Artificial Intelligence (AI) has the potential to bring profound digital disruption of healthcare by creating a smarter, more adaptive health system - the key to the sustainability of quality healthcare in Australia. AI will automate many tasks that were once solely reliant on human expertise from interpretation of imaging and pathology, triage and resource allocation, to personalisation of therapy based on individual characteristics.

The AI in Healthcare Roadmap shows the path that Australia should take to embrace the opportunities that AI brings. The Roadmap identifies the current gaps in Australia’s capability to translate AI into effective and safe clinical services and provides guidance on key issues such as workforce, industry capability, implementation, regulation, and cybersecurity. It also acknowledges the extensive work already undertaken nationally and internationally and builds on this work.

The Australian Alliance for Artificial Intelligence in Healthcare (AAAiH) has developed the Roadmap through extensive community consultation and a national survey conducted over July to August 2021. The Roadmap provides 24 recommendations across eight priority areas. The highest community priority identified was for healthcare AI to be safe for patients and developed and used ethically. AI privacy and data security was a major concern. Respondents also identified the need for genuine whole-of-nation leadership in the healthcare AI space as well as robust governance of the sector. Gaps in our workforce capability to build and use healthcare AI were clearly identified as was the need for consumers to be fully engaged in shaping the healthcare AI agenda. Respondents also rated the gaps in our capability to adopt AI into practice and the need to enhance local industry capability as issues needing clear attention.

AAAiH has been working intensively since it was founded in late 2018 to influence and guide the implementation of AI in healthcare in Australia. It brings together almost 100 national and international partners and stakeholders in academia, government, consumer, clinical, industry organisations, and peak bodies to translate artificial intelligence (AI) technologies into real-world health services.

Professor Enrico Coiera
Founder, Australian Alliance for Artificial Intelligence in Healthcare
# AI IN HEALTHCARE ROADMAP AT A GLANCE

<table>
<thead>
<tr>
<th>Priority</th>
<th>Key Recommendations</th>
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<td>1. SAFETY, QUALITY AND ETHICS</td>
<td>1. Develop a National ethical framework to support the development and deployment of values-based clinical and consumer AI in routine practice. (Timeframe: 1-3 years) 2. For healthcare AI to be safe and not harm patients, it needs to be developed and deployed within a robust safety framework. (Timeframe: 1-3 years) 3. Improve the effectiveness of national safety monitoring systems so that cases of patient risk and harm related to AI use are rapidly detected and communicated to all relevant parties including consumers. (Timeframe: 1-3 years)</td>
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<td>1. Develop a National AI in Healthcare Strategy to provide to provide strategic and national governance and leadership. (Timeframe: 1-3 years)</td>
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<td>4. RESEARCH AND DEVELOPMENT</td>
<td>1. Support the creation and translation of new technologies through existing funding mechanisms through the Medical Research Future Fund (MRFF), National Health and Medical Research Council (NHMRC), Department of Industry, Science, Energy and Resources (DISER) and the Australian Research Council (ARC), for example, committing to a national AI health mission. (Timeframe: 1-3 years) 2. Create targeted funding programs to support research and development collaborations between industry and academia. (Timeframe: 1-3 years) 3. Allocate funds for one or more Centres of Excellence in AI research and translation in healthcare. (Timeframe: 1-3 years)</td>
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<td>1. Understand knowledge and skills gaps and current capability building efforts. (Timeframe: 1-3 years) 2. Develop a foundation AI curriculum framework for health professionals. (Timeframe: 1-3 years) 3. Develop professional accredited training programs for specialist AI health professionals. (Timeframe: 1-3 years) 4. Accelerate training of the health workforce in AI use by supporting critical common core educational resources, tools and infrastructure. (Timeframe: 1-3 years)</td>
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<td>7. ADOPTION</td>
<td>1. Identify national challenges where AI can significantly enhance outcomes and effectiveness of current and emerging healthcare services and create national beacon sites where these challenges can be addressed. (Timeframe: 1-3 years) 2. To ensure cost-effective and appropriate procurement and operation of AI, support administrators and managers with best-practice guidance on system features (e.g. local calibration, transparency, explainability, implementation, and update). (Timeframe: 1-3 years) 3. Identify proven AI technology and products for implementation in healthcare to support procurement decisions. (Timeframe: 1-3 years) 4. Establish a program to ensure the nation is able to take advantage of AI to manage future crises and learn from our response to the COVID-19 challenge. (Timeframe: 1-3 years)</td>
</tr>
<tr>
<td>8. INDUSTRY</td>
<td>1. Identify new industries, export opportunities, jobs and capabilities to shape future policy development. (Timeframe: 1-3 years) 2. Provide support and incentives where they are needed to ensure local industry is competitive nationally and internationally. (Timeframe: 1-3 years) 3. Quantify economic benefits, costs and indicators of AI enabled healthcare in national health priority areas (e.g. ageing, disability, mental health). (Timeframe: 1-3 years) 4. Develop best practice industry standards for AI developers and users to comply with regulatory and legislative requirements. (Timeframe: 1-3 years) 5. Develop mechanisms to allow ethical and consent-based access to clinical data for industry to support AI development. (Timeframe: 1-3 years)</td>
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THE AI OPPORTUNITY FOR HEALTHCARE

We are at the beginning of a profound digital disruption of healthcare. If the last decade was one of big data and analytics, the next research frontier is Artificial Intelligence (AI). Indeed, in its Artificial Intelligence Roadmap, CSIRO’s Data61 identifies healthcare as one of three highest priority opportunities for the nation.

Creating a smart, adaptive health system is key to the sustainability of quality healthcare in Australia. AI-enabled health services, if developed in a meaningful, careful and collaborative way, will herald new modes of delivery and models of healthcare that are more personalised, effective and safe, and will ensure our healthcare system is sustainable and remains an international leader. The combination of machine learning that can exploit patterns in large-scale clinical datasets, and advanced computational reasoning methods that support human decision-making allows us to imagine entirely new ways of delivering care.

AI will automate many tasks once solely reliant on human expertise from interpretation of imaging and pathology, triage and resource allocation, to personalisation of therapy based on individual characteristics. AI offers us profound new opportunities to improve clinical diagnosis, treatment and workflows. From research bench to clinical bedside and into the hands of patients, AI promises to make Australian healthcare a learning system that is more nimble, adaptive, personalised, safe and effective.

Internationally, there have been significant investments in AI in healthcare. Over the past decade, the US Food and Drug Administration (FDA) has reviewed and authorized over 340 medical devices with AI or machine learning capabilities, with the bulk appearing in the last few years. KPMG data indicate US industry investment in AI for healthcare will reach US$6.6 billion in 2021 (a 40% compound annual growth), driven by potential total savings of US$150 billion by 2026. In 2019, the English National Health Service (NHS) created an Artificial Intelligence Laboratory (AI Lab) as part of a GBP 1 billion investment in AI. Lord Darzi’s review of the NHS identified productivity improvement from smart automation of £12.5 billion a year, 9.9% of the NHS England budget. Using AI to reduce UK non-elective hospital admissions could save up to £3.3 billion annually. AI breast cancer image interpretation could reduce the time UK radiologists spend reviewing images by 20% (880,000 hours annually).

While Australia is well positioned to be a global leader in AI, it is currently unprepared to manage the opportunities and risks of an AI enabled world.

ARTIFICIAL INTELLIGENCE (AI) IN HEALTHCARE

The AI opportunity is driven by three advances. Firstly, significant global investment in electronic health records is now producing massive clinical datasets. Secondly, low-cost access to massive computational power and storage is available at scale. Thirdly, deep learning technologies which rely on large data sets and computational power are demonstrating near or better than human capability on many tasks.

Learning: Machine learning systems discover patterns, categories, and relationships from clinical, population, administrative and personal health data, that can then be used to diagnose or suggest treatments. Deep learning methods are based on neural network models.

Planning: Using knowledge about tasks, resources, and goals as well as information about trade-offs, AI can be used to create plans as well as to dynamically update them, for example optimising a patient’s chemotherapy treatment regime over an extended period.

Communicating: Conversations are often essential to communicate complex ideas, or to obtain additional information in pursuit of a diagnostic or therapeutic goal. Chatbots are AIs that can participate in structured conversations with patients or clinicians to accomplish specific tasks such as obtain information or deliver cognitive behavioural therapy.

Discovery: A special class of learning algorithms is focused on creating new knowledge, for example discovering natural scientific laws, or previously unexpected associations such as the genetic basis of a disease, or the repurposing of a drug for a new “off label” use.

KEY SUPPORTING DOCUMENTS

- Artificial Intelligence Roadmap
- Australia’s Artificial Intelligence Action Plan
- Digital Economy Strategy 2030
### ABOUT THE AI FOR HEALTHCARE ROADMAP

This Roadmap has been developed through extensive stakeholder engagement in 2021 across the healthcare sector, including government, industry, peak bodies and consumers.

The AI in Healthcare Roadmap identifies potential gaps in Australia's capability to translate AI into effective and safe clinical services, including in industry capability, implementation, regulation and cybersecurity, and provides guidance on how to close these gaps. It builds on the extensive work that has already been undertaken nationally and internationally, including existing national frameworks (see Appendix B) and policies that relate to AI.

The AAAiH conducted workshops as well as a national survey across 180 key stakeholder organisations and individuals from healthcare between 28 July to 31 August 2021 to determine Australia's national priorities for Artificial Intelligence (AI) in healthcare. Where practicable, we asked that the survey respondent was a senior person with oversight of AI capable of providing an organisational view.

The survey sought open feedback on AI priorities in healthcare and specifically tested eight key priorities identified by the AAAiH Leadership Team. These were reviewed and confirmed through consultation with the AAAiH Working Groups and the AAAiH Industry Advisory Group.

We received feedback from 152 stakeholders and all States and the ACT with healthcare providers forming the largest group of the following sectors:

- Industry and technology providers
- Healthcare providers
- Government
- Academia
- Education and training providers
- Industry associations
- National boards
- Peak bodies (including consumer groups)
- Other organisations (including digital health, consulting).

### Survey respondent area of work, AAAiH National Survey August 2021

![Survey respondent area of work chart]

The chart shows the distribution of survey respondents across different sectors.

### OVERALL NATIONAL AI HEALTHCARE PRIORITIES

When asked “If the Government could do one thing now what should it work on?” respondents clearly made safety, quality and ethical use of AI their highest priority.

<table>
<thead>
<tr>
<th>National AI priorities in healthcare</th>
<th>Rank</th>
<th>Percentage (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Safety, quality and ethics</td>
<td>1</td>
<td>17.8</td>
</tr>
<tr>
<td>Privacy and security</td>
<td>2</td>
<td>15.3</td>
</tr>
<tr>
<td>Governance and leadership</td>
<td>3</td>
<td>13.7</td>
</tr>
<tr>
<td>Research and development</td>
<td>4</td>
<td>11.7</td>
</tr>
<tr>
<td>Workforce</td>
<td>5</td>
<td>11.6</td>
</tr>
<tr>
<td>Consumers</td>
<td>6</td>
<td>11.2</td>
</tr>
<tr>
<td>Adoption</td>
<td>7</td>
<td>10.5</td>
</tr>
<tr>
<td>Industry</td>
<td>8</td>
<td>8.2</td>
</tr>
</tbody>
</table>
SAFETY, QUALITY AND ETHICS

Ensure patients receive safe and ethical care from AI-healthcare services which have been developed in accordance with ethical principles, a safety framework and are appropriately monitored post-implementation.

Unfettered technology use comes with risks. The full benefits of healthcare AI will not be realised unless it can be safely, effectively and ethically integrated into clinical and consumer practice. Yet in Australia there are few standards or governance processes that oversee the safe and effective use of digital health systems, and there are none that specifically deal with AI. This situation is also true in many other developed nations, including the USA and the UK. This situation prompted the UK Academy of Medical Royal Colleges to warn that “dangerous AI could replicate harm at scale”.

Safety is not the only concern. Evidence from healthcare and beyond shows how decisions made all the way along the AI development and deployment pathway have the potential to uphold or violate ethical values. To ensure that we have safe and ethical AI we need consensus and guidance on how to incorporate agreed values into AI systems in healthcare.

Some progress has been made. The Royal Australian and New Zealand College of Radiologists, for example, have published Ethical Principles for AI in Medicine which are supported by their Standards of Practice for Artificial Intelligence. Standards Australia has released An Artificial Intelligence Standards Roadmap and identified four key areas: Privacy, Inclusion and Fairness, Safety and Security, and the need for a proportionate policy and regulator response to AI.

There is however an urgent need to move from contemplation to action and prevent patient harm because we know AI systems are already being deployed in health services and to consumers.

ROADMAP RECOMMENDATIONS

1. Develop a national ethical framework to support the development and deployment of values-based clinical and consumer AI in routine practice. (Timeframe: 1-3 years)
2. For healthcare AI to be safe and not harm patients, it needs to be developed and deployed within a robust safety framework. (Timeframe: 1-3 years)
3. Improve the effectiveness of national safety monitoring systems so that cases of patient risk and harm related to AI use are rapidly detected and communicated to all relevant parties including consumers. (Timeframe: 1-3 years)

Survey respondents suggested that the national ethics framework could cover issues such as value and fairness, privacy, trust, cultural safety, the limits of AI, consent, data security, transparency and explainability, risks and biases, and AI’s impact on vulnerable populations.

Ensuring the safety and quality of AI will require the involvement of consumers, clinicians and AI experts in the co-design of AI, and training in safe use of AI. AI safety will likely require regulation and post-market surveillance to monitor safety of working systems, to enable continuous quality improvement and assessment. The regulatory remit may come under that of existing digital health organisations but brings unique technological challenges that will require expansion of the capabilities of these existing organisations such as the Therapeutic Goods Administration (TGA). Safety governance will need to also account for vendor capability and the cost-effectiveness of vendor requirements. We should wherever possible learn from existing safety frameworks and build on existing standards.

KEY SUPPORTING DOCUMENTS

- An Artificial Intelligence Standards Roadmap: Making Australia’s Voice Heard
- Artificial intelligence for breast cancer screening: Opportunity or hype?
- Artificial Intelligence in healthcare
- Australia’s Artificial Intelligence Ethics Framework
- Ethics and governance of artificial intelligence for health: WHO guidance
- The Royal Australian and New Zealand College of Radiologists. Ethical Principles for AI in Medicine
- The Royal Australian and New Zealand College of Radiologists. Standards of Practice for Artificial Intelligence

GRAPH 1. Safety, quality and ethics

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PRIVACY AND SECURITY

Ensure the privacy of an individual’s healthcare data and the security of data from cybersecurity threats.

AI systems are critical organisational assets. Security breaches may result in theft of information or algorithms, or tampering with the performance of algorithms, with consequences for patient safety, patient privacy and intellectual property (IP) control. It is possible to reverse-engineer AI algorithms and obtain identifying information of patients whose data were used in developing the AI. Current requirements for privacy and security of patient data seem weak in comparison to those in other high-risk sectors such as the financial, aeronautical, and automotive industries.

In PwC Australia’s 2021 Global Digital Trust Insights Survey, almost 60% of respondents from the healthcare industry said they believe it is very likely that a ransomware attack will target their organisation in the next 12 months. 95% of Australia’s CEOs identify cybersecurity as a threat to business growth in PwC’s 24th Annual Global CEO Survey.

If trust in AI systems is low because of the risk of security or privacy breaches, or the unconsented use of patient data or algorithms, then they are less likely to be used widely and effectively. Success in detection of threats and attacks, and remediation of theft or system compromise remain challenging but will increasingly become mission critical.

ROADMAP RECOMMENDATIONS

1. Healthcare organisations should meet minimum standards for cybersecurity to be accredited as healthcare AI users. (Timeframe: 1-3 years)
2. AI systems developers and users must protect the privacy of individuals whose data is used to train AI systems. (Timeframe: 3-5 years)

SURVEY FEEDBACK

Respondents discussed the need for higher security standards (e.g. International Organization for Standardization), empowering consumers, the tension between privacy and data sharing (e.g. for research), the mandatory de-identification of data, patient consent, and adaptive regulation. Respondents raised the need to consider a formal cybersecurity accreditation process, reporting breaches or adverse outcomes, developing open standards, addressing clinical implementation of security and privacy systems, and better communication between healthcare organisations and security providers.

KEY SUPPORTING DOCUMENTS

- A consumer perspective on the intersection of healthcare and data
- Artificial Intelligence in healthcare
- Australia’s Cyber Security Strategy 2020
- Medical device cyber security guidance for industry
- Preparing the Australian health sector for ransomware attacks
GOVERNANCE AND LEADERSHIP

Maximise the benefits and opportunities of an AI enabled healthcare system through a whole-of-government and whole-of-nation approach.

With so many stakeholders engaged in a complex and competitive space, including multiple government and jurisdictional agencies, industry, consumers, and academia, taking a co-ordinated and whole-of-government approach to enabling industry development and health system adoption of AI will help to minimise fragmentation and maximise our national opportunity. A national approach to strategy and governance can help ensure clinical AI is rapidly, effectively, and economically adopted to create health service, industry, export and population benefits. Other nations such as England are already well on this path, with clear national co-ordination efforts and substantial budget allocation for healthcare AI. International coordinative efforts are also underway. For example the International Standards Association has established a Task Force to address the adoption and application of AI standards in healthcare.

Australia’s recent AI Action Plan has the ambition to establish Australia as a global leader in developing and adopting trusted, secure and responsible AI. The Action Plan, together with about $150 million Budget 2021-22 announcements, proposes a range of direct measures, programs and incentives and foundation policy settings as part of the Australian Government’s Digital Economy Strategy to become a leading digital economy and society by 2030.

However, healthcare has very specific requirements that are not addressed in this overarching national plan and current healthcare AI policy in Australia is still in its infancy and fragmented. The current National Digital Health Strategy sets a direction for the digital health system to support coordination, investment and collaboration, but the specific needs, risk and opportunities of healthcare AI are not a specific focus.

The national AI strategy should clearly define the expected benefits of AI, and identify areas of action where collaboration is possible, or agree on areas where one sector takes on national leadership. The strategy should support and encourage rather than control and hold-back. Areas of focus for the national strategy should include quality, safety and ethics, privacy and security, workforce development and support for research and development.

An expert advisory committee should work closely with government to develop evidence-based policy and regulatory proposals for a nationally coherent and strategic approach to guide the national adoption of AI and industry development. It should be multidisciplinary and socio-culturally diverse, and include knowledgeable experts, end users, medical, scientific and lay representatives.

Stakeholders raised the importance of having clear AI sector representation in government, ensuring alignment with international standards, involvement of consumers, visibility and adoption (e.g. a national database of AI solutions), and the importance of collaboration with AI technology providers and industry.

ROADMAP RECOMMENDATIONS

1. Develop a National AI in Healthcare Strategy to provide to provide strategic and national governance and leadership. (Timeframe: 1-3 years)

KEY SUPPORTING DOCUMENTS

- Australia’s Artificial Intelligence Action Plan
- Australia’s National Digital Health Strategy – safe, seamless and secure: evolving health and care to meet the needs of modern Australia
- An Artificial Intelligence Standards Roadmap: Making Australia’s Voice Heard
- Working together to improve the AI regulation system
- AI for healthcare: Creating an international approach together
RESEARCH AND DEVELOPMENT

Ensure relevant and targeted research and development programs are available and adequately funded to provide expert guidance in AI healthcare development and implementation.

Internationally, there is a race between nations to secure primacy in the healthcare AI space, given the huge commercial and health system benefits that are anticipated. Critical to success is the presence of a vibrant and innovative commercial and health system benefits that are anticipated.

The level of investment in healthcare AI in nations such as England is already well over 1 billion pounds in the last few years. Until now, there has been little comparable strategic planning or investment in Australia. In 2020 the Medical Research Future Fund (MRFF) awarded $19 million to several medical research projects using AI, small in comparison and not focussed on supporting platform technologies that could have widespread impact across the health system.

The scale of the AI opportunity, as well as the significant head start other nations have made, indicate there is a need for bold rather than incremental thinking. Australia already has a model of healthcare “missions”, starting with the Genomics Health Futures Mission, which has received more than $500 million. There is a strong case to repeat this strategy for AI.

Many existing mechanisms and models are available to support AI research and development and any investment strategy will need to balance the complementary roles played by academia and industry. Some strategies support the creation of concentrated efforts, such as centres of research excellence, or the national capability centres envisaged by Australia’s AI action plan. Existing funding streams such as the Medical Research Future Fund (MRFF), the National Health and Medical Research Council (NHMRC) and the Australian Research Council (ARC) are all well placed to oversee targeted research programs for healthcare AI.

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ROADMAP RECOMMENDATIONS

1. Support the creation and translation of new technologies through existing funding mechanisms through the Medical Research Future Fund (MRFF), National Health and Medical Research Council (NHMRC), Department of Industry, Science, Energy and Resources (DISER) and the Australian Research Council (ARC), and consider committing to a national AI-health mission. (Timeframe: 1-3 years)

2. Create targeted funding programs to support research and development collaborations between industry and academia. (Timeframe: 1-3 years)

3. Allocate funds for one or more Centres of Excellence in AI research and translation in healthcare. (Timeframe: 1-3 years)

KEY SUPPORTING DOCUMENTS

- Australia’s Artificial Intelligence Action Plan
- Opinion: whoever controls the algorithms controls the world
- Research Translators to Improve Healthcare Outcomes and Boost the Economy

GRAPH 4. Research and development

Many existing mechanisms and models are available to support AI research and development and any investment strategy will need to balance the complementary roles played by academia and industry. Some strategies support the creation of concentrated efforts, such as centres of research excellence, or the national capability centres envisaged by Australia’s AI action plan. Existing funding streams such as the Medical Research Future Fund (MRFF), the National Health and Medical Research Council (NHMRC) and the Australian Research Council (ARC) are all well placed to oversee targeted research programs for healthcare AI.

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Respondents commented on the need for incentives to encourage local and international collaborations across industry, health services and academia and that global partnerships can provide pathways to global markets.
WORKFORCE

Understand knowledge gaps in the workforce and then train the current and future healthcare workforce in the use and implementation of AI-enabled healthcare services.

The Australian research, clinical and health service workforces need to become “AI-enabled” to transform the healthcare sector. For this to occur, Australia will need a cohesive national educational program, leveraging existing and well-established training schemes wherever possible, and supporting new training schemes where gaps exist.

An appropriately skilled workforce that can engage throughout design, development, implementation, scale up and supporting new training schemes where gaps exist. A cohesive national educational program, leveraging existing healthcare sector. For this to occur, Australia will need a workforce in the use and implementation of AI-enabled healthcare services.

Understand knowledge gaps in the workforce and then train the current and future healthcare workforce in the use and implementation of AI-enabled healthcare services.

ROADMAP RECOMMENDATIONS

1. Understand knowledge and skills gaps and current capability building efforts. (Timeframe: 1-3 years)
2. Develop a foundation AI curriculum framework for health professionals. (Timeframe: 1-3 years)
3. Develop professional accredited training programs for specialist AI health professionals. (Timeframe: 1-3 years)
4. Accelerate training of the health workforce in AI use by supporting critical common core educational resources, tools and infrastructure. (Timeframe: 3-5 years)

SURVEY FEEDBACK

GRAPH 5. Workforce

Not everyone needs to learn about the intricacies of AI technologies, and we specifically need to explore what practical skills are needed by the many different workforce groups across healthcare. AI competencies can be embedded in existing pre- and post-qualification training programs, and specialist needs (e.g. radiology AI) can be met by the appropriate specialist Colleges.

KEY SUPPORTING DOCUMENTS

- AAA Health National Healthcare Workforce Survey 2019 – summary available on request
- AI for Healthcare: Equipping the Workforce for Digital Transformation
- National Digital Health Workforce and Education Roadmap
- National Nursing and Midwifery Digital Health Capability Framework
- Report: artificial intelligence in healthcare at AEHRC
- Research Translators to Improve Healthcare Outcomes and Boost the Economy
- The Royal Australian and New Zealand College of Radiologists. Ethical Principles for AI in Medicine
- The Royal Australian and New Zealand College of Radiologists. Standards of Practice for Artificial Intelligence
- The Topol Review: An independent report on behalf of the Secretary of State for Health and Social Care
- Transforming healthcare with AI: The impact on the workforce and organizations: Executive briefing
CONSUMERS

Help all Australians, including vulnerable consumers, navigate the complex healthcare system and be active participants in the management of their own care and wellbeing.

Consumers already access AI-enabled services every day. AI-driven recommender systems are transforming how we are guided in our personal decisions, from making purchasing decisions online through to selecting which movie to see next. By accessing huge data sets of consumer behaviours, retail giants such as Amazon and Netflix and Australian companies such as Woolworths, have harnessed deep learning technologies to guide us to the products they know we are likely to want. Social media companies including Facebook and Google target us with advertisements that are closely matched to our interests.

There is no reason healthcare decisions should not benefit from AI in the same way. Currently most of the AI-enabled health technology consumers use come in the form of healthcare mobile apps. These include symptom checkers which might tell a consumer whether they need to see a doctor or even provide a diagnosis, as part of a “digital first” primary care model. Other apps might help schedule appointments or alert a consumer that they have been in a COVID-19 exposure site. In Australia, some of this technology is government supported, such as the apps and services provided by Healthdirect.

Engaging consumers in the development of technology and AI models of care is critical to the success of AI-enabled healthcare and creating a resilient healthcare system. In 2020 the Consumers Health Forum of Australia (CHF) was engaged by the Government and funded by NPS MedicineWise to undertake Consumer Health Literacy Segmentation and Activation Research. We can anticipate the need for similar targeted work for healthcare AI.

ROADMAP RECOMMENDATIONS

1. Engage consumers in co-designing AI-healthcare services and systems. (Timeframe: Ongoing)
2. Develop and support AI healthcare literacy guidelines and resources for patients and carers. (Timeframe: 1-3 years)

SURVEY FEEDBACK

GRAPH 6. Consumers

As much of the AI available to consumers will come from industry, there is clearly a need to increase consumer awareness of AI benefits and risks, as well as how they can be safely used. Consumers may need to be made aware of upfront or hidden costs, ethical implications, types of consent, data use and quality.

Respondents raised the need to use consumer-centric language, ensure accessibility for all, give consumers complete rights to their data, support informed use of AI, and establish an independent complaint handling and rating system. Some respondents reiterated the need for these technologies to be created through co-design with consumers, and for the involvement of consumers in critical decisions about the oversight and use of these technologies. There was also a reminder that we must understand the needs and attitudes of diverse population groups including vulnerable consumers, the elderly and those with disabilities.

KEY SUPPORTING DOCUMENTS

- Consumer Health Literacy Segmentation and Activation Research Project. Final Report
- Consumers in Australia drive healthcare’s future
- Empowerment will be at the heart of the new healthcare experience
- Health Literacy and Quality Use of Medicines in Australia: A Rapid Review of the Literature
- The effective and ethical development of artificial intelligence: An opportunity to improve our wellbeing
ADAPTATION

Implement AI seamlessly and successfully across the healthcare system at a local, state and federal level to help create a resilient healthcare system.

In some ways creating new AI technologies is the easy part of the problem. For healthcare, the biggest challenges lie in the ‘last mile’ where AI technology must be embedded into pre-existing systems and workflows, and where clinicians and patients must be comfortable and effective users of these new technologies. The rapidly evolving nature of this sector presents challenges for CEOs and healthcare managers when faced with procurement and implementation decisions. Picking the right products is challenging, as is ensuring that they are used effectively with manageable cost of ownership.

Many healthcare services will find themselves locked into current inflexible and proprietary digital clinical systems, and thus are effectively locked out of expanding system functionality into modern AI services. Yet the timeframe of response needed from the health system to change its service offerings can be short, as we have learned through the COVID-19 pandemic. If we wish to see rapid increase in the adoption and use of AI-enabled services, there are formidable pragmatic challenges to be faced.

In 2021 ANZAI developed the “Translational Evaluation of Healthcare Artificial Intelligence – TEHAI" which is an evaluation framework to assess the functional, utility and ethical aspects of AI systems. TEHAI addresses the gaps in implementing AI in healthcare that have limited its adoption including inappropriate or incomplete evaluation of AI systems, a lack of internationally recognised AI standards on evaluation and little guidance on assessing the functional, utility and ethical components of AI systems in healthcare.

ROADMAP RECOMMENDATIONS

1. Identify national challenges where AI can significantly enhance outcomes and effectiveness of current and emerging healthcare services and create national beacon sites where these challenges can be addressed. (Timeframe: 3-5 years)
2. To ensure cost-effective and appropriate procurement and operation of AI, support administrators and managers with best practice guidance on system features (e.g. local calibration, transparency, explainability, implementation, and updates). (Timeframe: 1-3 years)
3. Identify proven AI technology and products for implementation in healthcare to support procurement decisions. (Timeframe: 3-5 years)
4. Establish a program to ensure the nation is able to take advantage of AI to manage future crises and learn from our response to the COVID-19 challenge. (Timeframe: 1-3 years)

SURVEY FEEDBACK

In the past, some health jurisdictions have sought to spread innovation informally across their services, but with AI there are arguments to initially concentrate effort in a few leading exemplar services. Focusing on priority challenges in healthcare would see early co-ordinated effort focus on areas of strategic importance, as well as provide a vehicle to rapidly develop national capability and experience which can then be moved to other parts of the healthcare system.

Technology procurement is subject to strict policies and guidance.

GRAPH 7. Adoption

In the past, some health jurisdictions have sought to spread innovation informally across their services, but with AI there are arguments to initially concentrate effort in a few leading exemplar services. Focusing on priority challenges in healthcare would see early co-ordinated effort focus on areas of strategic importance, as well as provide a vehicle to rapidly develop national capability and experience which can then be moved to other parts of the healthcare system.

KEY SUPPORTING DOCUMENTS

- A Buyer’s Guide to AI in Health and Care
- A guide to good practice for digital and data-driven health technologies
- A Health Interoperability Standards Development, Maintenance and Management Model for Australia
- Harnessing artificial intelligence for development in the post-COVID-19 era: A review of national AI strategies and policies
- Evaluation framework to guide implementation of AI systems into healthcare settings
- Injecting intelligence into health care. Executive survey of AI in healthcare Australia
- The Royal Australian and New Zealand College of Radiologists. Standards of Practice for Artificial Intelligence
Support the development of a local healthcare AI industry to become globally competitive and deliver significant clinical and economic benefits to Australia.

The economic opportunity created by AI in healthcare globally is substantial. KPMG data indicate AI for healthcare industry investment in the US alone is US$6.6 billion in 2021 (a 40% compound annual growth), driven by potential total savings of US$150 billion by 2026. Australian industry can and should be part of this.

With a highly skilled workforce and a benchmark global health system, many of the critical ingredients for success are in place. The Australian healthcare AI industry however is still very small and immature compared to that of other comparable nations. In the US, the Food and Drug Administration has already reviewed and authorized over 340 new medical devices with AI or machine learning capabilities, with the bulk appearing in the last few years. With investments exceeding GBP 1 billion into the English NHS, London has become a global capital of healthcare AI industry and is home to companies such as DeepMind and Babylon.

ROADMAP RECOMMENDATIONS

1. Identify new industries, export opportunities, jobs and capabilities to shape future policy development. (Timeframe: 1 to 3 years)
2. Provide support and incentives where they are needed to ensure local industry is competitive nationally and internationally. (Timeframe: 1 to 3 years)
3. Quantify economic benefits, costs and indicators of AI enabled healthcare in national health priority areas (e.g. ageing, disability, mental health). (Timeframe: 1 to 3 years)
4. Develop best practice industry standards for AI developers and users to comply with regulatory and legislative requirements. (Timeframe: 2 to 5 years)
5. Develop mechanisms to allow ethical and consent-based access to clinical data for industry to support AI development. (Timeframe: 1 to 3 years)

KEY SUPPORTING DOCUMENTS

- An Artificial Intelligence Standards Roadmap: Making Australia’s Voice Heard
- Australia’s Artificial Intelligence Action Plan
- Australia’s digital health industry set to drive economic growth
- Digital Economy Strategy 2030
- Digital Innovation: Australia’s $315B Opportunity
- How collaboration can help your business
- Medical products national manufacturing priority road map
- REDI Skills Gap Analysis Reports

SURVEY FEEDBACK

GRAPH 8. Industry

Industry requires a comprehensive policy roadmap. In our workshops with industry, the central point of discussion has been the significant barriers local companies face in taking AI to market nationally, let alone internationally. The pressure of innovation coming from international competitors is demanding companies reduce the time it takes to bring a product to market.

However small to medium sized companies face significant challenges in attracting a skilled workforce, in accessing IP that can be included in their products and have a need for health technology assessment services and guidance. The high standards required for healthcare technologies also mean that smaller companies require support to undertake proof-of-concept demonstrations, for example in identifying clinical trial sites, partners and independent evaluators, as well as financial support for these often-expensive exercises.

AI product development requires access to clinical data, and those companies with the best access to training data are advantaged in the marketplace when developing AI. Locally there remain significant barriers to obtaining clinical data from public sector health services, in contrast to arrangements available in other nations. There remain significant issues with using public health system data for commercial development, including the thorny but crucial issue of managing patient consent and privacy. Urgent attention to these issues would likely have significant benefits for local industry.

Some respondents have suggested replacing incentives with resources to support product development, encouraging partnerships between local companies and international leaders in the sector to support transfer of skills and IP, and revising procurement guidance to enable development of more local AI solutions.
ABOUT THE AUSTRALIAN ALLIANCE FOR AI IN HEALTHCARE

An AI revolution is unfolding globally and it is impacting everything from diagnostic interpretation of medical imaging to personalised therapeutics. However, in the Australian healthcare system, major gaps exist in our ability to translate recent and upcoming major AI advances into real-world health services. The critical research frontier for AI in healthcare is in implementation science, where formidable translational challenges exist.

AAAiH was formed in 2018 and brings together almost 100 national and international member organisations and 270 individuals in academia, government, consumer, clinical and industry organisations to translate frontier artificial intelligence (AI) technologies into real-world health services. At the simplest level, the Australian Alliance for AI in Healthcare (AAAiH) wishes to see the Australian organisations and 270 individuals in academia, government, consumer, clinical and industry workforce needed to make transformational AI programs succeed.

AAAiH STRATEGIC AREAS

PRECISION HEALTHCARE
Researching and translating AI technologies into clinical services so that patients receive the most personalised, safe, effective and timely care possible.

SAFETY, QUALITY AND ETHICS
Ensuring that those accessing the health system receive safe and ethical care from AI-enabled services.

CONSUMER HEALTH
Helping all Australians navigate complex health systems and be active participants in the management of their own care and wellbeing.

WORKFORCE
Developing the research, clinical and health services workforce needed to translate frontier artificial intelligence (AI) technologies into real-world health services. The critical research frontier for AI in healthcare is in implementation science, where formidable translational challenges exist.

AAAiH PARTNERS AND ENGAGED STAKEHOLDERS

NATIONAL
1. AARNet
2. Alcidion
3. ARC Training Centre in Cognitive Computing for Medical Technologies
4. Australian Commission on Safety and Quality in Health Care
5. Australian Digital Health Agency
6. Australian Genomics Health Alliance
7. Australian Institute of Health and Welfare
8. CareMonitor
9. Cognitive Software Group
10. CSIRO – Australian eHealth Research Centre and Data61
11. Energesse
12. Epworth HealthCare
13. Evidenti
14. GenomiQa
15. Harrison AI
16. HealthDirect Australia
17. Health Language Analytics
18. Innowell
19. Medi-AI
20. Murdoch Children’s Research Institute
21. Opyl
22. Outcome Health
23. Pathology Technology Australia
24. Prospection
25. SharpiedMinds.ai
26. Siemens Healthineers
27. Silverpond
28. Standards Australia
29. Telstra Health
30. The Florey Institute

WESTERN AUSTRALIA
1. Department of Health

PEAK BODIES
1. Australian Healthcare & Hospitals Association
2. Australasian College of Legal Medicine
3. Australasian Institute of Digital Health
4. Consumers Health Forum of Australia
5. COTA Australia
6. Cystic Fibrosis Australia
7. Leukaemia Foundation
8. Medical Software Industry Association
9. Save Our Sons Duchenne Foundation
10. The Royal Australian and New Zealand College of Ophthalmologists
11. The Royal Australian and New Zealand College of Radiologists

INTERNATIONAL
1. Accenture Australia
2. Amazon Web Services
3. Asia eHealth Information Network
4. Chartered Institute of Ergonomics and Human Factors (UK)
5. Google Health
6. IBM Research Australia
7. Oracle Corporation
8. Orion Health
9. Precision Driven Health
10. Talend

SOUTH AUSTRALIA
1. Adelaide BioMedCity
2. Australian Centre for Precision Health
3. Australian Institute for Machine Learning
4. Department of Innovation and Skills
5. Flinders Digital Health Research Centre
6. Flinders University
7. SA Genomics Health Alliance
8. SA Health
9. SA-NT DataLink
10. South Australian Health and Medical Research Institute
11. The University of Adelaide
12. University of South Australia

AUSTRALIAN CAPITAL TERRITORY
1. Australian National University

QUEENSLAND
1. Bond University
2. Brisbane Diamantina Health Partners
3. Clinical Excellence Queensland
4. Department of Health and Economic Development Queensland
5. Health Consumers Queensland
6. Queensland Genomics Health Alliance
7. The University of Queensland

NEW SOUTH WALES
1. Agency for Clinical Innovation
2. Australian Centre for Health Innovation
3. Clinical Excellence Commission
4. eHealth NSW
5. Macquarie University
6. UNSW Sydney
7. The Centre for Big Data Research in Health
8. The University of Sydney
9. University of Wollongong

VICTORIA
1. Austin Health
2. Deakin University
3. Department of Health
4. Melbourne Health
5. Monash University – Digital Health Program
6. RMIT University
7. Royal Children’s Hospital Melbourne
8. The Royal Melbourne Hospital
9. The University of Melbourne

TASMANIA
1. University of Tasmania
STAKEHOLDERS INVITED TO RESPOND TO THE NATIONAL AI IN HEALTHCARE SURVEY

Australian Information Industry Association
Australian Medical Association
Australian Medical Council
Australian Nursing & Midwifery Federation
Australian Pharmacy Council
Australian Primary Health Care Nurses Association
Australian Private Hospital Association
Australian Research Council
Australian & New Zealand Association for Health Professional Educators
Benito Health
Chief Scientist
Clinical Excellence Commission (NSW)
Clinical Excellence Queensland
College of Intensive Care Medicine of Australia and New Zealand
Community Services and Health Industry Training Board
Consumer Healthcare Products Australia
Consumers Health Forum of Australia
COTA Australia
Council of Ambulance Authorities
CSRIO - Australian eHealth Research Centre
CSIRO - Data61
Dental Assistants Professional Association Inc
Dental Hygienists Association of Australia
Dept of Health - NT
Dept of Health - SA
Dept of Health - TAS
Dept of Health - VIC
Dept of Health - NSW
Dept of Health - Qld
Dept of Health - WA
Dept of Industry, Science, Energy and Resources
Detmams Australia
Digital Health CRC
Federation Sterilising Research Advisory Councils of Australia
First Aid Industry Alliance
Health Consumers Queensland & Queensland Genomics Health Alliance
Health Education and Training (NSW)
Healthdirect Australia
Independent Hospital Pricing Authority
Independent Tertiary Education Council Australia
Innovation and Science Australia
Macquarie University Centre for Health Economy
Medical Software Industry Association
Medical Technology Association of Australia
Melbourne Academic Centre for Health
Mental Health Coordinating Council
MTPConnect
National Aboriginal and Torres Strait Islander Health Worker Association
National Aboriginal Community Controlled Health Organisation
National Children's Digital Health Collaborative - ADHA
National Disability Services
National Indigenous Australians Agency
National Institute of First Aid Trainers
National Rural Health Alliance
Optus Macquarie University Cyber Security Hub
Oral Health Professional Association
Orthoptics Australia Ltd
QLD AI Hub
RACGP - The Royal Australian College of General Practitioners
RACP - Australasian Chapter of Palliative Medicine
RACP - Australasian Chapter of Sexual Health Medicine
RACP - Australasian Faculty of Occupational and Environmental Medicine
RACP - Australasian Faculty of Public Health Medicine
RACP - Australasian Chapter of Addiction Medicine
RACP - Paediatrics and Child Health Division
RACP - The Royal Australasian College of Physicians
Rare Cancers Australia
Reseach Australia
Royal Australasian College of Dental Surgeons
Royal Australasian College of Medical Administrators
Royal Australasian College of Surgeons
Royal Australian and New Zealand College of Obstetricians and Gynaecologists
Royal College of Pathologists of Australasia
Royal Flying Doctor Service - NSW/ACT
Royal Flying Doctor Service - NT/SA
Royal Flying Doctor Service - QLD
Royal Flying Doctor Service - TAS
Royal Flying Doctor Service - VIC
Rural Doctors Association of Australia
Services for Rural and Remote Allied Health
Society of Hospital Pharmacists of Australia
Speech Pathology Australia
Standards Australia
TAFE Directors Australia
TAFE NSW
TAFE Queensland
TAFE SA
Territory Families (NT Government)
TGA
The Pharmaceutical Society of Australia
The Pharmacy Guild of Australia
The Royal Australian and New Zealand College of Pathologists
The Royal Australian and New Zealand College of Psychiatrists
The Royal Australian and New Zealand College of Radiologists
University - ANU Medical School
University - Bond University - Health Sciences & Medicine
University - Canberra Institute of Technology
University - Charles Darwin University - Monash School of Health Research
University - CQ University - School of Health, Medical and Applied Sciences
University - Curtin University - Health Sciences
University - Deakin University - Faculty of Health
University - Flinders University - College of Medicine and Public Health
University - Flinders University - College of Nursing and Health Sciences
University - Griffith University - Griffith Health
University - James Cook University - College of Public Health, Medical and Veterinary Sciences
University - James Cook University - College of Healthcare Sciences
University - James Cook University - College of Dentistry and Dentistry
University - Marquette University - Faculty of Medicine, Dentistry and Pharmaceutical Sciences
University - Monash University - Faculty of Medicine, Nursing and Health Sciences
University - Monash University - Faculty of Pharmacy and Pharmaceutical Sciences
University - Western Sydney University - School of Health Sciences
University - Western Sydney University - School of Medicine
University - Western Sydney University - School of Nursing and Midwifery
University - Western Sydney University - School of Psychology
University of Adelaide - Health & Medical Sciences
University of Melbourne - Faculty of Medicine, Dentistry and Health Sciences
University of New England - Faculty of Medicine and Health
University of New South Wales - Faculty of Medicine
University of New South Wales - Institute for Cyber Security
University of Newcastle - Faculty of Health and Medicine
University of Notre Dame Australia - School of Health Sciences
University of Notre Dame Australia - School of Medicine
University of Notre Dame Australia - School of Nursing & Midwifery
University of Notre Dame Australia - School of Physical Therapy
University of Queensland - Faculty of Health and Behavioural Sciences
University of Queensland - Faculty of Medicine
University of Sydney - Faculty of Medicine and Health
University of Tasmania - College of Health and Medicine
University of Western Australia - Faculty of Health and Medical Sciences
University of Wollongong - Faculty of Science, Medicine and Health
APPENDIX C
ACRONYMS

ADHA  Australian Digital Health Agency
AEHRC  Australian e-Health Research Centre
DISER  Department of Industry, Science, Energy and Resources
DOH   Department of Health (Australian Government)
PMC   Department of the Prime Minister and Cabinet
TGA   Therapeutic Goods Administration

APPENDIX B
REFERENCES AND KEY DOCUMENTS (CONTINUED)


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