health*, viewed 29 May 2018, http://www.cha.org.au/images/CHA-NATSEM%20Cost%20of%20Inaction.pdf
86 Thomacos, N, & Keleher, H, 2009, *Health literacy and vulnerable groups: What works?,* Melbourne: Department of Health Social Science, Monash University
87 Pew Research Center 2016, *Smartphone Ownership and Internet Usage Continues to Climb in Emerging Economies*, viewed 22 March 2018, http://www.pewglobal.org/2016/02/22/smartphone-ownership-and-internet-usage-continues-to-climb-in-emerging-economies/
88 Australian Human Rights Commission 2018, *Rights to equality and non-discrimination*, viewed 23 May 2018, https://www.humanrights.gov.au/rights-equality-and-non-discrimination

Designing mHealth tools that focus on improving health literacy from a low bar (e.g. eating healthier or finding meaningful employment) and that encourage prolonged usage is important. Such solutions would benefit from avoiding technical jargon, involving a greater use of iconography and colour, and being offered in a range of languages.

Internet access is an important social consideration. In some instances, those who possess a mobile phone may rely on free WiFi opportunities to use it due to financial limitations. However, investments must be made in community safety to ensure free WiFi locations do not place individuals at risk of exposure to violence, particularly after dark which can be a popular time to be socially online.

With many rural populations suffering from a lack of access to high speed or affordable internet, telehealth solutions are not the answer for all groups experiencing inequity. This is why a multi-faceted approach to behavioural change is critical. One that complements the delivery of mHealth tools with education (particularly early childhood initiatives) and incentives. For example, rewarding health checks, app use, participation in education programs, or the purchase of healthy foods with access to free internet could be particularly effective in remote and regional areas where internet costs are comparatively high.

Financial incentives could also be offered in return for access to the biometric and lifestyle data captured by various platforms, which holds value for a range of entities including private insurers, population health researchers, and governments. Incentives and gamification can also generate healthy competition amongst community members; driving further increases in digital or health literacy.

Potential enabling actions

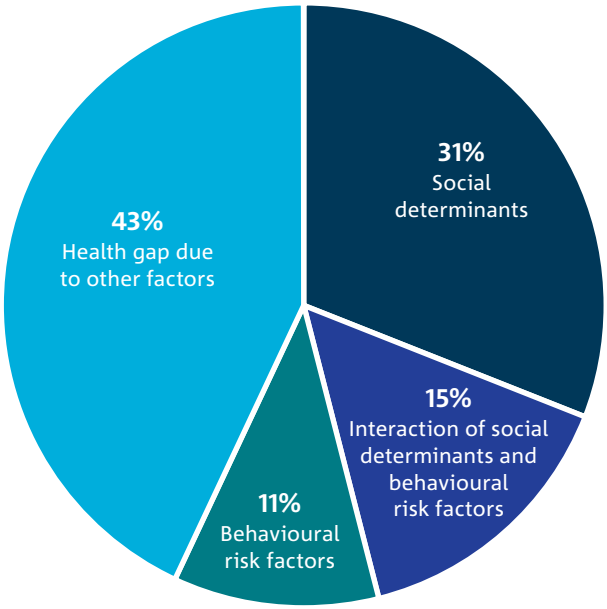
- Prioritise the support and development of tools and initiatives that target health issues faced by Australians experiencing inequitable health outcomes.
- Develop tailored incentives for engagement in personal health and wellbeing.
- Ensure AI-backed mHealth solutions utilise learning (input) data that is relevant to the intended target demographic.
- Develop community-tailored early childhood education programs around health and wellbeing to improve health literacy.
- Implement consumer focussed finance models that ensure rebates are accounted for at the point of payment.

MAINTAINING AND STRENGTHENING ABORIGINAL AND TORRES STRAIT ISLANDER HEALTH

One danger in attempting to address health inequity is homogenising Aboriginal and Torres Strait Islander peoples into one group in terms of the solutions required. In reality, there is great diversity amongst the Aboriginal and Torres Strait Islander peoples. For instance, communities may have varying social structures, histories, and health profiles. Further, dialogue on Aboriginal and Torres Strait Islander health often focusses on rural and remote communities, however health inequity is also significant in urban populations.[89,90]

At present, not enough is known about what initiatives work best within the diversity of Aboriginal and Torres Strait Islander peoples. Focussing future initiatives on better understanding key factors behind the health gap such as social determinants (34%) and other factors (47%) like inequitable access to health services is important (Figure 8). A responsive and precision population health approach is required.

FIGURE 8: FACTORS BEHIND THE HEALTH GAP BETWEEN ABORIGINAL AND TORRES STRAIT ISLANDER PEOPLES AND NON INDIGENOUS AUSTRALIANS [91]



As discussed, mobile health offerings are cost effective and wide reaching tools for addressing health inequity, however they require culturally appropriate development for Aboriginal and Torres Strait Islander populations. For example, some families may share a single mobile phone as part of collective cultural practice, meaning information recorded can be more complex – requiring understanding of who uses the phone to then provide more responsive healthcare. These strong family ties and potential phone sharing arrangements also mean that digital health solutions should consider providing information for the patient, but also to the larger family group who may be driving the patient's health engagement.

89 Closing the Gap Steering Committee for Indigenous Health Equality 2018, *A ten-year review: the Closing the Gap Strategy and Recommendations for Reset*, viewed 10 April 2018, https://www.humanrights.gov.au/sites/default/files/document/publication/CTG%202018_FINAL-WEB.pdf

90 Scrimgeour M & Scrimgeour D 2008, *Health care access for Aboriginal and Torres Strait Islander people living in urban areas, and related research issues: a review of the literature,* CRCAH discussion paper no. 5. Darwin: Cooperative Research Centre for Aboriginal Health

Digital tools for diagnosis and engagement are positive first steps but lack impact if the appropriate care is not then provided. Access to quality primary healthcare is essential for closing the health gap. As are preventative initiatives that involve school and community education around healthy eating and healthy behaviours, and efforts to ensure there is sufficient access to healthy foods in regional and remote communities.

Spanning all initiatives should be the co-creation and involvement of community consultation in the development of content to encompass cultural appropriateness. This could include Elders, role models, and influencers of the community who can assist in promoting health and wellbeing initiatives to enhance engagement and uptake. To ensure appropriate role models exist in the health sector, pathways for Aboriginal and Torres Strait Islander peoples to enter the health workforce could be made more accessible. This could be done through additional training scholarships and by encouraging higher employment commitments by health service organisations.

Finally, Aboriginal and Torres Strait Islander peoples have the longest continuing culture in the world – some over 65,000 years old[92] – and connection to Country is significant to this. Displacement of Aboriginal and Torres Strait Islander peoples from Country has had a significant negative impact on social and emotional wellbeing and mental health. Maintaining and strengthening Aboriginal and Torres Strait Islander connection to Country will assist in supporting social and emotional wellbeing; leading to overall improvements in physical health.[93] Aboriginal and Torres Strait Islander peoples' knowledge can also help non-Indigenous Australians better understand how to effectively and sustainably connect to Country, manage the Australian environment, and unlock the health benefits of a stronger integration of population and place.

Potential enabling actions

- Identify the most suitable health interventions and initiatives for diverse demographics and population attributes through further research and deep community engagement with Aboriginal and Torres Strait Islander populations.
- Improve access to quality primary healthcare services for Aboriginal and Torres Strait Islander peoples.
- Co-create appropriate health and wellbeing solutions by bringing together key Aboriginal and Torres Strait Islander influencers in the region, industry and research.
- Improve access to healthy foods in regional and remote communities through cheaper, more accessible, and easier to prepare healthy foods.
- Provide additional training scholarships for Aboriginal and Torres Strait Islander peoples and encourage higher Aboriginal and Torres Strait Islander employment commitments by health service organisations.
- Maintain and strengthen social and emotional wellbeing through provision of opportunities to connect to Country.

91 AIHW 2018, Australia's health 2018. Australia's health series no. 16. AUS 221. Canberra: AIHW.
92 Commonwealth of Australia, Department of the Prime Minister and Cabinet, Closing the Gap Prime Minister's Report 2018.
93 Davies, J., Campbell, D., Campbell, M., Douglas, J., Hueneke, H., LaFlamme, M., Pearson, D., Preuss, K., Walker, J. and Walsh, F 2011, 'Attention to four key principles can promote health outcomes from desert Aboriginal land management', *The Rangeland Journal*, vol.33, no.4, pp. 417-431.

4.3 Unlocking the value of digitised data

Behavioural change is needed by all healthcare stakeholders to ensure the growing volume of personal health data is securely shared, collated, analysed, interpreted, and paired with action for improved health and wellbeing.

The digitisation of the Australian healthcare system will go a long way towards improving integration and efficiency, but the shift needs to be more than just data sharing. It requires multidisciplinary and co-located teams and networks for improved decision making, treatment, and health management services. These networks will need to span both existing and emerging players (e.g. tech giants, start-ups, and educators).

Figure 9 highlights health care providers in Australia that have already begun to demonstrate the benefits of digitisation.

Unlocking the value of digitised data in the health sector will involve tackling issues that are present in many Australian sectors and so could involve collaborations for efficient solution development. Some of these issues, such as community levels of digital skills and literacy, trust in data sharing, and effective cybersecurity measures will be further discussed in the upcoming Digital Economy Strategy – a whole-of-government strategy being led by the Department of Industry, Innovation and Science.[94]

FACILITATING ELECTRONIC HEALTH RECORD ENGAGEMENT

Whether it be the national My Health Record or smaller-scale solutions, having accessible electronic health records (EHRs) will be key to unlocking many of the holistic, preventative, and precision health offerings of the future. EHRs can improve health outcomes by enabling safer medicines management, improving care coordination, and helping inform treatment decisions.[95]

Successful EHR platform roll-outs require five things:

- **Clear value communication** – The value must be understood by the consumer, the health professional, and any other parties involved to ensure uptake and engagement. This includes clearly articulating what the platform will and will not do.
- **Ease of use** – Data entry and management needs to be simple enough so that its use is not a significant change in the daily activities for health professionals or consumers. The scope could initially be limited to a simple data repository of metrics that rarely change (e.g. allergies, blood type, medical history, lifestyle habits) – those deemed most useful and time saving for health professionals and consumers alike. Expansion to more complicated data collection can evolve once health professional and consumer behaviours begin to accept the new norm.
- **KPIs around usage** – The success of the record system needs to be measured based on outcomes such as health professional and consumer engagement and health decisions that have been informed by the collected data, not registration numbers that can give a false indication of usage.
- **Interconnectivity** – A range of service providers must be able to securely share certain data points in order to provide the most impactful and efficient health solutions.
- **Effective education and training programs** – As with any new tool, those using it will require education and training to become familiar with the process of uploading data, data handling protocols, and how the tool can and cannot be used. This is required for both consumers and health professionals.

To ensure these five characteristics are met, large scale digital infrastructure programs could leverage elements of successful international systems and be developed in conjunction with the market; for example, through Public-Private Partnerships.

94 Due to be released later in 2018.

95 ADHA 2017, *Framework for Action: How Australia will deliver the benefits of digitally enabled health and care,* viewed 16 July 2018, https://conversation.digitalhealth.gov.au/sites/default/files/framework_for_action_-_july_2018.pdf

FIGURE 9: BENEFITS OF DIGITAL HOSPITALS

CASE STUDY

The Royal Children's Hospital (RCH), Melbourne[96]

RCH has built a hospital-wide Electronic Medical Record built on Epic. The system includes a patient portal and integration with hospital medical devices, clinician apps, and My Health Record.



Benefits of the Electronic Medical Record achieved after 12 months include:

- A **27% reduction** in medication prescribing and administration errors
- A **4% increase** in immunisation rates for children in hospital
- **6,768** fewer pathology tests performed
- **2,414** fewer medical imaging examinations

CASE STUDY

Princess Alexander Hospital (PAH), Brisbane[97]

PAH is Australia's first large scale digital hospital.

- Between 2015 and 2017, there was a **45% increase** in the early identification of deteriorating patients by the hospital's rapid response team.
- Between 2014 and 2016, there was a **4% reduction** in readmission rates and **6% reduction** in inpatient length of stay.



96 Victorian Government 2018, *Electronic Patient Records To Save Lives*, viewed 26 June 2018, https://www.premier.vic.gov.au/electronic-patient-records-to-save-lives/

97 Draheim, M 2017,*Going Digital Using data to support care,* viewed 25 June 2018, https://www.hisa.org.au/slides/hda/17/Michael_Draheim.pdf

Primary care health professionals will not require financial incentives to drive the cultural change necessary if these five characteristics are met as the cost and time savings will be clear. However, for more sophisticated changes to EHR management that have clear consumer outcome benefits but no discernible benefits for the health professional – such as adding additional / more complex data points to the record for other healthcare providers to use – financial incentives will likely be required.

Potential enabling actions

- Ensure EHR roll-outs involve clear value communication, are easy to use, have KPIs around usage, are interconnected, and are accompanied by education and training programs.
- Develop outcomes-based funding models that incentivise health professionals to adopt and engage with novel system changes where the primary value is captured by other stakeholders (e.g. consumers).
- Investigate merits of developing legislation to allow patient/legal guardian ownership of data contained in EHRs.
- Investigate how the digital health system can integrate with other sectors and systems (e.g. demographic and environmental data).
- Invest in digital storage solutions to accommodate the future explosion in personal health data.



CASE STUDY

OpenNotes[98]

105 primary care doctors and 20,000 of their patients participated in a one-year study of OpenNotes; where patients were invited to read their visit notes online using a secure patient portal. Both patients and doctors reported multiple health benefits and wanted to continue sharing notes. This transparency helped to improve understanding and adherence to health plans, and identify and address inaccuracies in the record. One study indicated that of patients who contacted their doctor to review notes, 29% perceived an error in the notes.[99]

ENSURING INTEROPERABILITY

Interoperability is the ability for different information technology systems and software applications to communicate, exchange data, and use the information that has been exchanged.[100] Interoperability is critical to unlocking the value inherent in pooling different data sets together for new and consumer-centric health services. At present, the fragmented Australian system has various regions adopting different systems from a range of technology providers using different standards.

In addition to assisting the sharing of information between healthcare providers within existing systems of information exchange (e.g. My Health Record), interoperability can also unlock completely new and more personalised structures for health data sharing that give consumers the choice to manage their health information the way they want to. This consumer-centric structure of data sharing is already present in the banking sector which will be further bolstered by Open Banking; the first implementation of the Consumer Data Right.[101]

98 OpenNotes 2018, viewed 2 July 2018, https://www.opennotes.org/notes-you/
99 Bell, S,K, Mejilla, R, Anselmo, M, Darer, J,D, Elmore, J,G, Leveille, S, Walker, J, 2017, When doctors share visit notes with patients: A study of patient and doctor perceptions of documentation errors, safety opportunities and the patient-doctor relationship. British Medical Journal of Quality and Safety, 26(4), 262270.
100 HIMSS *Dictionary of Healthcare Information Technology Terms, Acronyms and Organizations*, 2nd Edition, 2010, Appendix B, pp.190.
101 Australian Government 2017, *Open Banking: customers, choice, convenience, confidence,* December 2017.

Applying this concept to medical and health data could provide a more cost effective alternative to universal record management approaches and would help facilitate further consumer empowerment and increases in health literacy.

While successful pockets of interoperability exist, a fragmented approach means that individuals who move across State and Territory borders or between health service providers typically cannot take their health records with them. Efforts to address interoperability on a national scale are underway through the development of national interoperability specifications,[102] however as health services continue to become more globalised, it is also important that Australia is able to stay connected to the rest of the world (see *Integrating with the global sector*).

While Australia is not large enough to significantly impact international interoperability standards, it is important that governments, researchers, and businesses participate in discussions to ensure national planning and investment is aligned with global needs. Ensuring new health software adheres to standards around language, terminology, openness, and data security and privacy will help facilitate the effective and safe sharing of individual health data across Australian service providers as well as with international organisations.

It is important that national standards or any list of preferred system characteristics are not overly prescriptive or onerous. New and improved systems and providers will continue to arise and standards must be adaptable enough to incorporate these improvements. Allowing these systems to continue to evolve naturally, while focussing on their ability to communicate with each other, will help to ensure that individuals receive the highest quality and most relevant data management system for their needs.



CASE STUDY

Apple

Fast Healthcare Interoperability Resources (FHIR), originating from Australia, is the new health data exchange standard from international standards body HL7. FHIR is becoming more widely used to enhance interoperability and data sharing for both existing and new health systems and technology. Many technology companies have embraced FHIR – with Apple announcing in early 2018 an upgrade that would allow US hospitals to transfer health data to customers with iPhones and iPads.[103] Apple's health app brings together data from hospitals, clinics, the existing Health app and My Health Record, providing consumers with data from multiple providers.[104] The underlying technology uses a SMART on FHIR approach – SMART being the authentication and interface standard and FHIR being the exchange mechanism – to transfer the data onto the Apple Health Record.

Potential enabling actions

- Invest in digital and data infrastructure to ensure digital health data can be transferred quickly and securely between and within health organisations.
- Ensure Australian representation in international discussions around the global harmonisation of interoperability standards.
- Develop strategies at the healthcare organisation level for a hybrid standards environment – aggregating data from a variety of systems.[105]

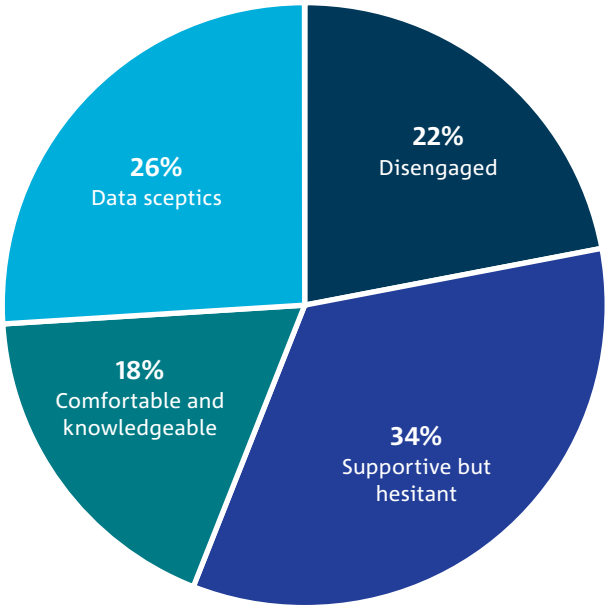
102 ADHA 2017, *Framework for Action: How Australia will deliver the benefits of digitally enabled health and care,* viewed 16 July 2018, https://conversation.digitalhealth.gov.au/sites/default/files/framework_for_action_-_july_2018.pdf
103 Apple 2017, *Healthrecords*, viewed 22 March 2018, https://www.apple.com/healthcare/health-records/
104 ADHA 2017, *Framework for Action: How Australia will deliver the benefits of digitally enabled health and care,* viewed 16 July 2018, https://conversation.digitalhealth.gov.au/sites/default/files/framework_for_action_-_july_2018.pdf
105 Medical Software Industry Association (MSIA) 2017, *When will Healthcare Catch FHIR?*, viewed 22 March 2018, https://www.msia.com.au/when-will-healthcare-catch-fhir/

CREATING TRUST IN DIGITAL TOOLS

Trust is essential for consumers to adopt digital health technologies that are reliant on the sharing of personal information. While there has been a broad social shift, purposefully and inadvertently, to sharing personal information in other sectors, consumer trust can be rapidly eroded if the confidentiality, integrity, or availability of their information is threatened.[106] In a survey of over 300 Australian health professionals, only 3% said they trust data sharing in the medical industry.[107]

Attitudes concerning the benefits of sharing information are improving across generations but are strongly countered by an awareness of the associated potential negative consequences. One study estimated that 26% of Australians were data sceptics, with another 34% supportive of sharing health data but still hesitant (Figure 10).

FIGURE 10: ATTITUDES TOWARDS PRIVACY AND SHARING OF HEALTH DATA[108]



The risk of an event that breaks trust is heightened for health and medical information, as healthcare is second only to the finance industry in the number of cyberattacks annually;[109] the implication of these attacks being at least inconvenient, and at worst life-threatening. Cultural diversity among Australian communities also result in varying views around who should own data, how it should be shared and what to do with incidental findings of health tests. In order to create a sustainable level of trust with broader society, the health sector must be proactive in enabling secure implementation and utilisation of consumer oriented digital health tools.

Fundamentally, building consumer trust for digital health tools is reliant on effective cyber security, as the key risks associated with digital tools and platforms centre on access, privacy, and integrity of data; infrastructure stability; insider threats; and extortion. The health sector needs to consider its overall security posture and work toward building an environment that allows emerging digital health technologies to easily adopt strong security practices.

Effective cyber security should allow the health sector to demonstrate the integrity of digital tools that are embedded in the health system, which would encourage consumer adoption and the sharing of personal information with health service providers.

A supplementary approach could focus on building empirical evidence that supports the secure transfer of personal information. Electronic health records are an ideal platform for this, where early adopters could be educated to opt-in to share privacy-preserved data beyond their primary health care professional. This data could be accessed by researchers to develop state or nationwide health analytics that improve decisions for the healthcare system, or the development of novel precision health solutions for the individual. Importantly, consumers are more likely to exchange data for outputs that are meaningful to them.[110]

106 CSIRO Futures 2018, *Cyber Security: A roadmap to enable growth opportunities for Australia*, Canberra, Australia.
107 Medical Director 2018, *Interoperability in Healthcare,* viewed 4 June, https://www.medicaldirector.com/wp-content/uploads/2018/05/Interoperability_White_Paper_2018.pdf
108 Consumers Health Forum of Australia and NPS MedicineWise 2018, *Engaging consumers in their health data journey,* viewed 5 June 2018, https://cdn0.scrvt.com/08ab3606b0b7a8ea53fd0b40b1c44f86/35dfcb232f9195d3/4a9011dcb57d/Engaging-Consumers-Health-Data-Report.pdf
109 Verizon Communications 2017, *2017 Data Breach Investigations Report*, viewed 22 March 2018, http://www.verizonenterprise.com/verizon-insights-lab/dbir/2017/
110 PC) 2016, *Digital Disruption: What do governments need to do?,* viewed 4 June 2018, https://www.pc.gov.au/research/completed/digital-disruption/digital-disruption-research-paper.pdf

Finally, initiatives that target health literacy or tools that help direct consumers to the most credible sources of information can also improve consumer confidence.



CASE STUDY

Viewing competitors as collaborators against cyber-attacks

Research suggest that 61% of customers would stop using a business product or service if a cyber-attack resulted in a known security breach.[111] As a successfully deployed cyber-attack on one organisation has a high chance of being successful for multiple organisations, there is benefit in sharing threat information and working with industry peers and government to understand the most appropriate methods to mitigate threats.

This approach is already utilised in the global financial services and banking sectors through communities such as the Financial Services Information Sharing and Analysis Center. However, the health sector faces an additional challenge: even if the entire sector falls victim to a cyber threat, individuals will still demand healthcare and governments will continue to fund it. This means the health sector lacks a profit driven motivation for collaborating around cyber risks. The Notifiable Data Breach Scheme will build a penalty based motivation for improved sector security posture, however the most effective outcome will be achieved when the sector assesses the savings that can be found by collaborating to mitigate cyber risks.

Potential enabling actions

- Build on existing initiatives to develop frameworks for improved health and medical data-sharing, focussed on privacy-preserving techniques for patient data.
- Improve healthcare networks and infrastructure, such that all new systems and upgrades are secure by design, promoting safe and effective information exchange.
- Develop incentives for competing healthcare providers to collaborate on building cyber resilience into their systems, such as medical indemnity incentives or education credits for health professionals.
- Facilitate data sharing by clearly outlining to consumers why, how, and when personal health data is being collected, and what the intended outcome is (i.e. the value to the consumer who owns the health data).
- Ensure comprehensive consultation of Australian stakeholders and communities in developing laws and guidelines around the ownership, sharing, and management of health data to account for ethical and cultural diversity.

111 PricewaterHouseCoopers (PwC) 2016, Digital trust Securing your future in the digital world, viewed 23 May 2018, https://takecontrol.pwc.com.au/digital-trust/


AFTER USING THIS ROOM
PLEASE REMEMBER TO:
• SWITCH OFF COMPUTER
• CLOSE ALL WINDOWS
• SWITCH OFF LIGHTS

4.4 Supporting integrated and precision health solutions

Greater systems integration and precision health solutions must be underpinned by improved predictive analytics, an outcomes-based mindset, and a new set of skills for health professionals.

ACCELERATING THE MOVE TO INTEGRATED CARE

A more integrated healthcare system can help combat the financial and time costs associated with Australia's existing fragmented health structure. Focussing on more coordinated and integrated forms of service will also enable improved consumer experiences and outcomes.

Integrated care is particularly pertinent to those suffering from chronic disease or complex conditions. These individuals often require the care of multiple health professionals in different locations and stand to benefit greatly from improved coordination of care. According to a nationwide survey conducted in 2016, one in six people saw three or more health professionals for the same condition. Among those, 12% reported that there were issues caused by a lack of communication between the health professionals.[112]

Existing literature and initial test cases have presented a strong case for the transition to integrated care models.[113,114,115] Existing examples of integrated care in the Australian context include the Victorian Integrated Cancer Services,[116] NSW Integrated Care Strategy,[117] and the Australian Government 'Health Care Home' model.[118] While some structures focus on a specific disease, this approach must be carefully selected as it could risk further fragmentation of healthcare systems. Ultimately, the long-term goal should be a healthcare system that provides integrated and relevant health and wellbeing services to an individual, whatever their needs might be.

The next step for Australia is to expand the number of integrated care sites. The sites can further test how care is delivered, outcomes are measured, and clinical governance is arranged; all underpinned by an evidence-base that is pertinent to the Australian context. To ensure the development of a data enabled learning healthcare system, it is important that these trials and any eventual application involve full cycle evaluation and iteration. Embedding health systems researchers into hospitals and Primary Health Networks is one approach to creating an ethos of continuous analysis and implementation.

Rural and regional areas often make strong candidates for initial trial sites as they typically have less bureaucracy, have a greater need for collaboration due to fewer resources, are smaller and so easier to get the whole healthcare community on board, and are often in greater need of health services.

112 ABS 2017, *Patient Experience in Australia: Summary of Findings,* viewed 5 June 2018, http://www.abs.gov.au/ausstats/abs@.nsf/mf/4839.0s

113 McKinsey & Company 2015, *The evidence for integrated care,* viewed 30 May 2018, https://www.mckinsey.com/~/media/McKinsey/Industries/Healthcare%20Systems%20and%20Services/Our%20Insights/The%20evidence%20for%20integrated%20care/The%20evidence%20for%20integrated%20care.ashx

114 Angus, L, and Valentijn, P,P, 2018, From micro to macro: assessing implementation of integrated care in Australia. *Australian journal of primary health*, *24*(1), pp.59-65.

115 Productivity Commission (PC) 2017, *5 year productivity review: Supporting Paper No.5, Integrated Care*, viewed 30 May 2018, https://www.pc.gov.au/inquiries/completed/productivity-review/report/productivity-review-supporting5.pdf

116 Victoria State Government 2018, *Integrated Cancer Services,* viewed 30 May 2018, https://www2.health.vic.gov.au/about/health-strategies/cancer-care/integrated-cancer-services

117 NSW Government 2017, *NSW Integrated Care Strategy*, viewed 30 May 2018, http://www.health.nsw.gov.au/integratedcare/Pages/integrated-care-strategy.aspx

118 Department of Health 2018, *Health Care Homes – Health Professionals,* viewed 30 May 2018, http://www.health.gov.au/internet/main/publishing.nsf/content/health-care-homes-professional

Potential enabling actions

- Expand the number of integrated care trial sites, generating empirical evidence around integrated models of care.
- Improve stratification and triage of consumers to help determine the best forms of care for each individual and allow less demanding and lower risk tests and procedures to be moved out of the hospital.
- Support the bundling of packages of care by private service providers to help bridge the gap between the provision of private and public healthcare services.
- Shift government subsidy focus towards more preventative activities and products (e.g. gym memberships and preventative diets).
- Model the potential economic impact of dietary and lifestyle based interventions to prevent or manage chronic diseases such as type 2 diabetes and bowel cancer to better understand the value proposition of shifting funding from illness treatment to management and prevention.
- Develop consortiums that bring together key sector stakeholders to tackle issues around data management and easing the consumer journey.
- Establish online networks to support knowledge sharing amongst health professionals.
- Open up collaborative spaces and develop sharing arrangements of existing facilities and infrastructure to facilitate collaboration across various service providers and efficient infrastructure use.
- Embed health systems researchers into hospitals and Primary Health Networks to create an ethos of continuous analysis and implementation.

MOVING TO MODELS OF VALUE-BASED CARE

Australia's existing fee-for-service funding model risks incentivising volume over value and treating illnesses rather than the overall health of an individual. Increasing the accountability of medical professionals through a shift to value-based care – focussing on the outcomes that are achieved relative to the cost of achieving them[119] – is one way to align the incentives of health professionals and consumers and improve clinical practice. This would also help address some of the issues around information asymmetry that arise in healthcare. A shift to value-based care may also reduce public hospital admissions and emergency department costs of approximately $3.5 billion annually.[120]

Value-based care should not just be defined as the implementation of outcomes-based funding models, but also the clear demonstration of value to all parties – not just the consumer.

However, this shift does not come without challenges. It is difficult to hold health professionals accountable for outcomes when consumer behaviour is such a strong determinant of health. It is also difficult to define and measure good outcomes and value at a system level – what is good for the community or a health professional may not be good for an individual. This means that even if medical professionals are able to agree on best practice, not all consumers will want it. For example, terminally ill patients may decide that their preferred outcome is to live a short but high-quality life rather than attempt to prolong life with severe mental or physical pain.

119 Harvard University, Value-based healthcare, viewed 2 July 2018, https://www.isc.hbs.edu/health-care/vbhcd/Pages/default.aspx
120 CSIRO Futures analysis based on data from the AIHW, BlueCross BlueShield, Independent Hospital Pricing Authority and Anthem Public Policy Institute.

These are just a few examples of the complex system level challenges that require addressing in order to reach this future care model. Tools including financing arrangements, education programs, workforce development, and infrastructure investments could all play a role in aiding this complex system transformation. While the full transformation is a shift that occurs over the long term, there are still activities that are crucial to value-based care that can be initiated and improved in the short term, such as measuring outcomes, better integrating teams and data, and better communicating best practice.

To work through these challenges, further trials of outcomes-based funding are needed to test the best mechanisms for properly incentivising health professionals. Trials based around acute care (e.g. surgical procedures) continue to be suitable as medical professionals can more easily agree on what quality care looks like and consumer behaviours like rehabilitation adherence can be more easily monitored and measured. As part of the findings of such trials, value must be identified and reported for all stakeholders (e.g. consumers, payers and health professionals).

These trials can be used to obtain a better understanding of the total cost of providing healthcare to each individual. As the implementation of outcomes-based funding grows, this information around total healthcare costs can be used to identify citizens in most need of coordinated care and to inform benchmarks for capitated[121] populations.

To ensure consumer perspectives are reflected in the discussion and measurement of outcomes, patient-reported experience measures (PREMs) and patient-reported outcome measures (PROMs) could be integrated into outcomes-based funding trials. For example, the use of standardised reports that combine PROMs and PREMs with clinical evidence of medical outcomes to produce a balanced outcomes scorecard.

Consumer reports could include details on whether the individual felt they were listened to, whether they had their desired level of influence over their treatment or health management approach, and whether they felt the service produced effective outcomes. The Australian Hospital Patient Experience Question Set could be leveraged to develop such experience-based reports for other health services in a standardised way.

Potential enabling actions

- Better understand clinical variation to enable the development of appropriate standards.
- Continue to introduce value-based care funding programs and publish the findings, including savings compared to episodic care and the value created for all stakeholders involved.
- Create partnerships between research and healthcare delivery organisations to allow for trials of new technologies and systems of care before adopting across larger population groups.
- Improve understanding of which health conditions and digital tools can be effectively managed and operated by consumers alone, and which require or experience significant outcome improvements when coupled with health professional support, to help inform divestment decisions around low value offerings.
- Support broader adoption of consumer reported outcome measures.
- Establish a national database for PROMs that promotes outcomes sharing by healthcare providers and private health insurers.

121 Capitation in healthcare is the concept of providing a health provider or group of providers with a set amount of funding for each individual within the population.

IMPROVING THE QUALITY OF PREDICTIVE ANALYTICS

Coupling routine health monitoring with predictive analytics can provide valuable data about a consumer's health risk profile that can support clinical decision making in precision and preventive care. These forms of data analytics can: result in faster and more accurate diagnosis, reduce costs on unnecessary investigations, re-purpose existing medications, halt ineffective or harmful healthcare, and ensure tailored treatments are only offered to those who will benefit.[122]

Existing monitoring and diagnostic tools typically focus on a single health risk, such as blood glucose levels for those with diabetes. However, it is the integration of these siloed data streams that harnesses the ability to create a step change improvement in the reliability and tailoring of diagnostics and subsequent health management action plans.

Bringing together medical data (mental, physical, emotional and social) with information around diet, activity levels and one's environment is key to health and wellbeing promotion.

Even genomic screening, which continues to gain interest from both consumers and health professionals, is limited in its predictive abilities when used in isolation. Putting aside the quality issues around some direct-to-consumer genetic tests, many commonly identified genetic variants have only modest effects on disease and there is still much to learn about the 1% of DNA that codes proteins and their complex and non-linear relationships with each other.[123]

As the research community continues to investigate these relationships, genomic testing can be improved by incorporating other biological information (e.g. gut health, epigenetics, and other affordable omics screens such as proteomics and metabolomics) as well as environmental and behavioural data to provide a more reliable diagnostic and health management service.

With the growing amount of personal health data being collected and shared, the importance of secure data transfer will rise substantially. This holds particularly true for genetic data which contains information about a consumer's relatives as well – raising additional ethical and cyber security concerns. For example, such tests may uncover previously unknown genealogy with confronting consequences or risk of inheritable disease. It will also be important for governments to establish clear guidelines around the use of genetic data for secondary purposes like health insurance, suitability for other health services, and employment. Grey areas around disclosure of information obtained from genetic tests can result in invalid insurance policies or discrimination.

Both consumers and providers will need to manage this increase in available health data. Artificial intelligence will be required to synthesise these increasingly complex data sets in ways that are meaningful for the consumer, including a tailored set of actions that can be monitored for ongoing proactive health management. While routine monitoring can be performed by the consumer for a number of health metrics, health professionals will be required for interpretation and development of health management strategies.

While the benefits of predictive analytics are significant, there are also risks that need to be managed. For example, widespread screening is unnecessary for many health conditions and can lead to an increase in the 'worried well'. As improved and additional options arise, over-testing will need to be carefully managed under the existing fee-for-service funding arrangements.

122 North, K 2017, *Genomics and the brave new world of personalised medicine: A local and global perspective,* Australian Genomics Heath Alliance, viewed 22 March 2018, http://vha.org.au/docs/11.15-kathryn-north--murdoch-children-s-research-institute--hva-north-genomics-overview-october-5-2017.pdf

123 Gambhir, S et al. 2018, *Toward achieving precision health*, Science Translational Medicine, vol. 10, no. 430, pp.eaao3612.

Potential enabling actions

- Invest in diagnostic and health management tools that integrate medical data with an individual's exposome.[124]
- Conduct research to further understand which diseases are best predicted with which biomarker, or combination of biomarkers.
- Develop screens that combine genomic data with other biological, environmental and lifestyle data for enhanced predictive abilities.
- Incentivise sharing of genetic and biological data for large scale studies and trials to inform population health issues and research.
- Develop clear and secure data management and disclosure protocols for genetic and biological information, including ethics.
- Investigate how best to prepare consumers to digest and manage the potential future outputs of genetic screens, including ethical, cultural, and mental health considerations.
- Investigate how to best prevent insurance and financing access and equity issues for consumers as the ability to predict an individual's health risk profile improves significantly.

PREPARING THE FUTURE HEALTH PROFESSIONAL

The shift in focus from illness treatment to health and wellbeing management cannot be achieved without buy-in and support of health professionals, both in planning and execution. As this transition represents a significant cultural shift for many, changes to processes and expected behaviours need to be multi-phased and carefully considered.

While many publications cite that 49% of work activities have the potential to be automated, very few occupations – less than 5% – are candidates for full automation.[125] This means that while very few health professions will completely disappear, many will undergo significant changes in the roles and skill mixes required.

Education and training programs, changes to funding models, and the clear communication of added value will greatly assist existing health professionals with necessary behavioural change and reskilling. However, with part of the required transition already occurring through a generational shift, focussing on tertiary education may be a more effective approach to shaping Australia's long-term capabilities and competitiveness in the increasingly globalised health sector. Ensuring the quality of education systems improves at least on par with the rate of technological improvement has also been shown to play an important role in keeping inequality levels low.[126]

While many publications cite that 49% of work activities have the potential to be automated, very few occupations – less than 5% – are candidates for full automation.

As the world's knowledge continues to be digitised and available to health professionals globally, it will be less important for courses to focus on teaching detailed technical knowledge around biology and human anatomy. Instead, critical thinking skills and the ability to consider and learn from new and high quality evidence will become more important. For many health professions, this will require exposing students to the process of data gathering, assessment, and decision making for both individual and population health, as well as developing basic skills in informatics so that graduates are both good consumers and producers of information.

124 The exposome can be defined as the totality of exposure individuals experience from conception until death and its impact on chronic diseases. For example, exposure can include toxicants in the general environment and in workplaces, diet, lifestyle choices and even socioeconomic status. Wild, C.P. 2012, The exposome: from concept to utility. *International journal of epidemiology*, *41*(1), pp.24-32.

125 Brandes, P, and Wattenhofer, R, 2016, Opening the Frey/Osborne Black Box: Which Tasks of a Job are Susceptible to Computerization?. *arXiv preprint arXiv:1604.08823*.

126 Goldin, C,D, and Katz, L,F, 2009, *The race between education and technology*. Harvard University Press.

Nurturing skills will also be highly valued in a future that is more automated. Future health professionals could benefit from greater training around equity, ethics, and providing care to people of different cultures. The incorporation of empathy into communication has been linked to improved patient satisfaction and health outcomes, as well as reduced physician burnout.[127] While graduates are often rich in clinical knowledge, they could also be better prepared by improving their business acumen – obtaining a greater understanding of how the current and future Australian health system works.

In addition to teaching all of these in-demand skills; educational institutes should assess – and healthcare organisations should hire – based on these attributes.

The incorporation of empathy into communication has been linked to improved patient satisfaction and health outcomes, as well as reduced physician burnout.

As new businesses emerge to address the information asymmetry between consumers and clinicians, health professionals will be required to become familiar with the most popular public information sources so that they are able to provide advice on which are the most reliable. This will require the development of platforms which assist healthcare professionals to filter through a growing repository of online health literature and is likely to result in an increase (from the current levels of roughly 25%) in Australian GPs who recommend apps to their patients on a regular basis.[128]

Health professionals will also experience changes to their required skill mix that are specific to their roles. For example, GPs will need to be able to navigate large networks of information to coordinate care and prescribe apps and other digital treatments. They will be required to interpret consumer-owned data from a variety of sources (wearables, point-of-care tests, electronic health records, and genetic screens), manage consumer health plans, and manage patient care across multiple specialists and allied health professionals.

Diagnostic specialists will need to shift attention away from diagnosis and towards treatment, developing data-informed tailored treatment and management plans. For example, pathologists will need specialised skills in genomic mapping and interpretation as disease becomes better defined at the molecular level and enables precision medicine services. They will also spend more time communicating with treating clinicians, explaining incidental findings of diagnostic tests, or becoming familiar with new best practice for treatment options to recommend; becoming a more integrated part of the overall care team.

Potential enabling actions

- Update tertiary education courses to reflect the needs of the future health professional – shifting focus from detailed textbook knowledge to learning from new and high quality evidence and how to translate it into practice effectively and safely.
- Invest in technology transfer skill development, and education programs in key areas such as genomics; health informatics; digital medicines; and solutions, to ensure new health professionals are adaptive to new roles and ways of working.
- Conduct research to investigate how to best prepare health professionals to manage the ethical complexities of providing and interpreting predictive screens.
- Support health professionals in adapting their practices to a greater utilisation of decision support tools.

127 October, T.W., Dizon, Z.B., Arnold, R.M. and Rosenberg, A.R., 2018, Characteristics of Physician Empathetic Statements During Pediatric Intensive Care Conferences With Family Members: A Qualitative Study. *JAMA Network Open*, vo.*1*, no.3, pp.e180351-e180351.

128 The Royal Australian College of General Practitioners (RACGP) 2017, *Technology survey*, viewed 15 April 2018, https://www.racgp.org.au/download/Documents/e-health/2017/RACGP-Technology-Survey-2017-Results.pdfs

4.5 Integrating with the global sector

Improved global integration will help the sector connect and contribute to world leading health and management solutions and encourage the development of novel and globally exportable solutions in Australia.

IMPROVING INTERNATIONAL COLLABORATION

The health sector has typically displayed low levels of globalisation, with the majority of services being provided by Australian organisations for Australian patients and consumers. However, technological advances are making geography and business size less relevant, presenting significant global opportunity for Australian businesses to export and collaborate globally.

International relationships can provide invaluable knowledge that can be used to improve the domestic sector further and ensure the best possible approach to increasing health outcomes is identified. Global collaborations will also be required in areas such as biosecurity to share best management policies and practices relating to biosecurity threats.[129]

Enhanced globalisation is opening Australia up to a variety of international healthcare providers. Linkages with international service providers will facilitate continuity of care as Australian consumers increasingly go overseas for health services – both physically and digitally. With much of the investment and cutting edge innovation in health now being delivered by global technology giants like Apple, Google, and IBM, it is important that Australia identifies ways to partner and collaborate with these organisations to gain access – and contribute – to world-class solutions. At the same time, it is important that Australia invests in home-grown context-derived platforms and federated models to ensure the nation does not become a buyer of next generation health technologies.

To demonstrate value to potential international collaborators, and ensure Australia's relevance on the global stage, the nation needs to aggressively pursue niches in the health market based on the nation's comparative advantages rather than attempting to be everything for everyone. For example, it is unlikely that Australia will become a global leader in cardiovascular management or diabetes clinical trials,[130] however the nation could excel in digital health[131] or precision medicine clinical trials due to Australia's strengths in data security[132] and medical research.

With much of the investment and cutting edge innovation in health now being delivered by global technology giants like Apple, Google, and IBM, it is important that Australia identifies ways to partner and collaborate with these organisations to gain access – and contribute – to world-class solutions.

Potential enabling actions

- Engage, partner, and collaborate with global technology companies and international research groups where relevant to Australia's needs.
- Enhance national coordination to make it easier for international organisations to collaborate with Australia; also aiding domestic data sharing and collaboration.
- Identify and assess national capabilities and identify areas of competitive strength for investment and pursuit of global excellence, while collaborating in areas of relative weakness.

129 CSIRO 2015,'Australia's Biosecurity Future – preparing for future biological challenges', viewed 23 May 2018, https://publications.csiro.au/rpr/pub?list=SEA&pid=csiro:EP146693&sb=RECENT&expert=false&n=1&rpp=25&page=1&tr=16&q=%20Australia%27s%20Biosecurity%20Future&dr=all

130 MTP Connect 2017, Economic profile and sector competitiveness plan, viewed 8 May 2018, https://www.mtpconnect.org.au/Attachment?Action=Download&Attachment_id=54

131 Austrade 2016, Digital Health Industry Capability Report

132 International Telecommunication Union (ITU) 2017, *Global Cybersecurity Index 2017,* viewed 10 May 2018, https://www.itu.int/dms_pub/itu-d/opb/str/D-STR-GCI.01-2017-PDF-E.pdf

IMPROVING PATHWAYS TO MARKET FOR NOVEL HEALTH MANAGEMENT SOLUTIONS

Safer and more efficient paths to market attract international investment and motivate Australian companies to commercialise onshore – providing economic and knowledge benefits to the nation and the potential for new industry creation. Safer and more efficient pathways also improve the quality and effectiveness of health solutions and ensure Australian consumers are best placed to receive first access to novel health solutions.

Building adaptive clinical trial capability

While Australia ranks 10th in the world for the total number of new trials per year for commercially sponsored drug and device trials, the nation has strong advantage in conducting industry sponsored clinical trials in complex therapeutic areas (e.g. oncology), in trials with complex design (e.g. adaptive trial design), and in early stage trials (e.g. Phase I drug trials and feasibility).[133]

Exploring the appropriateness of adaptive clinical trials (modifying the participant journey as the intervention data provides information on what is working best for them) can enhance the effectiveness of novel health solutions, reduce costs and speed up pathways to market. Building clinical trials capacity more broadly will require more streamlined site governance, higher levels of participant recruitment, lower trial costs and investing in developing capability in specialisation, high risk, and innovative trials for Australia to remain a leading trial destination.[134]

Improved regulation of emerging digital health solutions

Strong and clear regulation is a critical element of ensuring the safety and effectiveness of emerging and increasingly digital health solutions. There are an increasing number of combination therapeutics that are utilised by both the unregulated consumer sector and regulated health care systems.[135] As the boundaries between hardware, software, and drugs continue to blur, regulators will need to constantly monitor the suitability of existing product categorisations and approval pathways and clearly communicate associated changes.

In some, but not all cases, greater regulation will be needed. For example, current regulatory guidelines do not cover apps that use a phone's camera and AI to screen for cancerous moles as the app is not connected to a medical device. However, the potential risks associated with misdiagnosis are significant and should warrant regulation. Changes to regulation must be well communicated and introduced in an orderly way so as to provide private capital providers with as much certainty as possible; enabling a strong investment appetite in health.

133 MTP Connect 2017, Economic profile and sector competitiveness plan, viewed 8 May 2018, https://www.mtpconnect.org.au/Attachment?Action=Download&Attachment_id=54

134 MTP Connect 2017, Economic profile and sector competitiveness plan, viewed 8 May 2018, https://www.mtpconnect.org.au/Attachment?Action=Download&Attachment_id=54

135 Wireless-Life Sciences Alliance 2014, *Open Outcomes Based Regulation: The U.S. Needs a New Approach to the Validation and Use of Medical Products and Health Care Services,* viewed 2 May 2018, http://wirelesslifesciences.org/2014/11/open-outcomes-based-regulation-the-u-s-needs-a-new-approach-to-the-validation-and-use-of-medical-products-and-health-care-services/

The blurring of hardware, software and drugs is also making it harder to measure the potential likelihood and impact of harm that could be caused to an individual through use. Developing partnerships between research, industry and regulators can help regulators understand the complexity of emerging health solutions and how they align to existing risk frameworks. Such partnerships would also allow regulators to help industry and research better understand existing risk frameworks. Together, these stakeholders can establish improved regulatory guidelines to enhance approval pathways; testing systems of categorisation and comparing process versus product-based pathways.

Regulatory sandboxes, as discussed in the *CSIRO Medical Technologies and Pharmaceuticals Roadmap*, is one approach to speeding up pathways to market for digitally driven health solutions whereby the solution can be tested and optimised prior to more complex, time-consuming, and expensive regulatory approval processes.[136] This process would require regulators to incorporate new streams of data into their risk profiling and decision making processes.

Potential enabling actions

- Explore more efficient ways of conducting clinical trials, including adaptive clinical trials and smaller sub-population segmentation.
- Enhance the use of satellite sites and telehealth in clinical trials to speed up and improve recruitment numbers – particularly in regional and rural locations.
- Establish secure data transfer between clinical trials and other sources of data (e.g. My Health Record, GPs, and pharmaceutical companies) so that participants are not required to have the same analysis performed multiple times.
- Implement more streamlined data sharing and tracking of information across regulatory trial notifications, trial registries, and other trial sponsors and funding entities.
- Develop partnerships between research, industry, and regulators to help inform regulators early of emerging health solutions and their complexities.
- Review the regulatory classifications and guidelines underpinning regulators to ensure they have the necessary flexibility and responsibility to regulate the increasingly merging siloes of hardware, software, and drug-based health solutions.
- Implement State or region-based test sites that bring together industry, research, and regulators to test and refine regulatory classification and pathways for new technologies.
- Ensure health apps that state specific health claims are clearly supported by clinical or commercial evidence.

136 CSIRO Futures 2017, Medical Technologies and Pharmaceuticals Roadmap

Looking forward

Future health solutions aimed at empowering consumers, integrating care, and developing more effective health and wellbeing management can lead to both improved health outcomes and long-term cost efficiencies. However, resistance to change from those within the sector, and the low digital health literacy of many Australian consumers, is impeding the rate of uptake and correct use of both existing and emerging health solutions.

When planning the execution of the enablers and actions presented in this report, decision makers across governments, industry, and research must work together to focus efforts on initiatives and interventions that have evidence of both effectiveness and cost effectiveness relative to existing options.

As technological advancements continue to outpace sector uptake, policy decision making, and behavioural change, the sector will need to develop responses to – and responsibilities for – broader system questions such as:

- For every preventative measure invested in, what reactive protocol or treatment could investment be removed from?
- What are the priority digital infrastructure needs that will allow the sector to be effectively digitised?
- How can fit-for-purpose education programs be developed and implemented for the diverse demographic groups found in Australia?
- What role does sector leadership need to play in building capability and capacity to deal with the pace of health technology change?

The next wave of health management solutions also bring a range of ethical questions that need to be considered, including:

- How can consumers be protected against unnecessary risk and discrimination associated with an explosion in the volume of personal health data?
- How can national guidelines around the collection and management of personal health (including genetic) information be developed in light of cultural diversity and preferences?
- How can the sector ensure that the digital evolution positively impacts on the way individuals interact with their society?
- Who is liable when AI-based technologies make the wrong decision?[137]
- How can Australia best prepare consumers to deal with the ethical complexities of genetic testing outputs and how can health professionals be best prepared to provide and interpret this information?

137 Australian Academy of Technology and Engineering (ATSE) 2017, *The role of technology in active ageing*, viewed 31 May 2018, https://www.atse.org.au/Documents/policy/role-technology-active-ageing.pdf

Appendix A – Expert review panel

Of the over 30 organisations who helped inform this report through interviews, those listed below provided additional support through workshop participation and reviews of draft versions of the report. Organisations on this panel were selected for their diverse perspectives and technical expertise. We thank them for their robust and objective feedback.

- Bupa
- Commonwealth Bank of Australia
- Department of Health
- MTPConnect
- Monash University
- Murdoch Children's Research Institute
- nib
- Private Healthcare Australia
- Queensland Health
- The Lowitja Institute
- The University of Melbourne
- Weenthunga Health Network

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