

# Realising the value of digital health in Asia and the Pacific



# About Economist Impact

Economist Impact combines the rigour of a think-tank with the creativity of a media brand to engage a globally influential audience. We believe that evidence-based insights can open debate, broaden perspectives and catalyse progress. The services offered by Economist Impact previously existed within The Economist Group as separate entities, including EIU Thought Leadership, EIU Public Policy, EIU Health Policy, Economist Events, EBrandConnect and SignalNoise. We are building on a 75 year track record of analysis across 205 countries. Along with framework design, benchmarking, economic and social impact analysis, forecasting and scenario modelling, we provide creative storytelling, events expertise, design-thinking solutions and market-leading media products, making Economist Impact uniquely positioned to deliver measurable outcomes to our clients.

# Contents

- 4 About this report
- 6 Executive Summary
- 9 Introduction: what is digital health and why is it important?
- 12 The value of digital health for patients, providers, health systems and payers
- 16 Facilitators and challenges to digital health transformation
- 22 Digital health and the covid-19 effect
- 25 Making the value case for digital health in Asia and the Pacific
- 29 Final conclusions and opportunities for improvement

# About this report

Realising the value of digital health in Asia and the Pacific is an Economist Impact report, sponsored by Roche.

The report looks at the landscape of digital health in Asia and the Pacific, the benefits it offers multiple stakeholders, the barriers and challenges to realising its full value, and how the covid-19 pandemic changed the face of digital health seemingly overnight. It presents lessons on how to frame and promote the value proposition for digital health, and also offers key policy takeaways.

The research was supported by a targeted and pragmatic literature review and in-depth interviews with experts in the field of digital health. This report would not be possible without the expert insights of those on the front lines of digital health innovation and practice. Our thanks are due to the following for their time and insights (listed alphabetically):

- Dr. Zoran Bolevich, Chief Executive of eHealth New South Wales (NSW) and Chief Information Officer of NSW Health, Australia
- Dr. Ray-Jade Chen, Chair Professor of Surgery, School of Medicine, Taipei Medical University, Taiwan; Consultant Surgeon, Taipei Medical University Hospital, Taiwan
- Dr. Trisha Greenhalgh OBE, Professor of Primary Care Health Sciences, University of Oxford, United Kingdom
- Dr. Boonchai Kijsanayotin, Senior Lecturer, Faculty of Medicine Ramathibodi Hospital, Mahidol University, Thailand; Research manager, Thai Health Information Standards Development Centre, Health System Research Institute; Chair, Asia eHealth Information Network; and Member, WHO Digital Health Technical Advisory Group
- Prof. John CW Lim, Executive Director, Centre of Regulatory Excellence (CoRE), Duke-NUS Medical School; Chairman, Consortium for Clinical Research & Innovation Singapore (CRIS)
- Dr. Keren Priyadarshini, Regional Leader for Healthcare in Asia Pacific, Microsoft
- Assoc Prof. Soo-Yong Shin, Associate Professor, Department of Digital Health, SAIHST (Samsung Advanced Institute for Health Sciences & Technology), Sungkyunkwan University, South Korea
- Angela Ryan, Vice Chair, Australasian Institute of Digital Health (AIDH), Australia

The views of interviewees are their own, and not necessarily those of their affiliated institutions.

Economist Impact bears sole responsibility for the content of this report. The findings and views expressed in the report do not necessarily reflect the views of the sponsor. The report was written by Jane Parry and edited by Maria Ronald. The Economist Impact research team

consisted of Gerard Dunleavy, Cassandra Cheung and Neeladri Verma. While every effort has been taken to verify the accuracy of this information, Economist Impact cannot accept any responsibility or liability for reliance by any person on this report or any of the information, opinions or conclusions set out in this report.

# Executive summary

Digital transformation is taking place in all areas of life, including health. From electronic medical records (EMRs) to wearable medical technology and artificial intelligence (AI), digital health is changing the way we deliver medical services and organise health systems. Digital health technology is also a burgeoning market: one projection estimates that the value of digital health will be US\$1.5 trillion by 2030.

Digital health technologies hold the promise of healthcare that is more equitable and personalised, and that can advance the strengthening of health systems and universal health coverage (UHC). Bringing this potential to fruition, however, requires a conscious effort by governments, policymakers and healthcare decision-makers. Whether policymakers are ready or not, digital health ecosystems are already emerging, and they are growing because they offer value to the diverse players involved.

There is potential for widespread transformation through digital health solutions, including in the routine tasks associated with health promotion and continuity of care for noncommunicable diseases, as well as for data management and use of data to improve the speed of response. Studies have shown that digital health tools that enable patients to continue care outside of a healthcare facility are well received by patients

(and their caregivers); they contribute to a sense of empowerment, knowledge of their condition, and agency over clinical decision making.

For healthcare providers, the value of digital health tools lies in their potential to increase efficient use of time, maintain a flow of information about patients even outside the healthcare facility, further enhance patients' compliance to the treatment, and improve decision-making that, in turn, could avoid missed diagnosis and reduce medico-legal claims.

For healthcare systems, the value of digital health comes from improved transparency and accountability of care that transcends institutional and geographic boundaries. By streamlining processes, cutting wait times, and reducing over-treatment and errors, digital health tools can improve allocation of resources, thus increasing cost-efficiency. For payers, digital health tools offer the potential to reduce costs, offer better insights and streamline data management.

However, digital health tools and solutions do not necessarily guarantee better patient outcomes or value to the health system as a whole, or contribute to strengthening health systems and UHC. To achieve these improvements, and harness the transformative value of digital health, there must be an enabling environment that is

rooted in government strategy, policy and plans. When there is a clear regulatory framework, it encourages the acceptance of digital health technologies. To be effective, a digital health strategy must align with the government's broader digital direction and governance, and be embedded in the broader health strategy. Digital health implementation must follow a "whole-of-government" approach in order to be successful because it relies on citizen data held by multiple public entities. Without this, there is a risk of disconnected interventions of limited or no impact.

Technology is not at the core of digital health – users are. If digital health tools are deployed in ways that do not take end-users into account, they run the risk of being side-lined or even abandoned. Thus, systemic adoption of digital health tools requires enough people within the health system to have sufficient digital health expertise, as well as understand health information standards and the enterprise architecture for IT projects.

While issues of security and data sharing are not unique to healthcare, the patient-doctor relationship is one uniquely predicated on trust, in the context of asymmetry of information, and moral hazard. As a result, trust is at the heart of much of the controversy around digital health information technology.

AI has a unique role to play in transforming healthcare. It can help accelerate progress towards UHC by promoting task-shifting, self-management, and improving population-level outcomes through, for example, earlier disease detection and identification of cost-effective, high-impact measures. When data silos are broken down, the potential for data aggregation to feed into AI algorithms greatly increases. In turn, this aggregated data can power AI-derived diagnoses, tailor individual patient treatments with more precision, and dynamically assist in

targeting resources in the most effective and efficient way. However, the advent of AI compels healthcare stakeholders to grapple with both the benefits and the risk of augmented decision-making.

The covid-19 pandemic exposed several cracks in health systems across the world, including weak infectious disease surveillance, inefficient supply chain and distribution systems, under-powered health information systems, poor decision support for healthcare providers, and a pervasive unwillingness to recognise telemedicine as real healthcare. Since then, however, digital health technology has come into its own. Measures to rapidly screen for the virus, trace contacts of confirmed cases, as well as contain and quarantine them were all particularly successful in countries that rapidly deployed digital health technology.

Asia and the Pacific are at the centre of several colliding forces that are propelling the adoption of digital health, including rapid population ageing, health systems under pressure from increased demand, and below-average doctor-patient ratios in most countries. Digital health tools can alleviate many of these challenges, and also benefit from the fact that the region is home to widespread technological innovation and investment.

Digital health as a paradigm shift will only happen if powerful stakeholders in the health system, such as physicians or healthcare organisations, buy in.<sup>45</sup> This, in turn, can only happen if they are compensated for the time and financial investment of using digital health solutions, such as EMRs and telehealth consultations. As decision-makers in health systems grapple with digital technology solutions, it becomes increasingly urgent to develop regulatory, clinical, and pricing and reimbursement guidelines.

Digital health tools have the power to transform the way we deliver and use health care by creating more efficient, equitable and

sustainable health outcomes. Our report on realising the value of digital health reveals five policy takeaways:

## POLICY TAKEAWAYS



Understanding the current situation is the first step in delivering value for each stakeholder and will help target investments in priority areas.



The complexity of the health system must be embraced when formulating digital health strategies to meet identified needs.



Digital Health implementation must follow a "whole-of-government" approach in order to have a meaningful impact because it relies on citizens' data held by multiple public entities.



When designing digital health interventions, principles that offer transparent data stewardship, interoperability, and data sharing should be followed.



Now is the time to build on the momentum created by the covid-19 effect and emerging digital health ecosystems.

# Introduction: what is digital health and why is it important?

Digital transformation is taking place in all areas of life, including health. Digital technologies are now ubiquitous, and their use is increasingly widespread across the landscape of healthcare and well-being. From established technologies such as electronic medical records (EMRs) to newer developments in wearable medical technology and artificial intelligence (AI) technologies, digital health is changing the way we deliver medical services and organise health systems. Digital health technology is also a burgeoning market. Estimates of the current and projected future size of the market vary; they range from over US\$141 billion in 2020 and projected to grow to US\$427 billion by 2027, to US\$289 billion in 2021 and expected to reach US\$881 billion by 2027.<sup>1-3</sup> One projection puts the value of digital health at US\$1.5 trillion by 2030.<sup>4</sup>

## Defining digital health

The diversity of digital technologies has made it challenging to define digital health. Existing definitions range from the prosaic—“mobile health, health information technology, wearable devices, telehealth and telemedicine and personalised medicine”<sup>5</sup>—to the aspirational: “advanced medical technologies, disruptive innovations and digital communication [that] have gradually become inseparable from providing best practice healthcare.”<sup>6</sup>

Digital health tools can be patient-facing, such as digital health records accessible to patients, mobile apps and wearable technology. They can be health system-focused, for example, health management information systems. They include health service delivery modalities such as telemedicine; wearable, implantable and ingestible medical devices; patient-managed diagnostic tools; and health mobile apps. Added to this long list are AI and machine learning applications for prognosis and decision-making for both individual patients and for the protection of public health.<sup>7</sup> The covid-19 pandemic has shown how digital health tools can be transformational in dealing with an acute public health crisis; similarly, digital health tools also have the potential for more widespread transformation of the health system, including in the more day-to-day tasks associated with health promotion and ongoing care for noncommunicable diseases.<sup>8</sup>

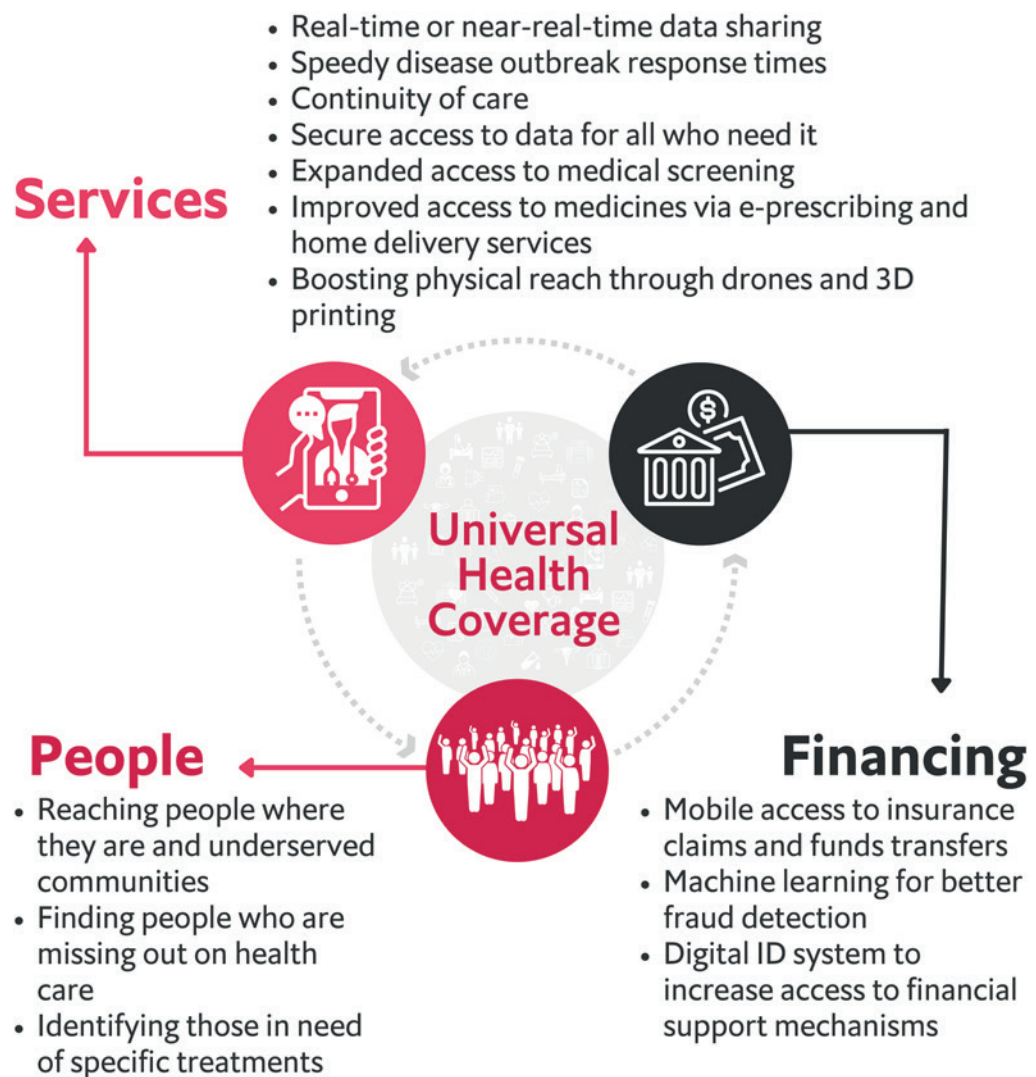
## Information is power

A healthcare system that makes full use of digital health tools is based on a secure flow of health information such that everyone who needs health data can get it, but no-one can get any more data than they need. This means regulations need to be in place about how to access data securely—and respecting the rights of patients should be embedded within such rules.

Digital health tools could be transformational for data collection, population health monitoring and data-driven health policy. Digital health technologies hold the promise of healthcare that is more equitable and personalised, and that can advance the strengthening of health systems and universal health coverage (UHC). Figure 1 illustrates the key mechanisms by which digital health tools support UHC. The World Health

Organization (WHO) describes the strategic and innovative use of digital and cutting-edge information and communications technologies as an essential enabling factor for ensuring that its triple billion targets (1 billion more people benefit from UHC, 1 billion more people are better protected from health emergencies, and 1 billion more people enjoy better health and well-being) are met.<sup>9</sup>

**Figure 1: How digital health tools support UHC**



Source: Adapted from Wilson D, Sheikh A, Görgens M, Ward K; World Bank. Technology and Universal Health Coverage: Examining the role of digital health. J Glob Health. 2021;11:16006. Published 2021 Nov 20. doi:10.7189/jogh.11.16006

Digital health technologies have the potential to transform healthcare. However, doing so in a way that is equitable, sustainable, rooted in ethical principles, and leading to safe and reliable care requires a conscious effort by governments, policymakers and healthcare decision-makers. As expressed in the WHO's Global Digital Health Strategy 2020-2025, to achieve this vision, digital health "should be developed with principles of transparency, accessibility, scalability, replicability, interoperability, privacy, security and confidentiality".<sup>9</sup>

### **Digital health in Asia and the Pacific**

Across Asia and the Pacific, there are strong forces motivating countries to explore digital health technologies with a view to addressing some of their most pressing challenges, including ageing populations, increasing demand for value-for-money healthcare, and, in many low- and middle-income countries, the drive towards UHC. In a region that encompasses great diversity in income and development status, size, population, health system structures, and healthcare financing ecosystems, it is not surprising that there is great variance in

countries' readiness to adopt digital health solutions. For example, some countries' health information systems, such as Japan and India, are still heavily paper-based. In contrast, Singapore and Taiwan are standout examples of advanced adoption of digital health data collection and management.

Digital health ecosystems are already emerging, driven by demand from the private sector, care delivery networks, insurers and other payers, and the public.<sup>8</sup> However, there is a distinct lack of detailed information about the extent to which digital health solutions have been adopted in the region,<sup>9</sup> and the existing ecosystems are at varying levels of maturity.<sup>10</sup> These ecosystems exist because they offer value to the diverse players involved.<sup>8</sup> However, digital health technologies alone cannot improve patient outcomes or add value to the health system as a whole or contribute to the strengthening of health systems and UHC. To harness the transformative (rather than incremental) value of digital health, there must be an enabling environment that is rooted in government strategy, policy and plans.

# The value of digital health for patients, providers, health systems and payers

## Patients and caregivers

Digital health tools offer patients significant benefits, including greater choice on how to access care, and speeding up access to diagnostic information, making care more personalised, and enabling better preventative care.<sup>11</sup> Digital health tools can help overcome geographical barriers to

accessing care and make both patients and their caregivers feel less isolated.<sup>12</sup> They can extend medical services beyond the physical confines of a healthcare facility. For example, chronic heart disease patients have been able to remain connected to their care providers after discharge through mobile apps and text messaging, both for remote monitoring and disease management.<sup>13</sup> A prescription digital therapeutic for hypertension in Japan has enabled lifestyle modifications for patients with hypertension and has demonstrated clinical efficacy in reducing 24-hour systolic blood pressure in phase III clinical trials. In addition, a modelling study highlighted that the prescription digital therapeutic, when paired alongside treatment as usual, demonstrated to prolong quality-adjusted life years (QALYs) and be cost-effective.<sup>14</sup>

Studies have shown that digital health tools that enable patients to continue care outside of a healthcare facility are well received by patients as a complement to face-to-face care;<sup>15</sup> they contribute to a sense of empowerment, knowledge of their condition, and agency over clinical decision-making.<sup>16</sup> The benefits of digital health tools also extend to caregivers, helping them to overcome isolation and loneliness in the caregiving role and gain support from other caregivers via Internet-based platforms.<sup>17</sup> Key facilitators of patient-oriented digital health tools include user-friendly design, privacy guards, time-saving functionality and the freedom to access information at their own convenience.<sup>18</sup>

**Figure 2: Patient perspective value of digital health**

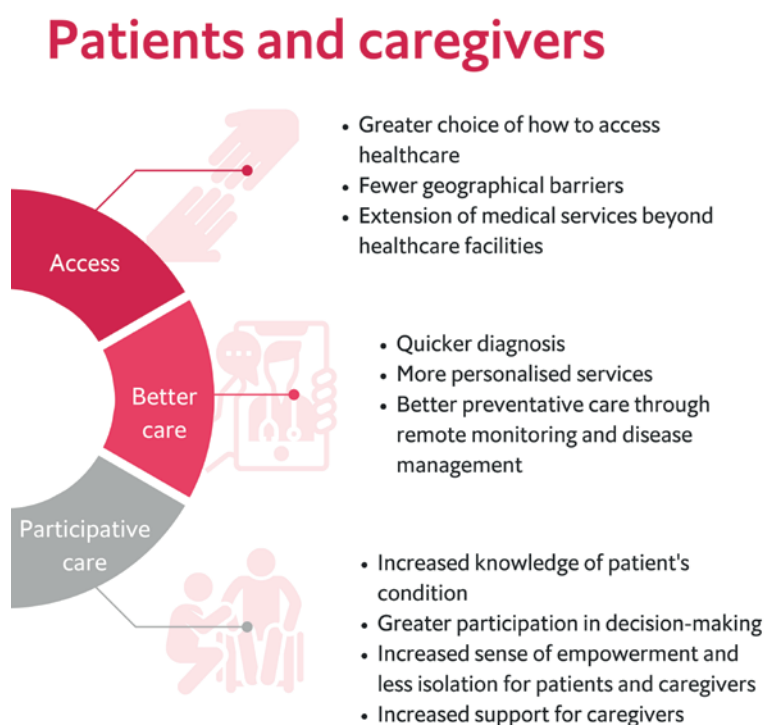
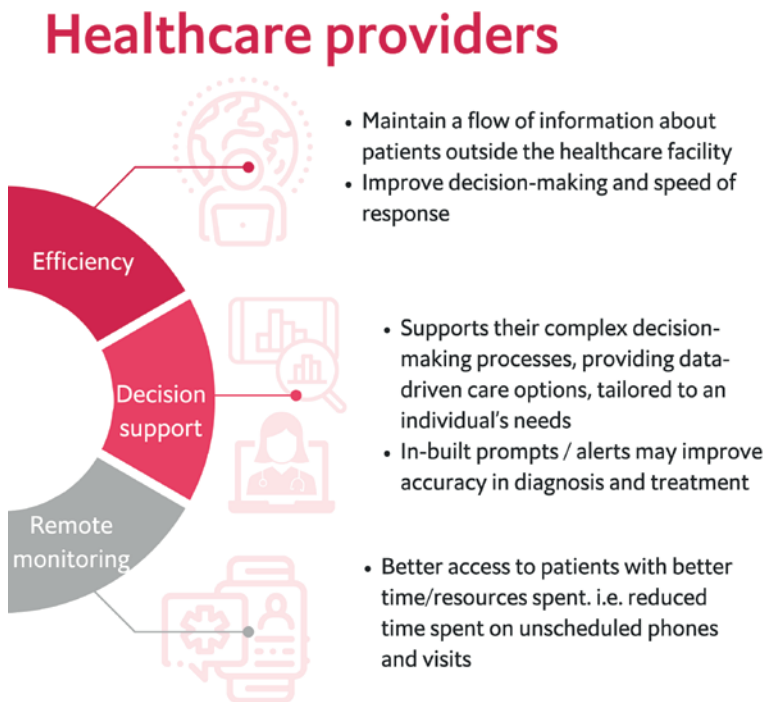


Figure 3: Healthcare provider perspective value of digital health



### Healthcare providers

For healthcare providers, the value of digital health tools lies in their potential to increase the efficient use of time, maintain a flow of information about patients even outside the healthcare facility, and to improve decision-making and speed of response.

Digital health tools enhance a provider's ability to provide data-driven, patient-centred care that is tailored to an individual's needs. Decision-making support systems, with in-built prompts and alerts, can also improve accuracy in diagnosis and treatment.<sup>12</sup>

Remote patient monitoring apps bring healthcare into the patient's home. Studies of remote patient monitoring tools in Canada, Denmark and Sweden have found that they reduce time spent on unscheduled phone calls or home visits.<sup>19</sup>

Remote monitoring can also reduce service utilisation. A clinical trial of a service for pregnant women in Denmark, whereby they could access

### Using data to tackle the scourge of sepsis in intensive care

Since severe sepsis and septic shock are the leading causes of death in intensive care units (ICUs), being able to recognise those patients who are most at risk, and rapidly detecting cases can be transformational for ICU outcomes and the cost of care.<sup>28</sup> ICU patient-monitors provide a stream of data on changes to a patient's condition, which feeds into a scoring system called the "sequential organ failure assessment (SOFA)" score, formerly known as the "sepsis-related organ failure assessment" score.<sup>29</sup>

The advent of AI has further enabled ICU data to be fed into an algorithm that has the potential to be more precise in flagging patients who are either at risk of sepsis or in the early stages of the condition. However, the heterogeneity of raw EMR data has made it difficult to take full advantage of AI in this area. "In Taiwan, we are always talking about AI; the government, universities and hospitals are enthusiastic about this, but the problem is we have limited data," explains Dr. Ray-Jade Chen, Chair Professor of Surgery at the School of Medicine, Taipei Medical University, Taiwan; Consultant Surgeon at Taipei Medical University Hospital, Taiwan.

The ICU of Taipei Medical University Hospital introduced a bespoke EMR, TED ICU to continuously record patient data from disparate monitoring devices and provide real-time chart data points on dozens of clinical features. Researchers chose 106 data points related to the diagnosis of sepsis and designed a sepsis-prediction algorithm, then compared the outcome of an AI-driven diagnostic process with traditional SOFA scores. They found that using TED ICU and the sepsis-prediction algorithm more accurately predicted patient status,<sup>28</sup> reduced length of stay,<sup>30</sup> and improved care and outcomes. The researchers are now looking into working with other hospitals to use pooled data to improve the algorithm.

home monitoring as an alternative to prolonged hospitalisation for pregnancy complications, found that it resulted in fewer outpatient visits, and a 75% reduction in staff time spent on patient monitoring, and almost halved the number of inpatient days for women with pregnancy.<sup>19</sup>

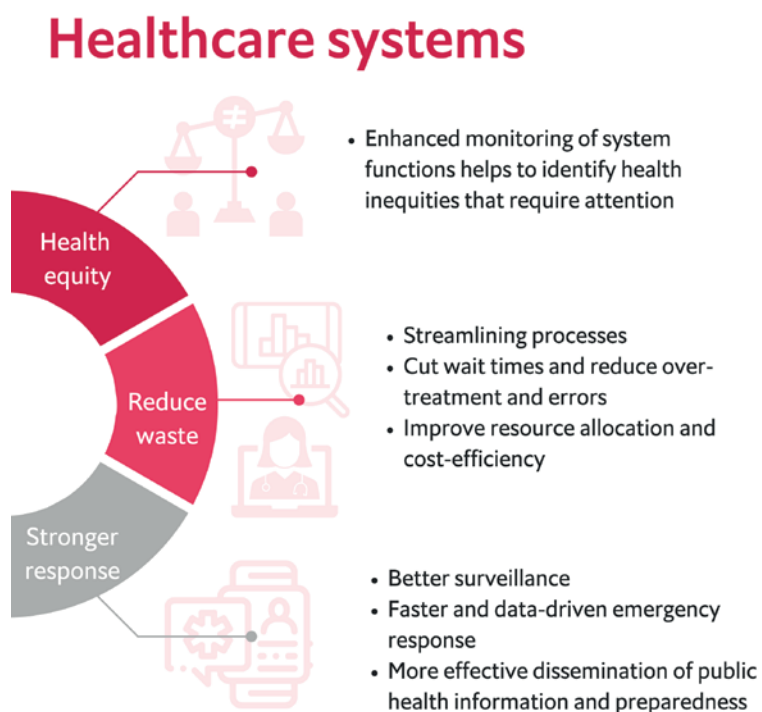
Digital health tools also give healthcare providers access to relevant data. During the covid-19 pandemic, a mobile app, the COVID Symptom Study (previously known as the COVID Symptom Tracker), was launched in the UK and US in March 2020, and collected data from 2.8 million users in the first two months.<sup>20</sup> This dataset, in turn, offered healthcare professionals and researchers data on risk factors, predictive symptoms, clinical outcomes and geographical hotspots. Digital health tools,

such as robotics, also add value for the healthcare provider, and can already be found in rehabilitation (where they help patients train independently), for example, and patient management, wherein robots guide patients around facilities to their appointments.<sup>20</sup>

### Healthcare system

For healthcare organisations, the value of digital health comes from improved transparency and accountability of care that transcends institutional and geographic boundaries.<sup>12</sup> By streamlining processes, cutting wait times, and reducing over-treatment and errors, digital health tools can improve allocation of resources, thus increasing cost-efficiency. They can also enhance the monitoring of system functions, which in turn could lead to better patient experiences. At the health system level, digital health tools can ensure that different parts of the system function holistically in a coordinated manner, by facilitating data interoperability between them. A health system that makes optimal use of digital health tools will reap benefits such as efficient workforce and resource planning, stronger public health threat monitoring, faster and better, data-driven emergency response, a more nuanced understanding of population health, more effective dissemination of public health information, and public health threat preparedness. For many countries in Asia, a decentralised model of healthcare is the norm. Telehealth, remote patient monitoring systems<sup>21</sup> and leveraging of digital health technologies in carrying out clinical trials<sup>22</sup> are just a few examples of how digital health tools can be used to reinforce these decentralised systems to lead to greater access, better connectivity between patient and provider, improved quality and reduced cost of care. Digital health tools can also play a key role in addressing health inequities by improving the monitoring of health system performance and quality indicators.

**Figure 4: Health system perspective value of digital health**

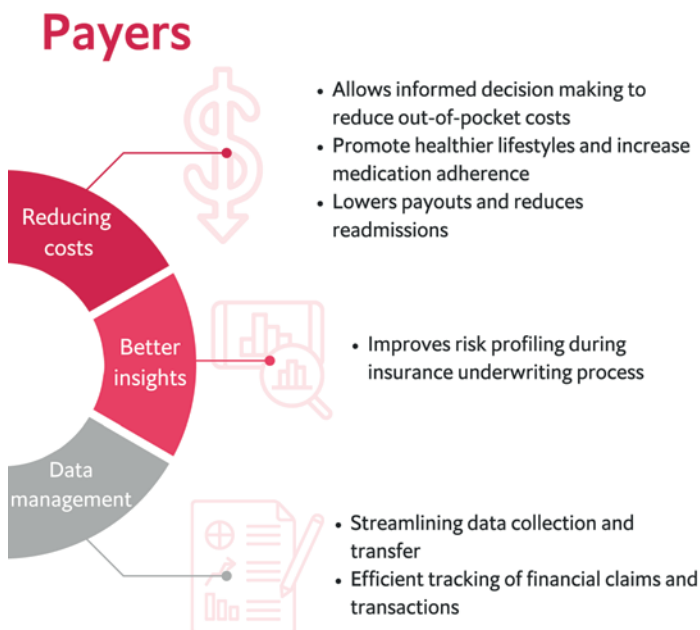


### Payers

Digital health tools have the potential to reduce costs, offer better insights and streamline data management for payers. Insurers can use digital tools to help consumers make more informed choices. For example, HCF, Australia's largest not-for-profit health fund, launched a digital platform in 2019 that was designed to provide information on out-of-pocket expenses for common procedures to help consumers make more informed decisions, with the aim of reducing cost of care.<sup>23</sup> In addition to this, mobile health devices and wearables offer

the capability to monitor high-risk individuals to allow for early interventions, and can track medicine intake to facilitate improved adherence to medication.<sup>24</sup> This would lead to better health care coordination, reduced hospital readmissions and lower payouts, which when combined with more informed consumer decision-making, could potentially save private and public health insurers significant costs.<sup>24, 25</sup> A prescription digital therapeutic (PDT) recently authorised by the US Food and Drug Administration (FDA) has enabled patients in the US with opioid use disorder (OUD) related to buprenorphine to receive neurobehavioural therapy via mobile devices.<sup>26</sup> By preventing hospitalisation and other hospital-related costs, treatment with this PDT led to a substantial reduction in medical costs of -US\$230,985 (US\$720 per engaged patient) after offsetting the cost of the therapeutic for the third-party payers.<sup>26</sup> Though potentially controversial, health monitoring devices and activity trackers could be used by insurers to capture information and data on their customer demographic, and provide the opportunity to update traditional medical underwriting attributes to improve risk management.<sup>24</sup> Processes like verifying insurance eligibility, determining coverage and medical reporting for insurance claims could be streamlined and made more efficient with digital interventions.<sup>25, 27</sup> Financial transactions and transitions between schemes could be made seamless and automatic through the integration of digital systems, and machine learning could offer improved fraud prevention.<sup>27</sup> By improving efficiencies in these processes, payers can provide bespoke offerings and better customer experience to the policyholders.

**Figure 5: Payers perspective value of digital health**



# Facilitators and challenges to digital health transformation

## A vision, and then governance

As a starting point for digital health regulation, governments need to envision the digital transformation of health on the same scale as that of other sectors, such as banking and education. To be effective, a digital health strategy has to align with the government's broader digital direction and governance, and be simultaneously embedded in the broader health strategy. A sound national digital health strategy covers the bases of governance, infrastructure, programme management, standards, and interoperability. With a robust enabling environment, as well as strong governance and policy frameworks, we can avoid the pitfall of short-lived technology solutions of limited impact—and the real, transformative value of digital health can be realised and delivered.

Often, digital technologies emerge and evolve faster than the regulatory environment can adapt. Mobile health (mHealth) technologies are a case in point. There are an estimated 6.6 billion smartphone subscriptions worldwide,<sup>31</sup> and smartphones can be used for a wide variety of digital health purposes, yet regulatory frameworks for mHealth are limited.<sup>32</sup>

Clear regulatory framework encourages the acceptance of digital health technologies.<sup>33</sup> “You have to invest in the foundation of digital health, which is policy and standards for the whole system. It's not about quick solutions,” says Dr

Boonchai Kijsanayotin, Senior Lecturer at the Faculty of Medicine, Mahidol University, Thailand. Conventional medical regulatory frameworks are not well-suited to the fast-evolving, iterative nature of software and digital health technologies.<sup>34</sup> The principle of adopting agile regulatory paradigms was applied in the context of more conventional therapeutics during the covid-19 pandemic, and given the effectiveness, should be encouraged for digital health solutions too, says Prof John CW Lim, Executive Director at the Centre of Regulatory Excellence, Duke-NUS Medical School, Singapore. “The evolving regulatory frameworks for digital health would benefit from a risk-based, agile approach, but they are relatively nascent”, he adds.

For some countries in the region, the development of regulatory “sandboxes” have enabled their health systems to test-drive digital health innovations in a responsible and controlled real-world environment. In these “sandboxes”, companies can experiment with innovative solutions in a relaxed regulatory environment, with the support of the national regulator for a limited period of time. In 2018, Singapore's Ministry of Health launched the Licensing Experimentation and Adaptation Programme (LEAP) sandbox initiative for telemedicine (TM) and mobile medicine (MM) “to better understand the risks and co-create corresponding risk mitigation measures with the industry in the use of these service delivery models prior to licensing under the Healthcare Services Act (HCSA) come 2023”.<sup>35</sup> More recently, in late 2020, the National Health Authority of India

launched its own regulatory “sandbox” as part of its National Digital Health Mission. The introduction of these “sandboxes” is an acknowledgement of the regulatory challenges faced by policymakers, and also their willingness to adapt and experiment with emerging innovations to drive informed policies that advance clinical and population health.

### Healthcare workforce with digital expertise

The systemic adoption of digital health tools also requires enough people within the health system to have sufficient digital health expertise, and to understand health information standards and the enterprise architecture for IT projects.<sup>19</sup>

Digital health technologies hold the potential to strengthen health systems by accelerating coverage, access, and monitoring and control of quality in service delivery. These could help the healthcare providers with decision support and telemedicine consultations with other healthcare professionals. However, such digital health interventions (DHI) are tools, not magic bullets, and they are as vulnerable as non-DHIs to the underlying challenges faced by health systems, including poor management, training shortfalls, infrastructure limitations and inadequate access to equipment.<sup>36</sup>

**“Health systems are dealing with workforce pressures, both for healthcare staff and IT skills. At the moment, there’s a real war for talent.”**

Dr. Zoran Bolevich,  
Chief Executive of eHealth NSW;  
Chief Information Officer of NSW Health

Moreover, technology is not at the core of digital health – users are. If digital health tools are deployed in ways that do not take end-users into account, they run the risk of being side-lined or even abandoned.<sup>37</sup> “Digital health solutions must streamline and automate the hospital workflow, while removing redundancies. Time is of essence when it comes to health and a seamless, well-integrated hospital system helps do just that—Save Lives,” says Dr. Keren Priyadarshini, Regional Leader for Healthcare in Asia Pacific at Microsoft. “I visited a public hospital and the doctor told me the nurse had to look at three different monitors for three different systems. This is a failure of integration,” she expounds.

**“It's also about listening, what are the real concerns coming back and how do we best address them? I think we increasingly need to engage users and consumers in the design of digital health systems and solutions”**

Dr. Zoran Bolevich,  
Chief Executive of eHealth NSW;  
Chief Information Officer of NSW Health



### How to navigate the complexity of digital health implementation

Too often in healthcare systems, digital health tools are deployed as if the root of the problem is technological, and this bit of technology will make the problem go away. This technological determinism often lies at the root of why many DHIs ultimately fail. “We need to move away from deterministic models,” adds Dr. Trisha Greenhalgh OBE, Professor of Primary Care Health Sciences at the University of Oxford, United Kingdom. “Healthcare is hugely complex. Illnesses are complex; organisations have complex policies; there’s no way of putting everything in at the top, turning the handle and out will come a successful IT project. It’s just not going to happen,” she explains.

Prof Greenhalgh defines the cause of the failures of digital health solutions as “non-adoption, abandonment, scale-up, spread and sustainability (NASSS)”.<sup>37</sup> To help health system managers, policymakers and other stakeholders avoid this, Greenhalgh and her team developed the NASSS complexity assessment tool.<sup>37</sup> This was co-designed through workshops with 50 stakeholders, and helps structure conversations between different groups of stakeholders. The tool could help policymakers and other relevant stakeholders escape their preconceived notions and guesswork, and help them design, implement, and objectively evaluate new health technologies, with greater chance of success.

“There is a tendency towards reductionism in healthcare, this sort of building a rocket analogy, that you break the problem down into tiny little bits and you solve each bit and then build it up again,” says Prof Greenhalgh. “But actually, what you need to do is get your head around the totality of it, and the human dimension as well, people’s confidence in using technology and their trust in it, and in particular, organisational relationships,” she adds.

Preliminary results from the use of the tool show that it is useful to tease out complexities and reconcile contradictions in proposed projects to avoid or resolve conflicts.

### The challenge of building and maintaining trust

Trust is at the heart of much of the controversy around digital health technology. “Trust is a key enabler to addressing concerns over data security,” says Prof Lim. “Various factors influence public trust in digital health and technologies, such as the level of digital health literacy in the population and the existence of robust regulations and policies to protect data collection, sharing, and analysis of personal and sensitive data. Governments should address these factors in order to positively influence the willingness of the public to use digital technologies,” he adds.

Dr Zoran Bolevich, Chief Executive of eHealth New South Wales (NSW) and Chief Information Officer of NSW Health, Australia, also emphasises that trust in healthcare institutions is critical for patients, healthcare providers and the health system to reap the potential benefits of digitalisation. Dr Zoran suggests that “The focus needs to be on open dialogue, on transparency, and on good governance. I think if we demonstrate that to the public, that we are managing risks well, that we are governing digital assets, protecting, looking after them well, I think that will go a long way towards building trust.”

Although issues of trust and data sharing are not unique to healthcare, the patient-doctor

**“Trust is a key enabler to addressing concerns over data security.”**

Prof. John CW Lim,  
Executive Director, Centre of Regulatory Excellence (CoRE), Duke-NUS Medical School;  
Chairman, Consortium for Clinical Research & Innovation Singapore (CRIS)

relationship is one uniquely predicated on trust, in the context of asymmetry of information, and moral hazard. The mutual trust between a doctor and patient is the foundation of care, and any digital health intervention that remotely threatens to undermine this trust is bound to be highly contentious.<sup>7</sup> The cybersecurity attack on Singapore Health Services (SingHealth) in 2018 caused a massive data breach that exposed the personal information of 1.5 million patients. The outpatient prescription data belonging to 160,000 people, including Singaporean Prime Minister Lee Hsien Loong, were stolen.<sup>38</sup> Since the security and confidentiality of patient information is a top priority for health systems, this incident highlights the importance of building and investing in robustly secure IT systems for healthcare providers.

Digital health technologies that aggregate individuals' health information and make it more widely accessible to patients, care providers, payers, government and health researchers raise novel questions for these stakeholders, such as “What is health data?”, “To whom does it belong?”, and “Who should have access to it and control over its use?”

**Public debate about private health information**

The introduction of “My Health Record” in Australia brought such issues into the public sphere for debate. In its original form, the

Personally Controlled Electronic Health Record (PCEHR)—introduced more than a decade ago, faced challenges in getting both providers and patients on board. In 2019, the platform, rebranded as “My Health Record”, switched to an opt-out model. “The national conversation that we had during opt-out became a very vocal public discourse around privacy and security, particularly of personal health information,” says Ms Angela Ryan, Vice Chair of the Australasian Institute of Digital Health.

“All of a sudden, it was on the front page of newspapers and the subject of talk shows and talkback. So it really forced a lot of people to have that conversation about personal health information and what it means to share it. People were asking, do I really think it's a good idea to keep that information hidden from my healthcare providers? Probably not. But do I trust the government enough to look after it? We hadn't had that conversation so publicly before, and at that scale,” she adds. Ms Ryan thinks that the true potential of digital health technologies such as “My Health Record” lie in how the data-rich environment they create can fuel innovation in healthcare and service delivery.

Digitalisation, thus, brings opportunities and concerns in healthcare data processing. The need for good data management among different stakeholders is the basis of FAIR (findable, accessible, interoperable, reusable) data principles. These principles provide a more transparent approach to data stewardship and aim to strengthen data sharing, reduce duplicated efforts, and move towards the harmonisation of data from heterogeneous unconnected data silos.<sup>39</sup> Hospitals in Europe are increasingly adopting the FAIR principles as a key strategy for nationwide healthcare research data infrastructure. For instance,

Leiden University Medical Centre (LUMC) in The Netherlands has reported the implementation of FAIR principles for covid-19 observational patient data to address data sharing and multiple analysis challenges across their clinical and research groups.<sup>40</sup> Developing similar “permissive guidelines” for use of private health information can improve trust among people.

### **The promise of artificial intelligence**

One obvious area where aggregation of health data can stimulate innovation is in AI and

machine learning. The global market for AI-based hardware, software, and services in healthcare is estimated to be worth US\$34 billion by 2025.<sup>41</sup> The market has the potential to grow to US\$300 billion in value by 2030.<sup>42</sup>

AI has a unique role to play in transforming healthcare.<sup>27</sup> It could help accelerate progress towards UHC by promoting task-shifting, self-management, and improving population-level outcomes through, for example, earlier disease detection, and identification of cost-effective, high-impact measures.

### **Building a digital highway for South Korea's health system**

South Korea was one of the earliest adopters of the digitalisation of medical data and EMRs in Asia and the Pacific. “Korean hospitals started to adopt EMRs in the early 2000s, and even earlier than that the government health insurance reimbursement system used an electronic data interface so we have more than 30 years of experience,” explains Assoc Prof Soo-Yong Shin, Associate Professor, Department of Digital Health, at Sungkyunkwan University, South Korea.

The 2021 launch of South Korea's “My HealthWay” app was heralded by the government as a “digital highway of personal health records,”<sup>47</sup> and was a key component of a wider drive by the government towards digitalisation of the health system, supported by an US\$850 million research and development budget for digital health.<sup>48</sup>

### **Digital highway, but to what destination?**

My HealthWay integrates data from national health insurance records, prescription and vaccination data, and by 2023, it is expected to house all medical records and health records, as well as patient-generated data from wearable digital devices. However, My HealthWay's ability to store vast amounts of confidential medical information has drawn mixed reactions from the South Korean public, with concerns about data privacy and security. “Ensuring that the app doesn't simply hand over ownership of the data without sufficient safeguards is essential, and should be achieved not only through technological means but by transparent governance,” writes Junho Jung, a researcher at the Centre for Health and Social Change in a BMJ opinion piece. “Without this, there is a very real risk that My HealthWay will cause harm that offset its benefits.”<sup>47</sup>

Such critiques of My HealthWay are part of a broader ongoing debate in society, and within the medical informatics community, about how to balance privacy concerns with the drive for bigger, better health datasets, says Prof Shin. “Some experts think that we need a big cloud-based EMR system operated by the government. This is the easiest and cheapest way, but then we would have a Big Brother,” he says. Shin argues that My HealthWay creates scope for hospitals to develop their own application programming interface (API) (also known as an interoperability layer) to connect to My HealthWay. Shin prefers the decentralised solution. “I prefer the API approach because we can control those APIs and who can access the data. Do we have the ability to control the big government-owned cloud? I don't think so.”

When data silos are broken down, the potential for data aggregation to feed into AI algorithms greatly increases. In turn, this aggregated data can power AI-derived diagnoses, tailor individual patient treatments with more precision, and dynamically assist in targeting resources in the most effective way. However, there is inherent tension in AI between the possibilities for superhuman decision-making and, therefore better, more personalised care, and fears that it will dehumanise healthcare.

The black box nature of algorithms could undermine trust in medical decision-making. AI algorithms are also prone to bias,<sup>43</sup> which could exacerbate social inequalities.<sup>44</sup> In some jurisdictions, there is a legally established requirement for the “right to explanation” of algorithm decisions and for human intervention.<sup>45</sup> Arguably, in the context of healthcare, the need for this layer of human intervention is so important that the real meaning of AI is “augmented”, rather than “artificial”, intelligence.<sup>46</sup>

### **Digital literacy and the digital divide**

All digital tools rely to some degree on the digital literacy of the user. In the hands of individual patients, digital health tools can improve knowledge of their own health status, give them control over their own medical

records, and enable remote consultations with a healthcare provider. However, reaping said benefits from digital health tools assume access to a computer and/or smartphone and a stable internet connection. Although access to both is increasing, many groups are disadvantaged in terms of digital access; lack of digital access is correlated with poverty, low literacy and lack of familiarity with technology.<sup>49</sup>

The dynamics of digital literacy and unequal access to digital technologies are such that the digital ecosystem is a determinant of health in its own right.<sup>50</sup> If the benefits of digital health technologies are to be diffused equitably, it will be necessary for governments to adapt the definition of a health service to include those that are directly dependent on digital technologies in publicly-funded UHC packages.<sup>50</sup> This once again comes down to governance that engenders trust in digital health by empowering patients, protecting vulnerable groups, and regulating the dynamics of power and influence that occur within the digital health ecosystem. Digital literacy is also a limitation within the health system, wherein healthcare workers are expected to become data managers, but may lack the skills, time or the motivation to do so. Furthermore, healthcare workers may run the risk of compromising their core purpose when they are called upon to become data managers.

# Digital health and the covid-19 effect

The covid-19 pandemic revealed the many deficiencies that health systems have around the world. These include weak infectious disease surveillance, inefficient supply chain and distribution systems, under-powered health information systems, poor decision support for healthcare providers, and a pervasive unwillingness to recognise telemedicine as legitimate healthcare that should, therefore, be reimbursed by payers.

However, necessity is the mother of invention—with widespread lockdowns, there was an accelerated pivot to remote care and acceptance of care at home.<sup>51</sup> Almost overnight, care providers, and payers for health services, had to embrace remote care modalities.<sup>52</sup> These had previously existed, but had been discouraged or even outright banned, or had failed to take off, in part because reimbursement systems did not recognise the value proposition.<sup>53</sup>

Alongside increased teleconsultation, and asynchronous remote care,<sup>54</sup> the covid-19 pandemic brought about a revolution in the use of remote monitoring, from simple WhatsApp patient support groups<sup>55</sup> to wearable sensors.<sup>56, 57</sup> Research shows that patients report high levels of satisfaction with synchronous and asynchronous remote care,<sup>54</sup> and that in the future, hybrid models of care are likely to sustain, not least because they have the potential to increase access whilst reducing costs.<sup>56</sup>

## Crisis and opportunity

The covid-19 pandemic has undoubtedly been devastating, but it has also created several opportunities. Digital health technology came into its own when the covid-19 pandemic began in early 2020. The ability to rapidly screen for the virus, trace contacts of confirmed cases, as well as contain and quarantine them were particularly successful in countries that rapidly deployed digital health technology.

Singapore and South Korea, for example, deployed aggressive contact tracing using digital tools.<sup>58</sup> When covid-19 reached South Korea in early 2020, the government implemented an information technology-driven tracing strategy, based on the technological and legislative groundwork laid in 2015 in response to the Middle East respiratory syndrome (MERS) outbreak. The use of this strategy, which pulled data from many sources, including credit card records and surveillance cameras, was highly successful in containing the outbreak, but it raised significant privacy concerns, and put businesses and individuals at risk of public shaming and opprobrium.<sup>59</sup>

Taiwan was able to make use of its population-wide digitised national health insurance system to distribute facemasks and rapid testing supplies. “We started our national health insurance 15 years

ago, so everyone has an integrated chip (IC) card,” explains Dr. Chen. “When the government wanted to distribute masks or testing kits, people just used the national IC card, took it to the pharmacy store, scanned it and got the supplies, and the government could control the distribution.”

The early digitalisation of the health insurance system laid the groundwork of the public’s familiarity with digital tools such as IC-enabled cards. “I think what countries can learn from Taiwan is digitalisation,” says Chen. “What I’m seeing is people know how to use the IC card, and how to use a cell phone and QR codes. I’ve seen that digital transformation in Taiwan, so if you want to develop any Internet of things or anything like that, I think you start from this [widespread] use of the IC card, or QR code, and then the people, even the old age senior citizens, they know how to use it.”

In countries with lower levels of general and digital literacy, however, the sudden and heavy reliance on digital health technologies was seen to amplify the digital divide and with that, healthcare inequities.<sup>56, 58</sup> The pivot to online care relied on patients having access to the internet and the digital literacy skills required to use it.<sup>56</sup> In Asia,

however, the comparatively high rates of mobile phone use per capita may have helped surmount these obstacles. The widespread adoption of mobile technology and smart wearables have enabled people to be more aware and in control of their health, says Priyadarshini. “In countries like the Philippines, Vietnam, Thailand etc. mobile adoption is one of the highest globally, which means hospitals can actively engage with them through a digital front door. The widespread usage of smartphones, tablets, wearables and other handheld devices to provide healthcare support, has provided easier access to records, improved systems, a better quality of patient care, treatment adherence and much more.”

“Covid-19 changed everything,” observed Kijsanayotin. “Now we see people in their 60s and 70s who had never used a mobile phone for payment, for example, but who at least were aware that their children were using such technology to order food deliveries for them. At least they were aware of the concept of mobile payment, so when the government provided financial support, people had to learn how to register online and then use the government money digitally through their digital wallets. Covid-19 improved digital literacy.”



**“In countries like the Philippines, Vietnam, Thailand etc., mobile adoption is one of the highest globally, which means hospitals can actively engage with them through a digital front door.”**

Dr. Keren Priyadarshini,  
Regional Leader for Healthcare in Asia Pacific, Microsoft

**Care in the community, a helping hand and value for money**

Virtual models of care hold the promise of both convenience for patients and positive outcomes for health service providers, including reduced avoidable hospital visits/admissions, shorter hospital stays and stronger connections to primary care.<sup>60</sup> Virtual hospitals are one way in which digital technology is being used to downshift care from hospitals to individual patients at home.

In early February 2020, Sydney Local Health District (LHD) launched a new service, RPA Virtual Hospital as a bridge between hospital specialist services and community-based patient care. Housed in a purpose-built virtual care centre, it has a multidisciplinary team that works around the clock to support patients who are being cared for at home. Just four weeks after opening, it went from being an optional service for patients to a lifeline for those infected with covid-19, as well as for those in “health hotel” quarantine. “Sydney LHD should be applauded, like so many similar services that the pandemic spawned, for keeping many covid-19 patients out of hospital and caring for them at home with the support of remote monitoring” says Ms Ryan.

Patients responded well to this virtual model of care, with 88% reporting that they “felt confident at home knowing their condition/symptoms were monitored daily”.<sup>61</sup> In just over two years, the hospital has provided virtual care to 52,000 people. The success of, and demand for, the service has driven the need to expand its workforce, from six nurses to now more than 70 staff, comprising doctors, a multidisciplinary allied health team, a Digital Patient Navigator and an Aboriginal Cultural Response Team.

Beyond covid-19-related care, the virtual hospital is now looking at a wide range of conditions that can be managed from home with virtual support, such as: uncomplicated acute diverticulitis; minor trauma, fracture and rehabilitation; post-discharge lower back pain care, chronic headache, and wound assessment.

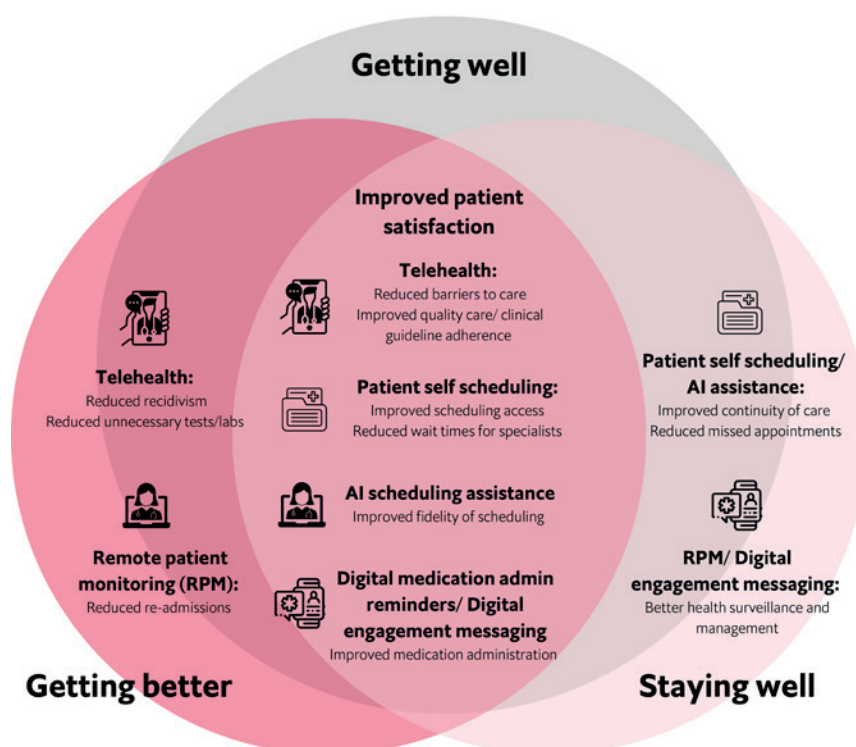
# Making the value case for digital health in Asia and the Pacific

Asia is at the centre of several colliding forces that are propelling the adoption of digital health. Many countries in the region are experiencing rapid population ageing, and there are widespread concerns about the sustainability of existing health systems under pressure from increased demand. The region also has below-average doctor-patient ratios in most countries.<sup>62</sup> Digital health tools can, to some extent, help alleviate these challenges. Fortunately, Asia and the Pacific region is also home to widespread technological innovation and investment.<sup>63</sup> Demand from end-users and patients for digital health solutions is creating value that are expected to proliferate. The rapid expansion of e-pharmacies is a case in point. China is at the forefront of this trend, but India and Indonesia have also seen a rapid growth in demand for e-pharmacy services. Similarly, telehealth consultations experienced explosive growth at the beginning of the covid-19 pandemic, with providers such as China's "Ping An Good Doctor", "Practo" in India and "Halodoc" in Indonesia all seeing exponential increases in traffic.<sup>64</sup> The Australian federal government expanded reimbursement for telehealth services under Medicare during the pandemic, allowing increased telehealth access to general practitioners and specialists across a much greater range of healthcare activities than

before. The initiative incentivised organisations and professionals to shift from reluctant support for remote consultations to resolute endorsement of this modality.<sup>65</sup> As another example of this trend, Hong Kong's Insurance Authority (IA) encourages insurers to use "Insurtech" or big data technology to reduce costs and enhance services.<sup>66</sup> In fact, many leading life and health insurers in the region are focusing on digital transformation and have introduced big data to analyse risks, determine premiums and manage claims.

A useful paradigm for understanding the value transformation potential of DHIs comes in Brian D'Anza and Peter J. Pronovost's recent publication "Digital Health: Unlocking Value in a Post-Pandemic World".<sup>54</sup> In it, they describe a number of digital health technologies with evidence-based benefits, and their interactions, within three states of health: "Getting Better", "Getting Well" and "Staying Well". "Getting better" refers to treating acute illness both in and out of the hospital; "Getting well" refers to managing chronic illnesses in the community; and "Staying well" refers to maintaining good health through preventive care. Digital health tools, be they for direct care, digital service access or health monitoring, all contribute to these three states of health (Figure 6).

**Figure 6: Evidence-based benefits of digital health interventions across three states of health**



Source: Adapted from D'Anza B, Pronovost PJ. Digital Health: Unlocking Value in a Post-Pandemic World. *Popul Health Manag.* 2022;25(1):11-22.

When new digital health tools or innovations are introduced, there is often tension between perceived value at the outset and realised value at the end. There may also be a mismatch of perceptions between patients and providers. Patients, for example, can see the value of advanced, patient-focused digital health tools. However, the benefit to the care provider may be less clear.<sup>53</sup>

A paradigm shift in digital health will only happen if powerful stakeholders in the health system, such as physicians or healthcare organisations, buy-in.<sup>51</sup> This, in turn, can only happen if they can be compensated for the time and financial investment of using digital health solutions, such as EMRs and telehealth consultations. In the past, reimbursement has proven to be a stumbling block for the

introduction of digital health solutions. In Canada, for example, physicians, who are remunerated from a single payer, were unable to include the cost of digital health infrastructure investments into their billings, a major disincentive for such investments. As a result, EMR adoption in the country lagged behind peers such as the UK and New Zealand, and was only resolved when the federal and provincial government provided financial incentives to adopt EMRs.<sup>53</sup>

In South Korea, where there is a single national insurance system, physicians cannot charge for any digital health innovation that is categorised as an existing health technology. Moreover, the decision-making process on what constitutes a “new” rather than “existing” technology is also cumbersome, with decisions taking up to a year. This is a major

disincentive to South Korean innovators targeting digital health innovations that could benefit the domestic healthcare system.<sup>47</sup> Instead, the focus is on developing digital health innovations with export potential, something that is also encouraged by the South Korean government, says Prof Shin. “Korea is a small country, with only 50 million people, and the economy is based on exports, so one aim of the Korean government’s digital health innovation research and development incentives is to develop a digital health solution to export.”

Digital health innovations do, however, have the potential to gain traction in South Korea when they can help reduce the cost to the government, says Prof Shin. “Korea’s population is the fastest ageing in the world, and, therefore, people will likely visit the hospital more often. We worry about the shortage of the healthcare budget. By adopting digital health technology to manage patients’ health at home, we can reduce the number of hospital visits. This reduces the cost to the government, because healthcare management solutions used at home are not clinical care at a hospital. This might open new business opportunities to private companies to offer these solutions.”


Dr Zoran reflects on the challenges of demonstrating and quantifying the value of digital health, adding, “I think it is one of the central issues for all of us who are responsible for traditional healthcare, strategy planning, investments and litigation: ‘How do we build compelling business cases?’ ‘How do we measure and evaluate benefits to demonstrate that to the funders and ultimately to the taxpayers?’ I think we definitely need to invest in more capability in that space, and it goes back to the smarter use of data; it goes back to how we use the data that we’ve already collected from any of these platforms to demonstrate improvements, safety and quality, in productivity and in outcomes.”

### **Assessing the value of digital health**

As health system decision-makers grapple with the ongoing profusion of DHIs, it becomes increasingly urgent to develop digital health regulatory, clinical, as well as pricing and reimbursement guidelines.

When trying to establish the value of a DHI, the path of least resistance might simply be to adapt health technology assessment guidelines already in place for pharmaceuticals and other medical products. These assessments typically adopt a cost per quality-adjusted life-year (QALY) approach, but health economists Katarzyna Kolasa and Grzegorz Kozinski, who recently published a systematic review of “How to Value Digital Health Interventions?” argue that some of digital health’s distinct features make the QALY approach inappropriate; this means that impactful DHIs, which may offer great value to a health system, its users and wider society, could receive an unfairly negative assessment.<sup>67</sup> “The value of digital health solutions does not only depend on clinical and economic aspects, but also on technical features, perceived benefits for healthcare managers, willingness to adopt by end-users, and finally, the healthcare system’s capacity to benefit from the innovation,” they write.<sup>67</sup>

Kolasa and Kozinski make several recommendations for a value assessment framework for DHIs. The incremental advantage a particular DHI can deliver compared to the current standard of care should be what determines its value, and this should take into account all beneficiaries, including patients, clinicians, payers and healthcare managers. The efficiency gains from digital health solutions are only as high as the healthcare system preparedness, and their value assessment should take this into account. This requires looking at value delivered across clinical, organisational, behavioural, and technical dimensions. The systematic review also highlights the importance of interoperability and considers that connectivity to other data sources is an essential metric in the value assessment of any digital health tool.<sup>67</sup> As Ms Ryan describes it, “Interoperability is the glue that enables patient-centredness, and achieving that is the digital health equivalent of nirvana—because you want your information to follow you when you move from one care setting to another.” When patient data can be securely and seamlessly shared by disparate care providers, it creates a golden thread of data for individual patients, a cornerstone of continuity of care, and with it, greater value for all health stakeholders.



**“Interoperability is the glue that enables patient centeredness, and achieving that is the digital health equivalent of nirvana - because you want your information to follow you when you move from one care setting to another.”**

Ms. Angela Ryan,  
Vice chair at the Australasian Institute of Digital Health (AIDH)

# Final conclusions and opportunities for improvement

Digital health tools have the power to transform the way we deliver and use health care by creating more efficient, equitable and sustainable health outcomes. Our report on realising the value of digital health reveals five policy takeaways:

**Understanding the current situation is the first step in delivering value for each stakeholder and will help target investments in priority areas.** In depth knowledge of the current situation is the first step in the roadmap to materialise the value of digital health solutions. A digital health assessment such as “GAPS” (governance, architecture, people and standards and interoperability) could help countries understand where they are in the process of digital transformation of their health system. The Global Digital Health Index’s Digital Health Maturity Model methodology, which focuses on people, processes, technologies and organisational capabilities, is a helpful guide to this process. There are numerous tools to help countries assess the current state of their digital health readiness, which are available from the Asian Development Bank<sup>51</sup> and World Bank;<sup>51</sup> furthermore, WHO’s Global Strategy on Digital Health 2020-2025 lays down guiding principles and strategies, as well as implementation guidelines for countries.<sup>6</sup> By performing these assessments, decision makers can identify priority areas to target investment. This will allow them to harness a transformative (rather than incremental) value of digital health for all stakeholders, including that of patients and caregivers, healthcare providers, healthcare systems and payers.

**Complexity of the health system must be embraced when formulating digital health strategies to meet identified needs.** At every level, from national government to individual institutions, putting a workable digital health strategy in place entails accurately mapping the actual needs that digital health solutions can address, and co-creation of solutions with all stakeholders, including patients and the public. The complexity of healthcare has to be embraced in this process. Tools like the NASSS complexity assessment framework can help with this process.

**Digital Health implementation must follow a “whole-of-government” approach in order to have a meaningful impact because it relies on citizens’ data held by multiple public entities.** As countries grapple with the challenge of creating the most value out of a healthcare system with growing demands and constrained resources, the role of digital health tools becomes ever more important. The transformational power of digital health tools for data collection, population health monitoring and data-driven health policy is increasingly being recognised in all stakeholder groups—in the public and private sectors, by insurers and other payers, policymakers, and not least by the public. For the digital health ecosystems that are already emerging organically to coalesce successfully into a fully digital health system, it is essential for there to be a strategy covering governance, architecture, programme management, interoperability, a clear regulatory framework, investment in human resources, and an understanding of how to navigate

the complexity of healthcare. To be effective, this has to align with the government's broader digital strategy and enmesh in the national health strategy. Without this, there is a risk of disconnected interventions of limited or no impact.

**When designing digital health interventions, principles that offer transparent data stewardship, interoperability, and data sharing should be followed.** Digitalisation brings opportunities and concerns in health care data processing. The need for good data management among different stakeholders is crucial. There is a need to develop "permissive guidelines," offering a more transparent approach to data stewardship and aim to strengthen data sharing, reduce duplicated efforts, and move toward harmonisation of data from heterogeneous unconnected data silos.

The value of digital health comes from improved transparency and accountability and principles promoting these should be adopted while designing new digital health interventions.

**Now is the time to build on the momentum created by the covid-19 effect, and emerging digital health ecosystems.** Covid-19 created unprecedented opportunities to showcase the value of digital health technology in both healthcare and public health, but it also highlighted the need to overcome the digital divide to avoid widening existing health inequities. The digital health ecosystems that are already emerging are proof of a drive by providers, payers, and patients, and supply from the private sector, and their expansion demonstrates that they offer value.

# References

1. GMI. Digital health market. Delaware (DY): Global Market Insights; [Updated July 2021]. Available from: <https://www.gminsights.com/industry-analysis/digital-health-market#>.
2. IMARC. Digital health market: global industry trends, share, size, growth, opportunity and forecast 2022-2027. Wyoming (WY): IMARC Group; [Updated 2022]. Available from: <https://www.imarcgroup.com/digital-health-market>.
3. Statista. Projected global digital health market size from 2019 to 2025. Hamburg: Statista; [Updated June 2021]. Available from: <https://www.statista.com/statistics/1092869/global-digital-health-market-size-forecast/>.
4. Grand View Research. Digital health market size worth \$1.5 trillion by 2030. San Francisco (CA): Grand View research, Inc; [Updated April 2022]. Available from: <https://www.grandviewresearch.com/press-release/global-digital-health-market>.
5. FDA. What is digital health? New Hampshire (MD): US Food & Drug Administration; [Updated 22 September 2020]. Available from: <https://www.fda.gov/medical-devices/digital-health-center-excellence/what-digital-health>
6. Meskó B, Drobni Z, Bényei É, et al. Digital health is a cultural transformation of traditional healthcare. *Mhealth*. 2017;3:38.
7. Cordeiro JV. Digital technologies and data science as health enablers: an outline of appealing promises and compelling ethical, legal, and social challenges. *Front Med*. 2021;8:647897-.
8. Xiong S, Palileo-Villanueva L, et al. . Use of e-health programmes to deliver urban primary health-care services for noncommunicable diseases in middle-income countries. New Delhi: World Health Organization Regional Office for South-East Asia; 2021. Available from: <https://apo.who.int/publications/i/item/super-use-of-e-health-programmes-to-deliver-urban-primary-health-care-services-for-noncommunicable-diseases-in-middle-income-countries>.
9. WHO. Global strategy on digital health 2020-2025. Geneva: World Health Organization; 2021. Available from: <https://www.who.int/docs/default-source/documents/gsa4dhdad2a9f352b0445bafbc79ca799dce4d.pdf>
10. Singh K, Singh P, et al. Harnessing the potential of digital health in the WHO South-East Asia Region: sustaining what works, accelerating scale-up and innovating frontier technologies. *WHO South-East Asia Journal of Public Health*. 2019;8(2):67-70.
11. Morley J, Floridi L. Enabling digital health companionship is better than empowerment. 2019;1(4):E155-156.
12. WHO. Regional action agenda on harnessing e-health for improved health service delivery in the Western Pacific. Manila, Philippines: World Health Organization Regional Office for the Western Pacific; 2019. Available from: <https://apps.who.int/iris/bitstream/handle/10665/330700/9789290618959-eng.pdf?sequence=1&isAllowed=y>.
13. MacKinnon GE, Brittain EL. Mobile health technologies in cardiopulmonary disease. *Chest*. 2020;157(3):654-664.
14. Nomura A, Tanigawa T, et al Cost-effectiveness of digital therapeutics for essential hypertension. *Hypertens Res*. 2022.
15. Foley K, Freeman T, Ward P, et al. Exploring access to, use of and benefits from population-oriented digital health services in Australia. *Health Promot Int*. 2021;36(4):1105-1115.

16. Ienca M, Schneble C, Kressig RW, et al. Digital health interventions for healthy ageing: a qualitative user evaluation and ethical assessment. *BMC Geriatr*. 2021;21(1):412.
17. Newman K, Wang AH, Wang AZY, et al. The role of internet-based digital tools in reducing social isolation and addressing support needs among informal caregivers: a scoping review. *BMC Public Health*. 2019;19(1):1495.
18. Neher M, Nygårdh A, Broström A, et al. Perspectives of policy makers and service users concerning the implementation of eHealth in Sweden: interview study. *J Med Internet Res*. 2022;24(1):e28870.
19. SochaDietrich K. Empowering the health workforce. Strategies to make the most of the digital revolution. Paris: Organisation for Economic Co-operation and Development; 2020. Available from: <https://www.oecd.org/health/health-systems/Empowering-Health-Workforce-Digital-Revolution.pdf>.
20. Drew DA, Nguyen LH, Steves CJ, et al. Rapid implementation of mobile technology for real-time epidemiology of COVID-19. *Science*. 2020;368(6497):1362-1367.
21. Australian Trade and Investment Commission. Australian Trade and Investment Commission. Why Australia for digital health. Canberra: Australian Trade and Investment Commission. 2019. Available from: [https://www.austrade.gov.au/ArticleDocuments/10438/ATIC\\_DIGITAL%20HEALTH\\_MAY19\\_web.pdf.aspx](https://www.austrade.gov.au/ArticleDocuments/10438/ATIC_DIGITAL%20HEALTH_MAY19_web.pdf.aspx).
22. De Brouwer, W, Patel, CJ, Manrai, AK, et al. Empowering clinical research in a decentralized world. *npj Digit. Med*. 2021;4: 102.
23. HCF. HCF ahead of the pack on transparency. Sydney: Hospitals Contribution Fund of Australia; [Updated 29 July 2019]. Available from: <https://www.hcf.com.au/about-us/media-centre/media-releases/2019/HCF-ahead-of-the-pack-on-transparency>.
24. Swaraj S, Aggarwal G, Vishwakarma D. Top trends in health insurance: 2020. Paris: Capgemini; 2020. Available from: [https://www.capgemini.com/wp-content/uploads/2019/11/Health\\_Insurance\\_Trends\\_2020.pdf](https://www.capgemini.com/wp-content/uploads/2019/11/Health_Insurance_Trends_2020.pdf).
25. WHO. Classification of digital health interventions v 1.0. Geneva: World Health Organization; 2018. Available from: <https://apps.who.int/iris/bitstream/handle/10665/260480/WHO-RHR-18.06-eng.pdf>.
26. Velez FF, Colman S, Kauffman L, et al. Real-world changes in US health system hospital-based services following treatment with a prescription digital therapeutic for opioid use disorder. *Hospit Pract*. 2021;49(5):341-347.
27. Wilson D, Sheikh A, Görgens M, et al. Technology and universal health coverage: examining the role of digital health. *J Glob Health*. 2021;11:16006.
28. Yuan KC, Tsai LW, Lee KH, et al. The development of an artificial intelligence algorithm for early sepsis diagnosis in the intensive care unit. *Int J Med Inform*. 2020;141:104176.
29. Singer M, Deutschman CS, Seymour CW, et al. The third international consensus definitions for sepsis and septic shock (Sepsis-3). *JAMA*. 2016;315(8):801-810.
30. Kai-Hsuan Y, Kao WF, Yen-Kuang L, et al. Reducing length of stay and improving quality of care by implementation of informatics system and care bundle in the intensive care unit. *Rev Invest Clin*. 2020;72(1):25-31.
31. Statista. Number of smartphone subscriptions worldwide from 2016 to 2027. Hamburg: Statista; [Updated July 2022]. Available from: <https://www.statista.com/statistics/330695/number-of-smartphone-users-worldwide/>.
32. Kostkova P. Grand challenges in digital health. *Front Public Health*. 2015;3:134.
33. Cummins N, Schuller BW. Five crucial challenges in digital health. *Front Digit Health*. 2020;2:536203.

34. de Smalen AW, Kitikiti N, Muthalagu AP, et al. Enabling digital health adoption in the Asia-Pacific. Singapore: Duke NUS Medical School, Centre of Regulatory Excellence; 2020. Available from: [https://www.duke-nus.edu.sg/docs/librariesprovider5/whitepaper/2021\\_wp001\\_core\\_enabling-digital-health-adoption-in-the-asia-pacific.pdf?sfvrsn=b94a7442\\_0](https://www.duke-nus.edu.sg/docs/librariesprovider5/whitepaper/2021_wp001_core_enabling-digital-health-adoption-in-the-asia-pacific.pdf?sfvrsn=b94a7442_0).
35. . MOH Licensing Experimentation and Adaptation Programme (LEAP) – an MOH regulatory sandbox. Singapore: Ministry of Health; 2018. Available from: [https://www.moh.gov.sg/home/our-healthcare-system/licensing-experimentation-and-adaptation-programme-\(leap\)---a-moh-regulatory-sandbox](https://www.moh.gov.sg/home/our-healthcare-system/licensing-experimentation-and-adaptation-programme-(leap)---a-moh-regulatory-sandbox).
36. WHO. Recommendations on digital interventions for health system strengthening. Geneva: World Health Organization; [Updated June 2019]. Available from: <https://www.who.int/publications/i/item/9789241550505>
37. Greenhalgh T, Wherton J, Papoutsis C, et al. Beyond adoption: a new framework for theorizing and evaluating non-adoption, abandonment, and challenges to the scale-up, spread, and sustainability of health and care technologies. *J Med Internet Res*. 2017;19(11):e367.
38. MOH. Singhealth's IT System target of cyberattack. Singapore: Ministry of Health; [Updated July 2018]. Available from: <https://www.moh.gov.sg/news-highlights/details/singhealth-s-it-system-target-of-cyberattack>
39. Wilkinson M, Dumontier M, Aalbersberg I, et al. The FAIR guiding principles for scientific data management and stewardship. *Sci Data*. 2016;3:160018 .
40. Queralt-Rosinach N, Kaliyaperumal R, Bernabé CH, et al. Applying the FAIR principles to data in a hospital: challenges and opportunities in a pandemic. *J Biomed Semant*. 2022; 13(1): 12.
41. Working Group on Digital and AI in Health. Reimagining global health through artificial intelligence: the roadmap to AI maturity. New York(NY): Broadband Commission for Sustainable Development; 2020. Available from: <https://www.broadbandcommission.org/publication/reimagining-global-health-through-artificial-intelligence/>.
42. ITU. Assessing the economic impact of artificial intelligence. Geneva: International Telecommunication Union; 2018. Available from: [https://www.itu.int/dms\\_pub/itu-s/opb/gen/S-GEN-ISSUEPAPER-2018-1-PDF-E.pdf](https://www.itu.int/dms_pub/itu-s/opb/gen/S-GEN-ISSUEPAPER-2018-1-PDF-E.pdf).
43. Panch T, Mattie H, Celi LA. The “inconvenient truth” about AI in healthcare. *NPJ Digit Med*. 2019;2(1):77.
44. Igoe KJ. Algorithmic bias in health care exacerbates social inequities — how to prevent it. Cambridge (MA): Harvard TH Chan School of Public Health; [Updated March 2021]. Available from: <https://www.hsph.harvard.edu/ecpe/how-to-prevent-algorithmic-bias-in-health-care/>.
45. Atkinson K, Bench-Capon T, Bollegala D. Explanation in AI and law: past, present and future. *Artif Intell*. 2020;289:103387.
46. Shin S-Y. Current status and future direction of digital health in Korea. *Korean J Physiol Pharmacol*. 2019;23(5):311-315.
47. Jung J. South Korea's My HealthWay: a “digital highway” of personal health records, but to where? London: BMJ Publishing Group Limited; [Updated 8 October 2021]. Available from: <https://blogs.bmj.com/bmj/2021/09/24/south-koreas-my-healthway-a-digital-highway-of-personal-health-records-but-to-where/>
48. Lee, Byung-chul. Analysis on National Healthcare Data Budget. National Assembly Budget Office, Korea. 2021” 4-5.
49. Saeed SA, Masters RM. Disparities in health care and the digital divide. *Curr Psychiatry Rep*. 2021;23(9):61.
50. Kickbusch I, Piselli D, Agrawal A, et al. The Lancet and Financial Times Commission on governing health futures 2030: growing up in a digital world. *Lancet*. 2021;398(10312):1727-1776.

51. Bestseny O, Chmielewski M, Koffel A, et al. From facility to home: how healthcare could shift by 2025. McKinsey & Company; [Updated February 2022]. Available from: <https://www.mckinsey.com/industries/healthcare-systems-and-services/our-insights/from-facility-to-home-how-healthcare-could-shift-by-2025>.
52. Schlieter H, Marsch LA, Whitehouse D, et al. Scale-up of digital innovations in health care: expert commentary on enablers and barriers. *J Med Internet Res.* 2022;24(3):e24582.
53. Bhyat R, Hagens S, Bryski K, et al. Digital health value realization through active change efforts. *Front Public Health.* 2021;9:741424.
54. D'Anza B, Pronovost PJ. Digital health: unlocking value in a post-pandemic world. *Popul Health Manag.* 2022;25(1):11-22.
55. Walton K, Rahemtulla H. At your service: Indonesia's government agencies look to digital innovations amid COVID-19 [Internet]. Manila: Asian Development Bank; [Updated 5 November 2020]. Available from: <https://blogs.adb.org/blog/your-service-indonesia-s-government-agencies-look-digital-innovations-amid-covid-19>.
56. Brahmabhatt DH, Ross HJ, Moayed Y. Digital technology application for improved responses to health care challenges: lessons learned from covid-19. *Can J Cardiol.* 2022;38(2):279-291.
57. Corman BHP, Rajupet S, Ye F, et al. The role of unobtrusive home-based continuous sensing in the management of post acute sequelae of SARS CoV-2. *J Med Internet Res.* 2022;24(1):e32713.
58. Whitelaw S, Mamas MA, Topol E, et al. Applications of digital technology in COVID-19 pandemic planning and response. *Lancet Digit Health.* 2020;2(8):e435-e440.
59. Park S, Choi GJ, Ko H. Information technology-based tracing strategy in response to covid-19 in South Korea—privacy controversies. *JAMA.* 2020;323(21):2129-2130.
60. Moore G, Du Toit A, Jameson B, et al. A rapid evidence scan: the effectiveness of Virtual Hospital models of care. Australia: Sax Institute; 2020. Available from: [https://www.saxinstitute.org.au/wp-content/uploads/20.04\\_Rapid-Evidence-Scan\\_The-effectiveness-of-virtual-hospitals.pdf](https://www.saxinstitute.org.au/wp-content/uploads/20.04_Rapid-Evidence-Scan_The-effectiveness-of-virtual-hospitals.pdf).
61. Shaw M, Wilson A. RPA virtual hospital: proof of concept trial. Evaluation report February 2020 to January 2021. Sydney Local Health District; 2021. Available from: [https://ses.library.usyd.edu.au/bitstream/handle/2123/27474/90209%20RPA%20Virt%20Evaluation\\_A4\\_screen.pdf?sequence=3&isAllowed=y](https://ses.library.usyd.edu.au/bitstream/handle/2123/27474/90209%20RPA%20Virt%20Evaluation_A4_screen.pdf?sequence=3&isAllowed=y).
62. OECD/WHO, Health at a glance: Asia/Pacific 2020: measuring progress towards universal health coverage, Paris: OECD Publishing; 2020. Available from: <https://www.oecd.org/health/health-at-a-glance-asia-pacific-23054964.htm>.
63. Baur A, Yew H, Xin M. The future of healthcare in Asia: digital health ecosystems. McKinsey & Company; [Updated 5 August 2022]. Available from: <https://www.mckinsey.com/industries/healthcare-systems-and-services/our-insights/the-future-of-healthcare-in-asia-digital-health-ecosystems>
64. Soh S. . Digital health – APAC is paving the way for digital health ecosystems. Branding in Asia. [Updated 2 February 2022]. Available from: <https://www.brandinginasia.com/digital-health-apac-is-paving-the-way-for-digital-health-ecosystems/>.
65. Taylor A, Caffery LJ, Gesesew HA, et al. How Australian health care services adapted to telehealth during the covid-19 pandemic: a survey of telehealth professionals. *Front Public Health.* 2021;9:648009.
66. Insurance Authority. Insurtech Corner. Hong Kong: Insurance Authority. [Updated June 2022]. [https://www.ia.org.hk/en/aboutus/insurtech\\_corner.html](https://www.ia.org.hk/en/aboutus/insurtech_corner.html)
67. Kolasa K, Kozinski G. How to value digital health interventions? a systematic literature review. *Int J Environ Res Public Health.* 2020;17(6):2119.

While every effort has been taken to verify the accuracy of this information, Economist Impact cannot accept any responsibility or liability for reliance by any person on this report or any of the information, opinions or conclusions set out in this report. The findings and views expressed in the report do not necessarily reflect the views of the sponsor.

**LONDON**

20 Cabot Square  
London, E14 4QW  
United Kingdom  
Tel: (44.20) 7576 8000  
Fax: (44.20) 7576 8500  
Email: london@eiu.com

**GENEVA**

Rue de l'Athénée 32  
1206 Geneva  
Switzerland  
Tel: (41) 22 566 2470  
Fax: (41) 22 346 93 47  
Email: geneva@eiu.com

**NEW YORK**

750 Third Avenue  
5th Floor  
New York, NY 10017  
United States  
Tel: (1.212) 554 0600  
Fax: (1.212) 586 1181/2  
Email: americas@eiu.com

**DUBAI**

Office 1301a  
Aurora Tower  
Dubai Media City  
Dubai  
Tel: (971) 4 433 4202  
Fax: (971) 4 438 0224  
Email: dubai@eiu.com

**HONG KONG**

1301  
12 Taikoo Wan Road  
Taikoo Shing  
Hong Kong  
Tel: (852) 2585 3888  
Fax: (852) 2802 7638  
Email: asia@eiu.com

**SINGAPORE**

8 Cross Street  
#23-01 Manulife Tower  
Singapore  
048424  
Tel: (65) 6534 5177  
Fax: (65) 6534 5077  
Email: asia@eiu.com