Digital and data tools are fundamentally changing approaches to health and the design of health systems, but governance models have not followed the pace of innovation.

A joint The Lancet & Financial Times Commission entitled Growing up in a digital world: Governing health futures 2030 is exploring the convergence of digital health, artificial intelligence (AI), and other frontier technologies with universal health coverage (UHC) to support attainment of the third Sustainable Development Goal (SDG) and to bolster the health and well-being of future generations.

The Commission will:

- Strive for integrated digital development that improves the health and well-being of children and young people in an ever more digital world
- Examine existing policies for digital health, AI, and UHC to identify those with the greatest potential to improve health and well-being, maximise health equity in resource-poor settings, and ensure human rights
- Deliver a clear set of recommendations on the governance of digital health, AI, and UHC, taking into account geopolitical, economic, and social factors.

The Commission’s convenors:
The Lancet and the Financial Times

The Lancet recognises that AI and digital health, which will be central to the work of this Commission on health futures, are intersectoral. Partnering with the Financial Times will enable the Commission to engage stakeholders beyond the health community through outreach and communication to the business and economic sectors. The Commissioners can consider this in their work, bearing in mind that the Commission content is peer reviewed to the same rigorous standards as all Lancet content.

This is a unique opportunity for two publications to work together to showcase the crosscutting nature of this inquiry into digital technologies and AI, health, and the impact on future generations.

The ‘triangle model’ highlights the Commission’s three goals, bringing together governance of technology that supports equity and human rights and, ultimately, allows children to flourish.
Harnessing tech for good

In the wake of the pandemic, ethical and structural concerns over digital governance are falling sharply into focus. By Anurag Agrawal and Ilona Kickbusch

Much can be learnt from the Covid-19 pandemic about how we achieve the future health systems that we need. Our work chairing the Lancet-FT commission on the Governance of Health Futures points to three lessons. First, new technologies such as artificial intelligence, robotics and genomics have transformed our ability to respond to epidemics. Second, the concerted use of such technologies has been better in Asia than the west, possibly due to different governance. Third, there is a danger that short-term needs will blind us to longer-term risks.

The response to the Covid-19 outbreak in China highlighted the power of technology. From monitoring and tracking of cases, to rapidly analysing viral genomes and generating computational models, the response was built on digital platforms. To contain the outbreak, China leveraged the power of an authoritarian system equipped with cutting-edge digital technology.

Its approach included automated surveillance and tracking via thermal cameras and face recognition; big data epidemiology models to track and predict spread; chatbots and robots to provide advice and services with minimal physical interaction; and AI tools to scan radiology images and nucleic acid tests. These are signs that the concerted application of digital technologies permits unprecedented speed and scale.

The pandemic response was accompanied by a digital “infodemic”. While much useful information circulated, there was a significant surge in misinformation. Inaccurate opinions shared by digital influencers were often strident. There is clearly urgent need for better structures of digital information governance.

Digital governance models are a major focus of the commission. They may be driven by open technology, designed for scaling and growth; authoritarian, with strict rules for social cohesion and security; bourgeois, driven by a sense of minimum acceptable behaviour; or commercial, driven by ownership and monetisation.

With global organisations insufficiently prepared, it is unclear which approach will prevail, or how they will develop and interact. Non-authoritarian governance systems were lean enough to permit the rapid adoption of available technology, and a balance between commercial and governmental influence proved feasible.

In South Korea, within weeks of the outbreak in China, four companies manufactured tests from an open World Health Organization formula and obtained near-immediate regulatory approval, allowing the country to scale up using drive-through test stations. Open digital data, trust and international co-operation are vital components.

Rapid open availability of genomic, epidemiologic and clinical data enabled fast analysis and insights from around the world. Freely available peer-reviewed online publications made these accessible to all. While much may need to be improved and failures dissected, the spirit of digital co-operation was very much in evidence.

Yet there are also potential risks, with approaches to health emergencies acting as Trojan horses for other agendas. Privacy is a central issue: once eroded, it may not be easily regained. Digital surveillance — via phone tracking, facial recognition, contact tracing and smartphone apps — opens up possibilities of data being used for purposes other than personal or public health.

Beyond declarations of purpose, there must be verifiable tracing of data aggregation, retention and access. Data are also critical to commercially oriented models that see them as property that can be monetised. In other words, privacy may have a monetary cost and free services may have a privacy cost. Free open availability of data and tools are critical for global health emergencies, and provisions to enable them must be built into governance models. New forms of solidarity that also include the sharing of data must be explored.

A neglected aspect of digital health governance is the impact of telehealth on human psyche and wellbeing. For example, the use of chatbots and robots to minimise face-to-face interactions is critical in epidemic control, but the long-term consequences of such distancing could harm both patients and providers.

Health is not simply an absence of illness; it is a state that cannot always be deduced by the absence of symptoms on a list. Greater convenience in healthcare delivery should not undermine a necessary emphasis on wellbeing.

Privacy may have a monetary cost and free services may have a privacy cost

Anurag Agrawal and Ilona Kickbusch are co-chairs of the Lancet-Financial Times commission on Governing Health Futures 2030
HOW THE LANCET AND FINANCIAL TIMES COMMISSION WORKS:

In a world in which individual data is becoming one of the most valuable resources on the planet, the Commission will support the dialogue with a broad range of stakeholders on ethical guidelines, governance approaches, institutional responsibilities, and standards that need to be considered in relation to health, human rights, and public goods.

The report is expected for end of 2021.

The Commission will build on and establish links to international organisations, alliances, and NGOs in relation to the Commission’s work. It will make use of global high-level events to present its work and findings, and network with other Commissions and panels whose work is relevant to the Commission.

The Commission will make extensive use of digital communication tools to receive input from young people on its work. The Commission will also organise surveys and dialogues to ensure a strong voice from young people. Development agencies that have experience in similar events will be approached to support this work.

The Commission will conduct dialogues and hearings with broad groups of stakeholders through the work with Financial Times, World Health Summit, and Wilton Park.

Commissioners will convene at least three times between 2019-2021. Additionally, working groups were formed to address questions in three key areas:

- Data and paradigms: Will the data-driven digital and AI world create new health paradigms and new health ecosystems? What is the role of systems, technology, and people?
- Readiness and agency: How are digital ecosystems developing today? What and who are the key drivers?
- Governance and stewardship: How can digital health ecosystems be responsibly governed to ensure health benefits and people empowerment?

COMMISSION MEETINGS
COMMISSIONERS WORKING / EXPERT GROUPS
REPORT

PARTNERS:
- WORLD HEALTH SUMMIT (WHS)
- FINANCIAL TIMES
- WILTON PARK

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GOVERNING HEALTH FUTURES
THE LANCET & FINANCIAL TIMES COMMISSION
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Invest in order to deliver a data-fed, unified healthcare system
In South Kivu province in the conflict-torn Democratic Republic of Congo, technology is responding to the impact of sexual violence against women. To counter one of the ugliest forms of human behaviour, Logistimo, a Bangalore-based company, has helped secure steady supplies to thousands of women in rural clinics of a medicines pack to prevent pregnancies as well as HIV and other infections transmitted through rape.

Local staff upload basic data on the distribution of the “Prévention” kits to a cloud-based system that issues text message warnings when supplies are running low. As a result, the project overseen by Panzi Hospital has countered one of the most widespread and fundamental brakes on tackling disease in much of the world: the timely restocking of medical supplies.

It is one of a number of digital health applications, many developed by and for those in emerging economies, that can boost prevention, diagnosis and treatment of disease. But there are also practical hurdles, and hubristic claims for more high-tech solutions — including artificial intelligence — can prove a distraction while raising concerns over ethics, equity and evidence.

“There’s been a lot of hot air in the business with respect to AI,” says Anup Akkihal, head of Logistimo, which focuses on less sophisticated but more robust

Game changer

Technologies such as AI and machine learning have the potential to transform healthcare in the world’s poorer regions but concerns remain over a lack of regulation, governance and equity.

By Andrew Jack
Health Organization, Facebook and Gustav Praekelt, a South Africans software developer and philanthropist, are together combating misinformation by using WhatsApp to disseminate science-based data on the disease.

Asian countries from China to India have proved swifter than their richer peers in using smartphone ownership to track the movement of people to limit the spread of infection. The concern is that such applications, once embedded, could undermine privacy and human rights.

More broadly, the potential of digital technology to improve health outcomes is undeniable. Many lower tech applications are already well established, with Africa and Asia able to leapfrog tardy investments in fixed-line telecoms systems and rapidly develop mobile networks to reach the most rural, isolated and low-income families.

To narrow the enormous gap between richer and poorer parts of the world, some argue there is no alternative but to embrace higher-tech approaches. “Africa has 15 per cent of the world’s population and a quarter of the global health burden but only 3 per cent of healthcare workers and 1 per cent of healthcare expenditure,” says Sangu Delle, managing director of Ghana-based Africa Health Holdings, which invests in several companies exploring AI. “Technology has to be part of bridging the gap or it will be impossible to respond.”
At the most basic level, SMS text messaging has become widespread. Even rudimentary mobile phones with low bandwidth can transmit health prevention messages and nudges to patients to take medicines for conditions such as tuberculosis and HIV. Telemedicine connects isolated patients directly to specialists, easing access to medical care at relatively low cost.

More sophisticated telecoms technology opens the possibility of remote diagnosis. Smartphones can capture audio and visual data and monitor movement, helping identify and share information to better understand medical conditions and track patient recovery.

Machine learning to identify patterns in “big data” may have a greater impact. In disease surveillance and forecasting, as during the coronavirus pandemic, satellite images and heat maps help measure economic activity. Online media reports, social media chatter and clinical reports flag up patterns to predict the spread of infections, and plan and track the impact of different policies.

Computer analysis of satellite photos helps vaccination workers and anti-mosquito insecticide sprayers increase coverage, allowing them to reach remote communities and people living in rapidly growing slum dwellings not marked on traditional maps.

In drug development, AI has scope to find patterns in the growing volumes of genetic data, the compound “libraries” of pharmaceutical companies and clinical trial results. In January Exscientia, a spinout from the University of Dundee, announced a first clinical trial resulting from AI, which identified a potential drug for obsessive compulsive disorder in just a few months.

Technology can also help accelerate testing of experimental medicines by more quickly recruiting those best suited for trials. Hence the growth in partnerships between drug developers, patient groups and providers of genetic tests such as 23andMe.

There has been a surge in projects exploring AI’s ability to more reliably interpret chest radiographs, retinal patterns and tomography readouts. The Novartis Foundation is working with Microsoft and the Fiocruz Institute in Brazil to collect and analyse digital photographs of skin lesions to help identify leprosy.

Kimetrica, a social enterprise backed by Unicef, is exploring face scanning as a less invasive and potentially more reliable predictor of child malnutrition than arm measurements. Meanwhile, services such as Ada (see page 43) are offering ways for patients in low income countries to enter symptoms online to identify diseases.

A final application of digital tools is the management, operation and financing of healthcare. Alongside supply

‘Half of the world is still unconnected and it’s the easier part that has been done’
chain services such as Logistimo, “digital wallets” such as MTiba and Mutti allow relatives to fund medical bills. That has sparked concerns because they prop up “out-of-pocket” payments that penalise the poor, rather than promoting fairer access for all. But such services have a beneficial side effect in the generation of large amounts of data on diagnoses and treatments prescribed, costs and patient outcomes. That offers a way for funders — whether individuals, donors or national health systems — to identify the best and most efficient providers.

Equity is one fundamental concern over technology and its expansion into developing countries with limited social safety nets. The gap between rich and poor is exacerbated by the “digital divide”. While network coverage and smartphone ownership is rising globally, Ann Aerts, who chairs the Broadband Commission set up by the International Telecommunications Union, cautions: “Half of the world is still unconnected and it’s the easier part that has been done. If we don’t connect the rest, even very well intended solutions cannot scale up.”

A second concern is over privacy and misuse of sensitive health information. Dubbed “data colonialism” by Nick Couldry from the London School of Economics, the commercialisation of data provided by users is fuelling a debate over confidentiality and ownership.

A third issue is reliability and safety. Big Tech is less regulated than Big Pharma, and typically quicker to make dubious claims. AI has raised concerns over biases in big data sets, which may generate unreliable findings in regions or among ethnic groups on whom less information has been collected.

A recent review of AI analyses of medical images in the British Medical Journal, led by Myura Nagendran from Imperial College, highlighted other drawbacks including the small scale of most studies and the limited use of the “gold standard” of randomised controlled trials. “Many arguably exaggerated claims exist about equivalence with or superiority over clinicians, which presents a risk for patient safety and population health at the societal level,” the BMJ study concluded.

At a more practical level, competing technology providers also need consistent standards to ensure “interoperability” and access to the cloud. “There is a lot of variability with the infrastructure to support the exponentially growing amount of data coming out of the health sector,” cautions Jonathan Stambolis, head of Zenysis, a company that collects and harmonises data to help health systems in Africa and Asia.

None of these challenges is insurmountable, but they point to the need for clearer international guidelines, consistent regulation and tougher governance. As Delle argues: “Some tech start-ups just come in, operate and take consumer data. There’s a real gap, with a lot of regulators behind the curve on these innovations.”
Robert Wachter, a former member of Google’s healthcare advisory board, remembers when the company first set its sights on the healthcare industry more than a decade ago. “They said: We’re Google, we’ll solve it,” says Wachter, head of medicine at University of California, San Francisco.

At the time, Google was trying to create individual accounts where users could store their electronic medical records. So when then-chief executive Eric Schmidt later abandoned the effort with an admission that Google had underestimated the challenge, it came as a shock. “They conquer industry after industry, it doesn’t seem like this would be very different,” Wachter says. “But it is.”

The world’s leading tech companies have long viewed healthcare as an unexploited opportunity. But making a dent in a heavily regulated industry, where medical practitioners are resistant to upsetting ingrained procedures, has been hard.

Machine learning has provided a new opening. Tech companies are utilising their particular strengths to break into the sector, as well as capitalising on their scale to produce valuable insights from large amounts of data.

Apple has used data collected from wearers of its Watch for the most ambitious research study yet undertaken with “wearable” technology, tracking heart irregularities across a large population in real time. Google has drawn on both expert knowledge and extensive patient data to produce a specialist health search engine. And Microsoft, through its cloud computing platform Azure, has taken on expansive projects including one with pharmaceutical group Novartis that covers everything...
from manufacturing and finance operations to drug discovery.

Amazon, meanwhile, has dipped its toe into healthcare in different parts of its operations. These include working with two other large US employers, JPMorgan Chase and Berkshire Hathaway, to shape healthcare services for its own staff, delivering prescription drugs through its delivery network, and using its cloud computing arm to improve efficiency at healthcare organisations.

Eric Horvitz, chief scientist at Microsoft, says that to have more impact in healthcare, tech companies will have to fit their technology more closely into the working lives of medical practitioners.

“We’ve continued, as a tech sector, to typically underappreciate a bottleneck,” he says, which comes from trying to move “from computer science principles to the real world of clinical care”.

Tech companies, he adds, have often underestimated the day-to-day needs of healthcare professionals, failed to create services that are tailored to specific medical settings, and ignored the many “human factors” that have limited adoption of new technologies.

“There’s quite a mismatch between the [AI] research and its practical use,” adds Eliot Siegel, a professor at University of Maryland’s medical school. Most of the work in AI has focused on individual applications, such as using imaging recognition in radiology, he says. But these one-off applications do not fit easily into the way doctors practice and do not integrate well with the medical systems they use. “It’s very difficult to scale that to the information systems we have. There’s not really at this point a universal platform,” Siegel says.
Another issue has been a tendency to over promise and under deliver. The height of hubris came with IBM’s attempt to apply its Watson question-and-answer system to cure cancer. A language technology developed to answer questions on a TV game show was capable of absorbing large amounts of information from medical textbooks. But IBM could not combine that with individual patient records to make useful recommendations to doctors.

“They made a bad mistake, coming out with marketing before a product,” says Wachter.

With its latest push into healthcare, Big Tech seems to have learnt from some of these failures. Along with what medical experts say is a new-found humility has come an effort to develop much greater expertise.

“They didn’t really take it seriously before,” says Eric Topol, a professor at Scripps Research, a US non-profit institution. “Now, each of these companies has chief medical officers, a big staff of physicians and clinicians. They realise it has to be different from what they have done in the past.”

The spread of digitalisation has helped. When Google first tried to break into healthcare most patient records were handwritten, now they are in digital form. Cloud computing, and the machine learning that is applied to the information these systems store and process, have provided the foundation for the wave of AI hitting healthcare. That has played to the strengths of the biggest tech companies, which can draw on vast reserves of data.

Venture capital investors claim that the openness of medical organisations to share their data has left room for start-ups — even more so since Covid-19 took hold. “The scale [of Big Tech] doesn’t necessarily directly correlate” with breakthroughs in healthcare, says Deena Shakir, a partner at Lux Capital, a venture capital group. “There are fascinating insights that have been extracted with small-scale companies,” she says.

‘There’s nothing fundamentally wrong about it, it’s fundamentally noble’

The first impacts of big data and machine learning on healthcare have come in operational areas, rather than in clinical settings. “AI and machine learning today have been focused heavily on the bottleneck issues, the back office issues,” says Taha Kass-Hout, chief medical officer at Amazon Web Services. Combining visual information about how the 41 operating theatres at Beth Israel Deaconess Medical Center in Boston are being used, together with data about patients and other information, the healthcare provider improved its operating efficiency by 30 per cent, Kass-Hout says.

Most medical experts see some gains on the horizon in using AI to support doctors. But the sort of treatment recommendations that IBM once believed it could make with Watson are widely thought to be a long way off. “Diagnosis definitely can be improved by AI,” says Herbert Chase, a professor of biomedical informatics at Columbia University. “But the much larger space is treatment, where we’re going to need a sophisticated AI in our decision-making — and we’re nowhere near accomplishing that.” There are too many treatment options available, and subtle clues about patients that only experienced practitioners can identify, he adds.

As they push deeper into healthcare meanwhile, the leading tech companies face new hurdles. One is ensuring the powerful new capabilities of today’s big data and AI technologies work with the existing processes in the health system. The use of Apple’s Watch to monitor for heart problems in real time, for instance, could throw off more patient data than systems can handle.

“You will break the healthcare system — it wasn’t built for that massive amount of data flow,” says Wachter. The deluge of information will require new ways for doctors to deal with their patients, perhaps including new AI-driven recommendation engines, he adds. “You need this new layer to be built and no one’s built it yet.”

Big Tech also needs to show it can forge partnerships across the healthcare industry, while at the same time winning the trust of patients and satisfying regulators.

Google’s partnership last year with Ascension Health in the US highlights the risks. It involved Ascension handing all its patient data to Google. One goal was to create new services, such as a medical search engine, to support Ascension’s doctors. But a dearth of public information about the arrangements — and Ascension’s decision to proceed without notifying its patients — brought a public outcry and prompted regulators to investigate.

Even Google’s supporters in the healthcare world see it as a lesson in the risks if tech companies do not tread carefully. “There’s nothing fundamentally wrong about it, it’s fundamentally noble,” Wachter says of Google’s efforts to help Ascension make better use of its patient data. “But you have to understand the environment is highly charged — particularly if you’re Google.”
The data will see you now

Machine learning for healthcare is only effective if it is based on accurate sources — such as that found in the mobile phones we all carry. By Benjamin Fels

From Palo Alto to Dar es Salaam, healthcare is high-tech when it comes to objects, but remarkably low-tech in the effective algorithmic use of data. The application of machine learning to the health of individuals should be the principal focus for technologists focused on the power of artificial intelligence.

AI can deliver higher quality care to more of the global population at lower cost. Drugs paired to the genetic code and million-dollar machines for imaging, even diagnostics, are not accessible for many of the world’s poorest people. We must turn towards the raw inputs that are within reach of most people on the planet in order to deliver on the promise of technology.

Machine learning is sensitive to the degrees of similarity between individuals; the clinician can learn what works for one patient and then adapt recommendations to the specific characteristics of another. Administrators and governments concerned with costs want healthcare systems that are simpler to manage with less variation.

The radical potential of AI is that health systems no longer need to choose between personalisation and scale.

What could go wrong? A great deal. Bias in medical machine learning is deadly. The most accessible data to train models for healthcare do not reflect the global burden of disease. Likewise in clinical trials, participants do not accurately reflect the diversity of patients.

Bias in machine learning is often the result of training an algorithm with data that does not properly reflect the world. The machine’s reality is what you show it. Realign the training data and the algorithm learns to correct former tendencies.

How do we get the right training data? One approach is to collect more information using technology. There are about 4bn smartphones on the planet. Mobile phones constitute intricate, real-time indices of our lives.

Tala, for instance, is a company that offers unsecured lending from an app. Where credit scores are absent, it uses data on the device and linked to its phone number to predict the likelihood of reimbursement. In the absence of easily accessible universal medical records, start-ups such as Ginger.io have sought to use the frequency and timing of texts or location patterns as indicators of mental health.

The mobile phone could become the universal medical record that picks up on existing and new health indicators: where we move, the limits of our mobility, what we eat and when, and how we work. The compressing of machine learning models and hardware advances have made it possible to run AI on a phone not connected to the cellular network or to data centres.

This means people living in rural areas, those not served by telecoms infrastructure and the privacy-conscious could all still derive — and later share — insights with healthcare providers. To support polio campaigns in challenging environments, macro-eyes, my company, is deploying an app that runs offline, counting vaccine vials with the click of the phone’s camera.

Still to be resolved is how to preserve privacy, yet share the right level of detail to build country-scale databases against which to compare patients. The greater the data analysed, the more productive the results. Multi-dimensional analysis allows providers to pinpoint interventions or patient characteristic that consistently and uniquely correlate with specific outcomes.

In Mozambique, macro-eyes is learning from frontline health workers who, using phones, share images and messages describing change they consider important. Our machine learning extracts information on supply constraints, where demand is unmet, and the impact of weather on access to care at the most local level.

This data stream moves faster than any disease. It will allow us to accurately predict the number of vaccines necessary for each facility.

The limitation is organisational. What is frightening about AI is not the technology, but the constant change it could usher in. Large organisations are driven by repeatability — what works on average. Yet change is a constant, particularly in the developing world. AI transforms that, forcing organisations to have their assumptions continuously challenged.

AI shows health systems that their patients are not a block but a group of individuals with different needs and risks. It is counter-intuitive but if done right, it could reinforce the humanity of medicine by emphasising what a provider notices about a patient, making the interaction between patient and provider ever more central. ●

Benjamin Fels is chief executive of macro-eyes, an AI company
When the Indian government realised in late-March that Covid-19 was circulating among preachers associated with an influential Islamic missionary movement, it began a frantic quest.

In its search for participants in a congregation at the Tablighi Jamaat’s headquarters in a working-class New Delhi neighbourhood a few weeks earlier, authorities turned to mobile phone records.

Within days, about 20,000 people suspected of infection with coronavirus had been hospitalised or quarantined.

At the same time, New Delhi launched a free app — the Aarogya Setu, or Bridge to Health — to harvest mobile phone records, artificial intelligence and big data to help identify individuals potentially exposed to coronavirus though contact with other infected patients.

Available in 11 languages, the app was downloaded more than 3m times on its first day, with users promised insights into their own risk of infection, and warnings if they enter high-risk zones with clusters of infection.

Local health authorities also used phones to monitor people under home quarantine to ensure they followed the restrictions. In Karnataka, people under quarantine were required to provide selfies — with hourly geotags — to ensure they stayed put, while New Delhi authorities warned they would use phone signal locations to determine whether restrictions had been violated.

The use of such techniques reflects how India has harnessed technology and big data to help meet the health needs of its population of 1.35bn people, many of whom live below the poverty line.

Although such methods have proven to be a powerful tool for authorities in their race to contain coronavirus, they have also raised concerns about patient privacy and confidentiality, and about how these extensive technologies could be used in the future.

“Technology is a double-edged sword — it can help and it can harm,” says Sujatha Rao, India’s former health secretary. “It can be helpful in an epidemic like this, but what do you do once the epidemic is over? The state has been given a huge power; how do you know the state is not tempted to keep hold over this power.”

Apar Gupta, executive director of the Internet Freedom Foundation, a privacy and civil rights groups, says: “Mass surveillance is something that the government never actually stated they were implementing until now. It now seems very transparent about its ambitions.”

Even before the pandemic, New Delhi has been turning to big data and AI to tackle a healthcare crisis that had
seen an estimated 60m vulnerable Indians pushed into 
poverty each year due to healthcare expenses.

With Indians confronting both poverty-linked 
infectious diseases — such as tuberculosis and diarrhoea 
— as well as illnesses linked to greater affluence such as 
diabetes and heart disease, public hospitals have struggled 
to cope with demand, prompting many patients to turn to 
costly private care.

In 2018, New Delhi launched a government-backed 
health insurance scheme — Ayushman Bharat, or Healthy 
India — which provides up to ₹500,000 ($6,600) in 
insurance cover for 500m vulnerable people, allowing 
them to be treated at private hospitals.

The foundation for this insurance system is Aadhaar, 
India’s vast biometrically linked database of citizens, 
which confirms the identity of patients seeking treatment 
and facilitates a centralised system of medical records.

“With more than 1.3bn people, unless we have a strong 
technology backbone, we can’t even think about universal 
healthcare,” says Indu Bhushan, chief executive of the 
National Health Authority, which runs the insurance 
scheme. The system also uses algorithms to help detect 
MEMO 

fraud — by patients, doctors or hospitals — that could 
otherwise drive up costs. “Artificial intelligence is being 
used very effectively in our system for the prevention and 
mitigation of fraud and abuse,” Bhushan adds.

The National Health Authority has developed 
algorithmstosoundthealarmon100triggerssuggesting 
possible fraud, including multiple claims for one-off 
procedures such as an appendectomy; patterns of 
frequent claims by one person; or doctors carrying out 
unusually high numbers of procedures. So far, about 200 
hospitals have been barred from the scheme due to fraud 
concerns.

“One has to be ahead of the game,” Bhushan says. “Any 
money that is leaked out because of fraud and abuse is 
money that is not going to support poor patients.”

Some remain fearful about such extensive data 
collection in a country with a poor record of protecting 
patient privacy. In trying to contain coronavirus, for 
example, some state governments publicised lists of 
individuals under home quarantine — including their 
addresses — prompting concerns about safety and privacy.

“There is no data protection framework in India 
and no public institution to ensure that personal data 
shared under these apps are following a level of purpose 
limitation, in which the personal data is only used for 
the purpose for which it is gathered,” says Gupta. “This 
complete legal vacuum can reasonably lead to a large level 
of government surveillance, resulting in other political 
forms of surveillance.”

He adds: “These measures responding to a public health 
emergency are being done in ways in which there is a 
repeated exercise of extraordinary executive power — 
without the legal authority which would normally exist.”

‘Unless we have a strong 
technology backbone, we 
can’t even think about 
universal healthcare’
Hooked on data

Drugmakers are investing billions of dollars in the hope troves of patient records hold the key to faster cures and bigger profits. By Sarah Neville

When Mac Holmes noticed a lump in the middle of his chest it took him a year to mention it to his physician. The 55-year-old, who flew packages for FedEx after a 28-year career with the US Air Force, appeared a picture of middle-aged vigour. But, immediately suspecting the worst, his doctor ordered tests. Days later he was diagnosed with breast cancer, a disease that has spread to his bones.

With women accounting for 99 of every 100 cases of the condition, Holmes became an unfortunate member of the 1 per cent club. Yet eight years since his diagnosis, he also stands as a symbol of an idea fast gaining traction in the pharmaceutical industry — that data itself can be the drug that unlocks faster cures, bigger markets and higher profits.

It is an approach that is gaining momentum in the pharmaceutical industry, with potential benefits for patients not only in richer countries but also poorer ones, including recent applications in research on malaria treatments. As non-communicable diseases such as those linked to diabetes become more prevalent alongside infectious conditions, it will have increasing global relevance. But that will also depend on new funding models and access to data.

Holmes’s disease is kept in check by Ibrance, a medicine developed by Pfizer in the US and approved by regulators only for “post-menopausal” women. Customarily, securing permission to prescribe an existing drug to a wider group of patients would have required full-blown clinical trials that might have delayed the change for several years.

Yet in a world where Big Pharma and Big Tech collide, investors are pouring billions of dollars into companies that offer access to the clinical insights contained in vast troves of anonymised patient records. Combined with artificial intelligence, the data offer hope of expanding the number of patients who can benefit from existing medicines, or even unearthing entirely new drugs.

Chris Bosshoff, chief development officer for Pfizer’s oncology division, says: “To conduct a study in men, because we didn’t include them in [the initial studies], would have taken us another three to five years and here we could do all the work within 12 months and get the expansion.”

For Niven Narain, co-founder of biotech group Berg, “the concentration and the sexiness started in discovery but the digital health world has grown exponentially in the past year. Eighteen months ago if I sat here I couldn’t even tell you what a chief digital officer was,” he adds, reeling off the names of Big Pharma companies such as Novartis, Pfizer and Sanofi that now have digital experts on their leadership teams.

For executives preoccupied with improving pharma’s poor record on productivity, the power of data to accelerate drug discovery and reduce research costs represents fresh hope for corporate profits as well.

‘18 months ago I couldn’t even tell you what a chief digital officer was’
as patients. Getting a drug from bench to bedside can cost $2.6bn, according to the Tufts Center for the Study of Drug Development, and take up to 14 years.

Zach Weinberg, co-founder of Flatiron Health, which aggregated and analysed part of the data underpinning Ibrance's label expansion to men, believes two major shifts in the landscape are driving pharma’s fascination with data. The first is a demand from insurers and other payers for more detailed evidence about the performance of a drug once it is in regular use. The other is the increasing complexity of drug discovery, as scientists’ greater understanding of individual biology drives the search for more personalised treatments.

Weinberg says: “If you wanted to launch a drug in breast cancer 20 years ago, we would have thought of it as breast cancer. But now we think of it as multiple subtypes of disease, so the need to generate evidence in each individual subtype means there are more questions [to be answered].” These developments have placed a premium on high quality data, shorn of mistakes and inconsistencies, that will be trusted by regulators such as the US Food and Drug Administration and the European Medicines Agency. Securing access to data from electronic health records “is really not that complicated. Making that data fit for research, that’s the hard part. It’s in the data curation,” he adds.

Medical applications for data and AI have rapidly become attractive to investors. Calculations for the Financial Times by Rock Health, a US venture fund focusing on digital health, suggest that in the five years to the third quarter of 2019 a total of $1.5bn across 69 deals was invested in companies that use AI or machine learning, and that “either sell to biopharma or have biopharma as an end user”.

Even five or six years ago, only about half the 20 biggest companies working on cancer drugs were deploying real world data, says Weinberg. “Now, when we walk into any of the 20 [businesses] there’s a group that has been identified which at least owns the area for that. It’s about augmenting and complementing clinical trials where we don’t have enough trial data. That’s really the big idea.”

Basel-based Roche has embraced that approach. In 2015 it took a 12.6 per cent stake in Flatiron, going on to buy the company outright in 2018. The relationship has delivered clear dividends, suggests Bill Anderson, Roche’s head of pharma. He cites Rozlytrek, a treatment for metastatic non-small cell lung cancer approved by the FDA in August, which targets genetic mutations seen in only about 1 per cent of all patients with the condition.

Roche used Foundation Medicine, a US company that genetically sequences tumours, to identify a group of patients with the right genetic make-up on whom to test...
the medicine. It then created the equivalent of another trial using the Flatiron database to find a group of patients with the same mutations who were taking what had been regarded, up to that point, as the best treatment. Anderson says: “We needed a 2m-patient Flatiron data set to find approximately 50 patients that had [the relevant] mutation, and it fit the trial criteria.”

At Novartis, Switzerland’s other global drugmaker, Vas Narasimhan describes his business as “a data science company”. While identifying molecules that could turn into money-spinning drugs is the traditional business of Big Pharma, the key insight, on which he has sought to reposition the company since becoming chief executive in 2018, is that the data generated around those molecules are also core assets.

Novartis is increasingly looking to integrate anonymised data from clinical trials with other information about patients, such as their genetic make-up, to find the “super-responders” most likely to benefit from new treatments. Narasimhan says: “If you look at the tech companies that’s the pivot they made; they realised that actually the core asset for them is the data-mining [of] all of that experience.”

Take canakinumab, a medicine for heart disease that had disappointed in initial trials. Rather than writing off hundreds of millions of dollars in investment, Novartis took the data of the 10,000 patients involved in these initial studies and “discovered that this drug has a significant impact on lung cancer”, he says.

The company has now embarked on several late-stage trials of the drug among people with non-small cell lung cancer, the most common form of the condition. Recent moves attest to Narasimhan’s belief that Big Pharma must increasingly leverage the skills and approach of tech specialists.

The most profitable outcome for many pharma companies would be to find a brand new drug by applying AI to big data sets — but Narasimhan strikes a note of caution. “Can we use this technology to find the drug, to actually unlock the underlying science? I still think we’re a long way away [from that] because we don’t understand so much about human biology. And to define how a machine would solve that for us would require significant advancement still.”

Berg’s Narain believes this year will deliver a reckoning that could explode some of the hype that has been generated around AI and medicine. Founded just over a decade ago, the biotech group has carved out a distinct path by testing hypotheses developed through computer modelling in an experimental laboratory setting. The aim is to produce a biologically validated finding that can then be further tested in animal and human clinical trials — a process that takes time, he emphasises.

“It’s not like you pool public data and you’re going to cure cancer in three months,” he says. It has teamed up with several large pharma companies, including AstraZeneca and Sanofi, in work that Narain believes can eventually lead to new drugs by yielding fresh insights into how they produce their effects.

However, he warns against the notion that AI is a short-cut that can circumvent all the hard work of understanding patient biology. “AI is not just like a magic wand that dismisses all the iterations of the science that are so necessary to get to a really verifiable answer. Because at the end of the day we’re dealing with patients.”

This article is adapted from a version published in the FT in January 2020

‘It’s not like you pool public data and you’re going to cure cancer in three months’
Two days after the World Health Organization declared coronavirus a pandemic on March 11, the South African data science competition platform Zindi set a challenge. Budding data scientists were asked to come up with a model to predict the spread of Covid-19 using open-source data. A fortnight later, more than 500 hopefuls had entered, vying for the $5,000 prize. Entries will be judged in June against the spread of the disease measured in global deaths.

Celina Lee, who co-founded Zindi in Cape Town 18 months ago, describes the platform as a way of showcasing budding African data scientists and matching them with companies that have data but lack the expertise to exploit it.

Winners of the regular competitions — which include topics such as classifying fields by crop type using satellite imagery in South Africa, or forecasting flood patterns in Malawi — are sometimes hired directly by the company or institution sponsoring the challenge. Others simply compete for the prize money or, more importantly, says Lee, the opportunity to improve their skills through tackling real-world problems. More than 12,000 aspiring data scientists have already registered.

The need for companies such as Zindi, essentially a matchmaker between problems and problem solvers, highlights a significant obstacle to the practical use of artificial intelligence in Africa. Whatever one thinks about the idea of clever computers patching up infrastructure shortfalls — whether in road networks, administrative capacity or healthcare — the real-world use of AI on the continent is falling well short of its potential.

“Africa has a lot of talent, but very few systems that make them useful,” says Bright Simons, a Ghanaian social innovator and machine learning expert, who says Zindi fills an important gap. “The most talented people rarely get their hands on interesting problems. People need problems to keep their skills sharp.”

In much of the continent, the biggest challenge is what Simons describes as the integration of complex data sets with the algorithms that can interpret them. “AI can do this and that,” he says. “But 90 per cent of these are lab problems. For real-world problems, you need to bring a lot of data together, very few of which are controlled by single entities.”

Aubrey Hruby, a US investor in African start-ups, recognises the potential of AI systems to solve some health problems in Africa but wonders whether too much faith is being placed in the concept of leapfrogging. “The next wave is centred around telemedicine, the portability of medical records and diagnostics,” she says. “But can those things really solve the fact that there are only so many [hospital] beds per population? A lot of these things are just one part of the health system.”

Zindi’s Lee believes that, given backing, technologies such as machine learning can help expand the reach and efficacy of healthcare resources. She describes a model, which resulted from another Zindi competition, that successfully predicted depression risk in rural Kenya based on answers to a questionnaire.

Questions might be as simple as where someone lives or what their house is made of. A computer can then analyse these answers for patterns that might elude a
Rush hour in Harare
‘Africa has a lot of talent, but very few systems that make them useful’
human interrogator. Once patients are identified, the problem becomes one of accessing effective treatment.

Another model developed by a Zindi-registered data scientist had a more immediate impact. It helped a child protection helpline operating in Nairobi, Kenya’s capital, to set efficient staffing rotas by predicting when most calls would come. “In the African context, resources are limited. Any efficiency you can introduce for delivering health services helps,” says Lee. “It can change people’s lives and it can save people’s lives.”

Precious Lunga, a Zimbabwean neuroscientist also convinced that AI can make a difference, founded Baobab Circle, which uses algorithms and behavioural science to help patients monitor chronic conditions. Once signed up to the app, patients enter regular dialogue with Afya Pap, a “digital health companion” (or sophisticated chatbot) that dispenses medical advice and encourages healthier behaviour.

“Our initial focus has been on the self-management aspect of diabetes and hypertension where we monitor data to help the user manage their condition,” says Lunga, whose company has 50,000 registered users in Kenya, Uganda, Zambia and Zimbabwe.

For hypertension, patients take their own measurements with a blood-pressure monitor, which they can use for a small fee in pharmacies. Patients log the results on the app, which can be read by doctors if users grant access. “You can see between doctor visits what’s been going on,” says Lunga. “You can see patterns, whether the patient is doing well or needs an intervention.”

Since the outbreak of coronavirus, the app has been adapted. “With Covid-19 it is becoming a trusted source of information,” says Lunga. “There’s a lot of fake news being passed around about Covid-19 such as WhatsApp messages that say heat will damage coronavirus. That’s wrong and potentially dangerous. We have repurposed the app to deliver health advice on prevention — and localise it, with messages such as ‘Avoid the market.’”

Long before coronavirus struck, Mahamudu Bawumia, Ghana’s vice-president, highlighted the value of digital information, from property addresses to hospital records. Although Ghana’s digitalisation drive — centred on national ID cards and government services — is primarily aimed at improving administrative efficiency and eliminating corruption, the government recognises the implications for health delivery.

Emmanuel Gyimah-Boadi, former director of Ghana’s Center for Democratic Development, welcomes the digital push, saying that governments cannot begin to solve people’s problems if they do not know who they are and where and how they live. The national ID system — a controversial concept in parts of the continent — is for him “the beginning of citizenship”, although implementation has been slow.

‘Should a system have to explain why it thinks you have pneumonia?’
Darlington Ahiale Akogo, founder of mimoHealth AI Labs, a Ghanaian data science start-up, says the country’s big hospitals have conducted tens of thousands of medical imaging tests. “But we don’t have any records of that,” he says. Akogo has developed a system that can detect various pathologies from chest X-rays, including pneumonia and fibrosis. “The AI system performs as well as the best radiologist,” he claims, adding that this is invaluable in a country with fewer than 40 radiologists. “How can we use technology like AI and big data to provide fully democratised healthcare that otherwise wouldn’t be available?”

Computer power can also be used for research, he says. He is using AI to try to determine why children from Kintampo, a town in the Bono East region, are less susceptible to malaria than those from Accra. “We are using AI to identify the key things that give people high immunity,” he says.

The hunger for data that such projects generates is tricky in a continent that has not yet grasped the regulatory implications of accessing personal information.

The Wellcome Sanger Institute, a UK genome research centre, was recently accused by whistleblowers of commercialising a gene chip without the consent of African people who donated DNA. Sanger denies the allegations, pointing to two separate investigations that found that “no wrongdoing took place”.

Akogo says the use of data must be carefully evaluated from both a legal and ethical perspective. “What is the right framework for collecting data and using it to improve diagnosis? It’s the same problem Facebook and Google are having now. The worst thing we can do is recreate with healthcare that kind of problem. Imagine Cambridge Analytica, but with healthcare,” he says, referring to the former UK political consulting firm that collapsed after being accused of misusing personal data.

Akogo says regulators will also have to develop rules on what he calls “explainability”. “Should a system have to explain why it thinks you have pneumonia?” he asks. “From a regulatory point of view, it is perfectly reasonable to expect a system to explain itself, but from a technology point of view that might not even mean anything,” he says. “If a patient is diagnosed by an AI system, who is responsible legally?”

Yet another ethical dilemma for Africa to grapple with, says Zindi’s Lee, is uneven access to broadband and to computer power, which puts many African data scientists at a disadvantage, particularly if they live outside big cities. “Even a typical university student in Nairobi would struggle with some of the larger data sets,” she says, adding that some solutions can take up to 12 hours to run on typical computers.

Zindi has recently partnered with Microsoft to allow participants to perform their computations in the cloud. “You should be able to be anywhere or anyone and be able to throw your hat in the ring,” she says.
When Geetha Manjunath lost a family member to breast cancer, she resolved to use her IT skills to help fight the disease.

“When my cousin went to the doctor, the cancer was already at an advanced stage, which made the treatment challenging,” says Manjunath, whose company Niramai uses artificial intelligence-powered thermal imaging to improve early detection of tumours.

The non-invasive test, which Manjunath says can be performed by a low-skilled healthcare worker and does not require a hospital, generates a provisional report within 15 minutes, using AI to read the thermal image's colour points.

The test costs about $20 in a hospital — less than half the price of a mammogram in India — while many rural patients are offered the test at a subsidised rate of less than $2, Manjunath says.

Such AI-led groups are becoming commonplace across India’s healthcare industry. When the Centre for Internet and Society, a non-profit research group, reviewed the country’s AI-led healthcare initiatives, it found that the main focus was to extend medical services to traditionally underserved populations in India. “AI...in healthcare in India appears to be addressing issues of economic disparity rather than widening existing gaps,” the CIS report says.

Two-thirds of India’s population lives in rural areas but is served by one-third of the country’s doctors, according to World Bank data. This statistic that has encouraged innovative companies to use AI to remedy the shortfall
by helping low-skilled health workers diagnose medical conditions.

Sattva MedTech, an Indian medical start-up, is using AI-powered electrocardiogram-based monitoring systems to diagnose foetal distress—a condition that contributes to India’s high neonatal mortality rate.

Vibhav Joshi, chief executive and co-founder, says the group’s technology—which received a $100,000 grant from the Bill & Melinda Gates Foundation to develop algorithms and conduct a pilot study—can be used by low-skilled healthcare staff.

“[Many rural] health centres don’t have foetal monitoring systems and even if they have the conventional doppler test, they don’t have the skilled personnel to conduct the investigation,” says Joshi. Sattva MedTech says its AI has a 93 per cent detection rate of foetal distress and is targeting 98 per cent before it starts offering the algorithm commercially.

Hyderabad-based Avyantra, a medical start-up, is developing an algorithm that it hopes can predict sepsis in newborns based on the mother’s risk factors and the baby’s medical parameters.

India has the world’s highest incidence of clinical sepsis—17,000 cases reported for every 100,000 live births—and Hyma Goparaju, Avyantra co-founder, believes the group’s technology can encourage better use of antibiotics in newborns and reduce sepsis-related deaths.

“We have identified about 30 parameters such as blood pressure and colour of the newborn’s skin,” she says. “The AI then generates a score which the health worker can use to decide [based on a risk score] if the newborn needs to be shifted to a hospital.”

Avyantra has received $100,000 funding from Unicef, the UN’s agency for children, to further develop its algorithm and is hoping to test its technology in the field.

Though these start-ups offer hope of providing timely, quality healthcare, critics worry about data privacy and the sensitivity of predictive AI, which are not always validated by regulators or independent reviewers.

No rules prevent hospitals from sharing data with companies developing AI for healthcare, says Vidur Mahajan, a member of the Indian Council of Medical Research’s committee dedicated to developing ethical guidelines for AI research.

India also lacks a regulatory watchdog solely dedicated to reviewing AI-powered healthcare companies, with the task currently falling to the Central Drugs Standard Control Organisation, a drug and medical device regulating authority.

“When my company started working with AI developers, we decided to explicitly take consent from patients for using their data for AI development,” says Mahajan, who also heads research and development at Mahajan Imaging, a diagnostic and imaging facility based in New Delhi. “In terms of regulation, software is not treated like a drug in India.”
An unexpected consequence of the Covid-19 pandemic is that governments everywhere are having to rethink the role of digital technology in healthcare.

To keep people away from hospitals, for instance, the US and Australian governments have both approved reimbursement for telemedicine consultations, allowing patients to speak to doctors via video-link. The UK government has launched a coronavirus chatbot to relieve the pressure on the National Health Service and reduce in-person contact. Experts say that such innovations will help in the longer term by reducing unnecessary use of health services that were already struggling to meet the needs of an ageing population, long before Covid-19 struck.

“The pandemic has drawn attention to the complexities of delivering healthcare within a massively decentralised market,” says Vincent Grasso, global healthcare and life sciences lead at IPsoft, an artificial intelligence company. “Part of [our] dilemma involves the inability to scale up human labour fast enough to meet new demands on resources. AI applications, including conversational computing, can be very helpful to meet this demand.”

Health agencies are also striking partnerships with tech companies at a speed and scale hard to imagine under normal circumstances. The NHS is working with the likes of Amazon, Microsoft and Palantir to create data models to optimise the allocation of ventilators, hospital beds and staff.

Data privacy restrictions are loosening. The UK Information Commissioner’s Office recently said it would be “pragmatic” in enforcing the usual rules, taking into account compelling public interest arguments. It acknowledged that organisations might fall short of their usual data protection practices due to their need to divert resources away from compliance and information governance, and might take longer to respond to information rights requests. “The ICO does not operate in isolation from matters of serious public concern,” it wrote. The crisis has been a big impetus for enabling digital health, says Klaus Boehncke, partner at LEK Consulting, a global management group. Governments were already working on new rules to facilitate the emergence of digital health, ranging from apps and wearables to “digi-ceutical” therapies that rely on software as a key component in managing a disease.

Germany passed a law in November to allow doctors to prescribe health apps, with insurers reimbursing the cost. Such moves are “a driver of innovation in German healthcare”, says Ramraj Puvinathan, research associate at Public, an accelerator for public sector-focused start-ups. “It is the first model of its kind anywhere in Europe, in terms of reimbursing healthcare providers through statutory health insurance.”

Regulators are breaking down data silos to better unleash innovation in digital medicine and AI. The EU is integrating data across member states to enable...

German doctors can prescribe health apps, with insurers reimbursing the cost.
cross-border digital prescriptions and patient data exchange, and the US recently passed rules to enable data to flow more seamlessly across the Medicare and Medicaid healthcare programmes.

Regulators are approving a growing number of digital health therapies. In 2017, the US Food and Drug Administration approved the first “digital pill”, a sensor-laden chemotherapy drug that allows clinicians to monitor whether patients are following their prescribed drug regimen. The FDA has also sanctioned mental health apps from Pear, a San Francisco-based technology group, that support people with addiction and chronic insomnia.

More products are expected. Apple and Johnson & Johnson are running a clinical trial exploring whether Apple Watch can be used to detect atrial fibrillation.

In Europe, the first wave of digital health start-ups has focused mainly on back-office tasks such as communications, staffing logistics and information flows. “Most successful European [digital health] start-ups are operational, and don’t classify under medical regulation categories,” says Puvinathan. “What is interesting now is a second wave of start-ups that we think will go into the ecosystem, requiring clinical evidence, ticking regulatory boxes and fulfilling European regulations.”

Clinical trials themselves could change significantly
interests in healthcare. Tech companies have faced public criticism, regulatory rebukes and even legal challenges for data privacy breaches.

The UK’s privacy watchdog said in 2017 that an NHS trust had broken data protection laws when it gave DeepMind, Google’s artificial intelligence arm, access to the personal medical records of 1.6m British patients. Google and the University of Chicago faced a lawsuit over a data-sharing agreement that failed to secure patient consent, and allowed re-identification of anonymised patients, by triangulating date stamps and doctors’ notes.

Even today, despite the gravity of the coronavirus threat, UK privacy campaigners have expressed concern about the involvement of tech companies in the NHS Covid-19 response. Palantir, for instance, also has a portfolio that includes tracking undocumented migrants for the US Immigration and Customs Enforcement agency. The NHS partnership with Big Tech has prompted an open letter from a group of campaigners, doctors and academics imploring the US agency to avoid cutting ethical corners and to maintain transparency in areas such as contact tracing.

Others have noted the rise of the “bio-surveillance state”. In China and South Korea, tech companies are playing a critical role in facilitating quarantines and mobility restrictions. This includes distributing QR codes via apps that assign colour codes determining quarantine status, based on factors such as travel history, time spent in infectious areas and relationships to virus-carriers. This has prompted allegations of inaccurate ratings and stigmatisation of the ill.

The speed of China’s Covid-19 lockdown cannot easily be disentangled from a techno-surveillance infrastructure that also allows the tracking of political dissidents and minority groups.

In the west, concerns have already been raised over the increased participation of tech companies in managing hospital data. A recent report found that 53 of the 50 US-based hospitals examined were working with Amazon, Google or Microsoft, but without standardised and open rules over data protection management. Hospitals cited cyber security concerns as the reason for not sharing such details with an investigation led by STAT, a subsidiary of the Boston Globe newspaper. In the consumer healthcare space, surreptitious data-sharing has been widespread; one review of medicine-related apps on the Android mobile platform found 79 per cent of those sampled shared user data with third parties including advertising companies, private equity firms and credit agencies.

Covid-19 has prompted an expansion of state power in healthcare that is a long way from over. These changes are helping tech companies and data innovators play a greater role in service delivery. Much will depend on whether regulators roll back the reforms once the pandemic is over.
A worldwide wake-up call

As medical innovation is thrust into the spotlight, artificial intelligence is helping to diagnose, treat and curb the spread of Covid-19. By Brooke Masters

The business case for using artificial intelligence in healthcare was strong even before the coronavirus outbreak stretched hospitals to their breaking point and put medical innovation atop the world's agenda. Investors were already funding scheduling programmes that sought to maximise the use of operating rooms, nursing staff and other resources as well as trying to embed AI-powered decision making into routine care.

Data provider CB Insights reported that 367 healthcare AI start-ups received $4bn in funding last year, and the consultancy Accenture estimates that in the US, machine learning will save $150bn annually by 2026.

Some of the most successful projects have involved using computers to monitor patients, both at home and in hospital, and send alerts to medics when the data suggest that interventions may be needed. Some programmes have helped cut the death rate from sepsis, and assisted people with type-2 diabetes to reverse their symptoms.

Other companies have harnessed AI to speed up drug development. The UK's BenevolentAI, for example, is trying to cut the time and cost of drug development by sifting through millions of scientific papers to match molecules to diseases. This work has been focused on so-called precision medicine, which allows doctors to find the drugs best suited to individual patients with particular genetic markers, boosting the chances of success.

Now much of this work is focused on managing, treating and preventing the spread of Covid-19, which will relieve pressure on health systems. AgileMD, for example, builds clinical decision-making tools to help doctors and nurses decide more quickly how to treat patients and manage resources. Those programmes are currently available for free to interested healthcare systems.

Companies including BioIntelliSense and Google's Verily division are focusing on tiny sensors and other equipment that allow patients to be monitored at home. BioIntelliSense's tiny sticker tracks everything from heartbeat and temperature to coughing, sneezing and vomiting frequency. The aim is to keep people away from emergency rooms where the risk of infection is high while ensuring that those who need care receive it.

Several Chinese companies have made significant progress in training AI systems to speed up diagnosis of coronavirus infections. The research arm of ecommerce group Alibaba has a system that can process chest scans in 30 seconds, compared with 10 minutes or more for a human, and claims to have used it to diagnose more than 30,000 cases. Florida hospitals are trying a visitor screening system that analyses facial attributes such as sweating and discolouration as well as data from a thermal scan. China's SenseTime combines thermal scanners with facial recognition technology that can pick out people who fail to wear masks in public places. (The scanners are controversial because they purportedly can identify people even when they are wearing masks).

South Korean officials credit the technology with helping their world-leading efforts to test for and track the disease — molecular biotech company Seegene used AI to speed up development of its testing kit.

Other efforts will take longer to have an impact on patient care. Six big US research universities are joining with Microsoft and C3.ai, an AI software provider, to launch the C3.ai Digital Transformation Institute with $567m in industry funding. It is starting with a call for proposals on how to use the technology to curb the spread of Covid-19 as well as prepare for future pandemics. Participants include the University of Chicago, Princeton, MIT and Carnegie Mellon.

The White House's Office of Science and Technology Policy also has asked AI researchers to analyse 29,000 scholarly articles to see if they can come up with the answers to basic questions about the disease. The data set is being made publicly available.

And both China's Baidu and Google's DeepMind have used their AI technology to help predict the possible chemical structure of the coronavirus's proteins, which may make it easier to create a medicine or vaccine.

So far, companies have prioritised speed over profits, with many groups making public data that they would normally consider proprietary information. "It's really all hands on deck for this," says Eric Horvitz, Microsoft's chief scientific officer.

Over the long-term, many analysts believe that the pandemic is a wake-up call that only reinforces the importance of bringing AI into healthcare — and using it to save both money and lives.

Brooke Masters is the FT's opinion and analysis editor
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few years ago a dance craze called the Vosho swept South Africa. The dance involves variations on a hop, a kick, a drop and a pop — hop on your left foot, kick out your right, drop your backside into a crouch and pop back up. Not for the weak-kneed, it is both endlessly adaptable and quite specific — you know a good one when you see one.

Babusi Nyoni, a developer and designer, saw in the dance an opportunity to test a new machine learning model called Tensorflow — which was released by the Google Brain deep learning artificial intelligence unit — that can estimate and judge a body’s movements.

In December 2018, he and his team at Triple Black, the Amsterdam-based agency he co-founded, released Vosho Fo’sho, a mobile app that judges users’ ability to perform the perfect Vosho.

“The intention was just to take something that was fresh off the shelf — the latest in the trend of computer vision — and put it in the most unexpected space, and have it have this context that the creators of that technology would never have envisioned,” says Nyoni, 32.

Nyoni soon realised he could take it somewhere even more unexpected and, he says, meaningful — a home for the elderly in his hometown Bulawayo in Zimbabwe. The Vosho app was, at its core, an assessment of movement over time, which is the kind of assessment necessary to diagnose Parkinson’s disease.

“The idea behind that was: ‘How can we build this world-first application through an African lens?’” he says. “I’m building the tech. I’m going to do the research in a small city in Zimbabwe. We’re going to build this for...

CASE STUDY

From dance to diagnosis

A Zimbabwean developer has turned a dance app into a tool for assessing Parkinson’s disease. By Neil Munshi
and the performance of the AI tech. It is designed to work on the low-end smartphones that are common across Africa, so that users can simply point and shoot in order to perform the assessment.

Nyoni has a history of turning seemingly trivial technology toward more meaningful use. In 2016, while working at an advertising agency in Cape Town, he developed a custom AI football commentator for the brewer Heineken, which was deployed during that year’s Uefa Champions League. The algorithm collected football-related tweets from around the world and converted them into language that allowed a Twitter bot to banter with fans about the sport in a natural way.

But Nyoni then realised that he could repurpose it to predict forced migration patterns across Africa. His team removed the football banter and plugged in information including population growth, food production, extreme weather and gross domestic product changes.

The results revealed patterns showing when countries had reached tipping points that led to mass migration in the past—and, crucially, can help to predict under what conditions countries might reach those points in the future.

That project led to a partnership with UNHCR, the UN Refugee Agency, trying to predict the movements of displaced people in Somalia. However, the project hit a snag when they realised the available data was too limited to provide insight into how or when people might move.

Then the project team discovered that people sell their goats — a key vessel of wealth in rural Somalia — when they are preparing to move, which sends prices down. Those types of unorthodox data points are now included in the system, which provides for a more complete picture of potential mass displacements.

Nyoni says his ability to tap into innovative solutions is borne of his impoverished upbringing in an economically devastated Zimbabwe.

“Growing up in an environment where you have to always constantly be solving in some way or another, just to improve the quality of your life, is something that I guess prepared me for that moment where I could look at what I built and then imagine the use case for it that would be much more impactful than a dance move assessment or a football commentator.”
Article 196 of Brazil’s constitution is unambiguous: “Health is a right of all and a duty of the state and shall be guaranteed.” The constitutions of Venezuela, Mexico and Peru make similar promises, yet the reality is quite different in the world’s most unequal continent.

Wealthy Brazilians enjoy high quality private care that compares to anything on offer in Europe or the US. While those in formal employment can access good treatment if they have insurance, most workers toil in the informal economy and instead rely on an overstretched and patchy public health service with waiting times of up to six months for an appointment.

“Brazil has a unified health system, says Thomaz Srougi, chief executive of Dr Consulta, a low-cost medical treatment provider that uses algorithms and other digital tools to reduce healthcare costs for the less well-off. “In theory it’s beautiful, in practice it doesn’t work. There’s 160m people who rely on the government because they can’t afford health insurance. The government health system is underfunded and understaffed…there’s a huge access gap.”

Can the application of digital technologies to healthcare broaden access and improve the quality of medical treatment for Latin America’s tens of millions of impoverished citizens? Or will the new technologies become the preserve of a privileged few?

Pablo Orefice, head of Salud.uy, the Uruguayan government’s digital health initiative, believes that digital healthcare is a “paradigm shift for the least fortunate” in Latin America, giving those who live in more remote areas better access to specialist services more quickly.

Entrepreneurs such as Rafael Figueroa are helping drive change. Aiming to connect Brazil’s remote Amazon communities to the medical expertise in the cities of São Paulo and Rio de Janeiro more than 3,000km away, Figueroa founded Portal Telemedicina in 2013.

“We had a patient in the remote Amazon town of Coari,” Figueroa says. “He had been in bed for a year and people thought he was already dying.” The local doctor travelled 24 hours by boat up the river to reach him, carrying an electrocardiogram, which measures heart activity, in a backpack. The data was uploaded to the cloud, enabling a cardiologist in São Paulo to diagnose a heart problem and save the patient’s life.

Portal Telemedicina, an online diagnostic platform connecting primary healthcare workers and specialists, offers its services in more than 300 cities in Brazil and in Portuguese-speaking Angola in Africa. One of its breakthroughs was the development of what it calls a “Master Patient Index” to overcome the problem of medical data scattered between different systems under incompatible identifiers.

“Our AI program uses 16 algorithms to do a probabilistic matching of the patient across different databases…and merges the different health records under a single data link with all the information on the patient…all the diagnostic images, lab results,” says Figueroa. “That way, the doctor can get a 360-degree holistic view of the patient.”

Digital patient records are one of the biggest challenges for Latin American nations. Many use a variety of identifiers for patients, including social security, driving...
“These are Amerindians, Maroons and other ethnic groups and they live in the jungle…and don’t go out of this area,” says Leah-Mari Richards of Paho, who worked on the project. “The challenge has been linking them and their health needs with the broader national system.”

The solution was a portable, solar-powered mini web server that can upload patient medical data to the capital Paramaribo. After being tested in six clinics, the team aims to extend the project to 30 more by July.

The Covid-19 pandemic is speeding up the use of digital medical technologies across Latin America, experts say.

“The first thing that we are seeing now is…an unequal adoption of these technologies,” says Marcelo Cabrol, social sector head at the Inter-American Development Bank in Washington. “If you have an internet connection and enough bandwidth, you can have a teleconsultation and pretty much have a diagnosis. If you’re not—and
There is general agreement that the data must remain the property of the patient.

mistrust government. Years of inefficient weak national states dogged by corruption have bred an instinctive suspicion among populations of those who rule them — something Cabrol calls “a very fragile social contract”.

A survey by regional pollster Latinobarómetro in 2018 found that 79 per cent of Latin Americans agreed with the statement that “we are governed by a few powerful groups who look after their own interests”. This presents problems for governments trying to win consent for digital technologies that gather and hold large amounts of sensitive personal medical data.

Among health tech entrepreneurs in the region, there is general agreement that the individual data must remain the property of the patient, though many also believe that aggregated anonymised data should be used by researchers to develop and improve services.

“We’ve always been obsessed about data privacy and data usage,” says Srougi of Dr Consulta. “I believe that the patient owns the data. It’s his health, his information.”

Dr Consulta uses non-identified data to support medical decisions “so when we build a clinical algorithm, say for a gynaecologist, the doctor will be able to see the statistics of patients with similar social demographic and health profiles, what’s been done, how the algorithm has performed and what are the statistics for that particular patient”. Srougi says: “Doctors love it.”

Dr Consulta has treated 2m patients in 60 cities across Brazil. Srougi founded the company in São Paulo’s biggest favela, or slum, of Heliópolis in 2011, having left a career in corporate finance to study public policy at the University of Chicago.

“You can set up an appointment online, come to the clinic, check in, pay and be seen, all in less than 50 minutes,” he says. “In the public system, it can take a day to see a clerk to book a doctor’s appointment in three months’ time.” The company also aims to iron out inequality in the supply of doctors in Brazil by connecting patients in remote areas to top specialists for diagnosis, all at affordable prices.

Now, the region’s digital health players are scrambling to press their technologies into service against the common enemy of coronavirus. “It’s a warlike moment to save lives,” says Srougi. “Right now we are doing as many tests as we can and we’re trying to track the sick people using our technology. We have never worked so fast and communicated so fast.”

Cabrol of the IDB believes the pandemic will lead to more profound and wide-ranging changes in Latin America. “What this has done is to highlight the importance of extending access to technology to poorer populations,” he says. “There is now a vibrant debate on whether internet access across the continent should be subsidised as a public good. I’m optimistic that what will come out of the crisis is more democratic access to technology.”

Two-thirds of the population in Latin America would not have access to adequate broadband connections — you’re excluded.” One of the biggest difficulties, Cabrol says, is the lack of collaboration in the continent between the public and private sectors in digital healthcare, meaning that many solutions never get to scale. “We have only a solution for 200 individuals, we don’t have the solution for 2m.”

Data sets used to train AI algorithms can also lead to unconscious bias or discrimination among diverse populations. Cabrol highlights a provincial government study into the high rates of teenage pregnancy in the northern Argentine province of Salta, using AI to predict where pregnancies would occur.

The algorithm proved 88 per cent accurate but, he adds: “Something goes wrong along the way...when they look at the sample, they see that they only included poor families, and that’s a discriminatory way of doing it.”

Deployment of new technology can have unintended consequences. In Chile, the government adopted a new digital diagnostic tool to identify cases of diabetic retinopathy, a condition that can cause blindness if untreated. “It was successful in diagnosing retinopathy but was not trained to look for other issues,” says Cabrol.

“So they saw a huge backlash...The poor were going there but...nobody was looking for other problems because the model wasn’t trained...that was reinforcing inequality.”

In addition, he adds, the system was designed to deal with a shortage of ophthalmologists but was deployed so widely that it put many of them out of work. “This is technology trying to reach the poor...and ending up actually discriminating against the poor.”

Latin America is also a region where people profoundly...
When Mozambique was hit by two cyclones in rapid succession last year — causing death and destruction from a natural disaster on a scale not seen in Africa for a generation — government officials added an unusual recruit to their relief efforts. Apart from the usual humanitarian and health agencies, the National Health Institute also turned to Zenysis, a Silicon Valley start-up. As the UN and non-governmental organisations helped to rebuild lives and tackle outbreaks of disease including cholera, Zenysis began gathering and analysing large volumes of disparate data.

“When we arrived, there were 400 new cases of cholera a day and they were doubling every 24 hours,” says Jonathan Stambolis, the company’s chief executive. “None of the data was shared [between agencies]. Our software harmonised and integrated fragmented sources to produce a coherent picture of the outbreak, the health system’s ability to respond and the resources available.

“Three and a half weeks later, they were able to get infections down to zero in most affected provinces,” he

The full picture

Data analysis by Silicon Valley start-up Zenysis proved vital in helping the Mozambique authorities extinguish an outbreak of cholera. By Andrew Jack

CASE STUDY

1 Children playing in Mozambique in the wake of a 2019 cyclone. Zenysis helped stop the spread of cholera there

2 Zenysis chief executive Jonathan Stambolis says data analysis helped with prioritising areas for vaccination
Machine learning applied to disparate data helps manage shortages of medical supplies

The output was daily reports distilled from data issued by health facilities and accommodation centres in affected areas, disease monitoring and surveillance from laboratory testing.

Eduardo Samo Gudo, deputy director-general of Mozambique’s National Health Institute, says that such information, combined with epidemiological bulletins and detailed presentations, helped inform daily discussions and decisions.

“It’s the most compelling example of our impact so far,” says Stambolis. “It all happened so quickly and it was measurable. It’s normally harder to establish causation but the results were so compelling and observed so quickly. There was a direct line between our collaboration with the government and that outcome.”

Mozambique marked a new area of advising on humanitarian relief for Zenysis, which had previously focused on health systems before branching out into humanitarian relief. Over the past few years, Zenysis has expanded into nearly a dozen lower- and middle-income countries — including Ethiopia, Rwanda and Vietnam — where it is helping to identify patients with tuberculosis.

In parts of Africa and Asia, patient health data is not collected, or is written on paper that is filed haphazardly and difficult to analyse. While technological improvements have led to a rise in electronic reporting of medical information, the capacity to collate, process and apply it remains limited.

Ministries, departments, clinics and non-government organisations may submit reports in varied electronic formats over different time periods. Sometimes the limits to comprehensive data pooling can be as basic as variations in the way local place names are spelt.

Zenysis helps make these data sets compatible by collating, cleaning and analysing the information, presenting it in simple visual formats and using machine learning to help make predictions. The start-up says its output helps tackle disease outbreaks, manage shortages of medical supplies, reduce waste, aid more efficient distribution, cut costs and ultimately save lives.

Stambolis says that funding for early stage businesses providing innovation in digital health remains difficult, because investors and donors often move too slowly to provide necessary support.

For Zenysis, however, he remains confident. The company is employee-owned, with backing from committed investors and income from multiple governments.

“We have a lot on our plate,” he says. “We are going to be even busier this year and beyond because of organic growth and massive investments to be made in health systems in low- and high-income countries because of coronavirus.”
n late January, word disseminated through the medical world of an alarming new coronavirus disease that was spreading through China. In the UK, biotech company BenevolentAI turned its formidable artificial intelligence machine — set up to discover and develop new drugs — towards understanding the novel infection, then called 2019-nCoV.

The company used its “knowledge graph”, a large repository of medical information including connections extracted from scientific literature by machine learning, to look for existing medicines that could move quickly into clinical trials. AI enables it to solve pharmacological puzzles much faster than human experts, says Peter Richardson, BenevolentAI’s head of pharmacology.

“Rather than focusing solely on drugs that could affect the virus directly, we explored ways to inhibit the cellular processes that the virus uses to infect human cells,” says Joanna Shields, chief executive of BenevolentAI.

Within a week, a strong candidate had emerged: baricitinib, an oral drug marketed by Eli Lilly, the US pharmaceuticals group, to treat rheumatoid arthritis under the brand name Olumiant.

The analysis, published online in The Lancet medical journal on February 3 as the first cases of the new coronavirus were being reported in Europe, showed that baricitinib had several advantages as a treatment for Covid-19. Its anti-inflammatory properties could damp symptoms caused by a misdirected immune response in more advanced disease, while the drug also blocks viral replication by inhibiting an enzyme called AAK1 that the virus uses to enter human cells.

The AI exercise found further advantages of baricitinib over other drugs that target AAK1, says Richardson. Its side-effect profile is low at concentrations in blood plasma that are predicted to have an antiviral effect, and it appears to be compatible with direct-acting antivirals and HIV medications that are being tested as Covid-19 treatments. This opens up the possibility of combination therapies — where two or more drugs simultaneously target different aspects of Covid-19 pathology.

It was BenevolentAI that alerted Lilly to baricitinib anti-Covid potential. “Lilly responded with astonishing speed,” says Richardson. “They immediately went out and tested it in their labs. It did what we predicted.”

Lilly then scheduled a clinical trial of baricitinib in Covid-19 hospital patients in collaboration with the US National Institute for Allergy and Infectious Disease. The Indianapolis-based company says it plans to expand the baricitinib trial to hospitals in Europe and Asia, and expects results within two months.

Other AI-driven drug discovery and development companies are also directing resources to fight the pandemic. Exscientia, another UK biotech, is collaborating with Diamond Light Source, the country’s national synchrotron facility, and Calibr, the drug development division of Scripps Research in California, to develop compounds that could rapidly become viable.

‘We explored ways to inhibit the cellular processes that the virus uses to infect human cells’
treatments for Covid-19. Exscientia has access to Calibr’s 15,000 clinically ready molecules, which includes drugs already on the market and others that have passed clinical and animal safety studies.

Exscientia will first screen the complete molecule collection against key viral drug targets of Sars-Cov-2, the virus that causes Covid-19. Priority targets are enzymes that are vital for viral replication and also the virus’s spike surface protein, which interacts with the human cell receptor Ace2 to gain entry to human cells.

“The initial priority is to search for any existing drug that can be repurposed to protect the human population,” says Martin Redhead, head of quantitative pharmacology at Exscientia. “Then we can design superior molecules with our AI-design systems to work even more effectively against the virus.”

The role of Diamond — a facility in Oxfordshire that generates light beams 10bn times brighter than the sun — is to act as a molecular microscope, investigating how potential medicines interact with viral and human proteins and feeding the information back to Exscientia’s AI drug discovery algorithms. A third AI-powered UK biotech throwing resources into finding Covid-19 treatments is Healx, a Cambridge-based group looking for combination therapies.

Healx says that uncovering such treatments for Covid-19 requires detailed analysis of 8m possible pairs and 10.5bn triplets from the 4,000 approved drugs already on the market. Like Exscientia, the company’s AI platform uses a knowledge graph. Its version, called Healnet, integrates and analyses biomedical data from multiple sources to predict combinations most likely to succeed in the clinic.

“Our AI is able to combine two to three existing drugs to formulate the most effective treatment,” says David Brown, Healx chairman. “This approach ensures that any potential treatments we identify can be used by clinicians to help patients very quickly.” The company expects to have candidate combinations available in May for pre-clinical testing in collaboration with partners. Beyond drug development, AI is being applied to analyse sounds and images of Covid-19. Researchers at Cambridge university have launched a mobile phone app that will collect data to develop machine learning algorithms for detecting whether someone is suffering from the disease — based on the sounds of their voice, breathing and coughing.

Because Covid-19 is a respiratory condition, it may affect these sounds in a specific way. The Cambridge team hope that a large, crowdsourced data set, collected using the app, can be used to develop machine learning algorithms for detecting the disease. The European Research Council is funding the project.

Cecilia Mascolo, the project leader in Cambridge’s computer science department, says that doctors have noticed the way patients with the virus catch their breath when speaking, as well as their breathing patterns and a dry cough.

“There are very few large data sets of respiratory sounds, so to make better algorithms that could be used for early detection, we need as many samples from as many participants as we can get. Even if we don’t get many positive cases of coronavirus, we could find links with other health conditions,” she says.

AI is becoming a useful tool for medical image analysis, and at least two separate UK groups are harnessing it to help diagnose Covid-19 symptoms in lung X-rays. Researchers at Birmingham City university have adapted a neural network called DeTraC (short for decompose, transfer and compose) to detect Covid-19.

Early experimental results showed that DeTraC could detect Covid-19 cases from an image data set collected from several hospitals around the world. It achieved 95 per cent accuracy in distinguishing Covid-19 X-rays from comparable images of other lung diseases.

Zegami, a data visualisation spinout from Oxford university, has developed a machine learning tool that aims to diagnose Covid-19 from lung X-rays. The company says it could not only differentiate Covid-19 from pneumonia caused by other pathogens, but could also predict likely outcomes based on the experience of previous patients.

To improve its AI tool, Zegami asked the UK’s National Health Service to provide it with data in the form of Covid-19 X-rays and details of patients’ treatment and outcome. “Covid-19 is a huge challenge and technology should play a key role in defeating it,” says Roger Noble, the company’s chief executive.

BenevolentAI’s Richardson agrees: “As human scientists working together we couldn’t possibly have identified baricitinib so quickly because there are so many competing ideas. We needed our AI ‘knowledge graph’ and the ability to query it to find new relationships and new ways to tackle disease.”

Protein puzzle

Diamond Light Source researcher Alice Douangamath aims X-rays at coronavirus proteins to see if they bind to various drugs

‘Covid-19 is a huge challenge and technology should play a key role in defeating it’
Ada Health has worked with a team of doctors to develop a chatbot in Swahili. By Ben Turner

With one doctor per 25,000 people, the Swahili-speaking east African country of Tanzania struggles to serve the needs of its 59m people. Life expectancy is 62 for men and 66 for women, while just two-thirds of the population live within 5km of a health facility.

“Traditional models will not fix this problem,” says Hila Azadzoy, managing director of the Global Health Initiative unit at Ada Health, a Berlin-based artificial intelligence-powered medical company. “Technology can empower users to take decisions about their own health by putting the power of AI into their hands,” she adds.

Available since 2016, Ada Health’s chatbot symptom checker app has attracted 9m users worldwide, mostly in low- and middle-income countries. The free-to-download app invites users to input symptoms and pre-existing medical conditions before using AI-based questioning to pinpoint possible diagnoses — it then recommends next steps such as resting or seeking professional help.

The digital doctor now speaks Swahili — the lingua franca of 100m people in east Africa — thanks to Ada’s Global Health Initiative. Launched last November, the project is aimed at improving access to healthcare in developing countries by offering reliable medical advice via its chatbot app.

Ada, which was designed in 2011 to help doctors in Germany diagnose rare diseases, now faces the challenge of integrating into a country hampered by poor infrastructure and a shortage of medical staff.

The app can help Tanzania overcome obstacles of low accessibility and unaffordable healthcare fees, says Nahya Salim, a lead clinician at Muhimbili University of Health and Allied Sciences in Dar es Salaam. “The lower levels of the healthcare system are overwhelmed with too many patients and not enough resources,” she adds.

Salim, who partnered with Ada to build the app alongside Swiss non-profit group Fondation Botnar, believes it will improve access to healthcare by encouraging “timely and appropriate health seeking behaviour”, though the user base remains limited to young city-dwelling men. This is the demographic that is most likely to use smartphones, Salim explains, while adding that Ada must increase awareness of the app across the population. The company says it is working towards this. Its target is 1.5m users in the country by the year-end, although it is yet to reveal its current user numbers and only 7.5m Tanzanians own a smartphone capable of downloading the app.

Aidan Peppin, a researcher at the Ada Lovelace Institute in London, says that involving locals in the app-building process is vital to ensuring that Ada can integrate with the population. Ada Health says it has worked with local partners to make the app culturally relevant.

Despite the similarity in names — both a nod to 19th century British mathematician Ada Lovelace — Peppin’s institute is more sceptical about AI’s prospects for solving health problems. “These apps use a crude reductive process,” Peppin says. “In medicine there are too many unknown anomalies and AI can only deal with what it has seen before, it can’t make inferences.”

Sheena Visram, an associate editor at the Future Healthcare Journal and a clinical dietitian, agrees: “Digital health can supplement and enrich decision-making but it isn’t a silver bullet. Clinical decision-making is multifactorial, often with clinicians of different specialities working together to deliver patient care.”

Although trust and accuracy have been problems for various symptom checking apps, Ada acknowledges that it offers a “probabilistic assessment of possible causes for symptoms”, rather than definitive diagnoses.

Ada’s Swahili language app was built in a year by a 250-strong team, including 60 doctors, which prioritised diseases prevalent in east Africa such as malaria. While donors such as the Bill & Melinda Gates Foundation have financed Ada Health, the company also runs a for-profit model and has raised $69.3m from investors since 2011.

Replacing doctors is not Ada’s intention — instead it says it wants to facilitate interaction between users and healthcare experts while deterring unnecessary clinic visits by providing health information via smartphones.

Visram agrees that Ada can relieve pressure on Tanzania’s healthcare system by educating and triaging patients, but adds that training doctors and building hospitals must follow so that tech can be harnessed to improve health results.

Peppin concurs: “Unless tech is integrated with existing physical systems there’s a risk of creating serious health burdens and stretching existing infrastructure.”

PHOTO: ALAMY

CASE STUDY

Waiting in line
Patients queue at a Tanzanian hospital. Ada Health’s symptom checker can only be used by the minority who have access to a smartphone. 

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Having your first child is a daunting prospect for any expectant parent, but it is much harder without easy access to reliable healthcare information. What immunisations should your child receive? What should you eat during pregnancy? How do you tell if something is wrong?

In South Africa, a free messaging service partly run on artificial intelligence offers pregnant women a direct link to healthcare providers. MomConnect, which operates using WhatsApp and free text messages, reminds women to attend their antenatal appointments, guides them through what to expect at each stage of their pregnancy and encourages them to adopt healthy behaviours.

For every 100,000 live births in South Africa, 119 women die — below the global average of 211, according to the UN children’s agency Unicef, but triple the country’s target of 38.

Debbie Rogers, managing director at the Praekelt Foundation, an African non-profit organisation that designed the app, says roughly two-thirds of all pregnant women in South Africa sign up for MomConnect at their first antenatal appointment. Run by South Africa’s department of health, the service has been adopted by 3m women.

Recalling the scramble in 2014 to get MomConnect up and running from scratch in seven months, Rogers says: “Some people thought it was crazy when the department of health put a call out [to the mobile health sector] to launch a digital national pregnancy register.”

The programme has since been replicated in Uganda through a Unicef programme called FamilyConnect. The
Praekelt Foundation also has plans to launch in Malawi and the Democratic Republic of Congo.

The Praekelt Foundation also worked with the department of health to produce a Covid-19 messaging platform based on the same technology, which has more than 2m users. The foundation is planning to launch a similar service that will prompt stable HIV and diabetes patients to obtain their medication.

“MomConnect created another layer of community participation in strengthening health systems, generating data which has informed training programmes for healthcare providers,” says Maurice Sayinzoga of the Digital Impact Alliance, a digital technology group that examined MomConnect’s effectiveness as a mobile messaging platform.

“When dealing with any health communication system, the privacy of the patient’s data and its appropriate use is of paramount importance. The choice of WhatsApp when they expanded the tool to include an internet-based messaging application was, in large part, motivated by the fact that WhatsApp uses end-to-end encryption,” he says.

The MomConnect information transfer goes both ways — mothers learn from the app, and the department of health gains valuable data about what pregnant women want. Feedback from women is used to improve the quality of care at individual clinics, and they can ask questions about their pregnancy.

Pertunia Matsemela, 25, from Burgersfort in Limpopo province, signed up for MomConnect during her second pregnancy. She liked the idea but felt the registration process could be improved. She received messages at the wrong times after being registered with an incorrect due date. “But it could be useful if it teaches us to be healthier, to bond with our babies, and how to deal with pregnancy hormones,” she says.

To cope with the hundreds of questions received each day, Praekelt has experimented with AI to speed up response times. An algorithm triages the requests and suggests responses to frequently asked questions for staff to approve or correct.

The service is not fully automated due to caution around misinterpreting a user’s health concerns. South Africa has 11 national languages, and WhatsApp only supports English and Afrikaans, so providing quick responses in multiple languages remains a challenge.

Two years ago the South African government took over the day-to-day funding of MomConnect from donors, which included USAID, the US development agency, and Johnson & Johnson, the medical device maker.

Peter Barron, former technical assistant to South Africa’s department of health, estimates the MomConnect programme costs $750,000 a year to run, but hopes this figure will fall as more women switch to WhatsApp, with donors picking up any extra innovation costs.

“Funders are terrified that a project is going to end when they can no longer fund it. That was our experience when we tried to do a similar project in Nigeria,” says Rogers. “But it’s not been the case here.”
Caring over the airwaves

Call for Life's system automatically phones HIV patients to check their welfare. By Federica Cocco

When Dr Rosalind Parkes-Ratanshi started a new job in 2012 at a clinic in Uganda's capital Kampala, the staff were swamped by 400 HIV patients a day. Many were visiting to collect medication and figured that since they were there, why not see the doctor? With as few as six doctors on duty, the situation was unsustainable.

To thin the queue, staff established a system of digital medical records that can redirect patients to pharmacies or community drug distribution groups. “We leapfrogged from paper to electronic prescriptions,” says Parkes-Ratanshi, who now directs the academy of health innovation at Uganda's Institute of Infectious Diseases.

Aided by another digital system known as Call for Life, developed by Janssen, Johnson & Johnson's pharmaceutical arm, the number of daily visitors fell to 120. Call for Life was developed to monitor low-income patients who were prescribed new drugs. “It’s an online platform that we provide with a free licence,” says Theresa Pattery, disease management programme leader at Johnson & Johnson.

Patients receive daily automated calls. “Hello friend," a soothing voice says as it greets any one of 3,500 patients on their mobile phones. “How are you today? Have you taken your medication?” The patients press 1 if they have and 2 if they have not.

“Would you like to report any symptoms?” the voice continues, as the information is translated into anonymised clinical data and sent to the clinic’s medical records management system. If disturbing data is flagged, the patient receives a call and is asked to come in for assessment.

Johnson & Johnson does not have access to the data. “We have a hands-off approach,” says Pattery. “That’s one of the goals of sustainability: in the country, they should be able to support themselves and expand it further. With us managing everything, that wouldn't happen.”

For the patients, the call is not over. They can request health tips from an archive of 500 options, ranging from general health and information about HIV drugs to sexual health and advice for new mothers.

Many patients report feeling comforted by the calming voice on the phone — offered in five languages — and the routine check-up. But others, particularly younger patients, can be more resistant.

“Young people are a big worry — adolescent engagement is different, you can’t use the same tech as with the older population. They are less tolerant when the calls break up and are also not as rigorous at taking their medications regularly,” Parkes-Ratanshi says.

Yet doing so means patients can keep their sexual partners healthy and save lives. Pattery explains: “If you are taking your medication and your virus is completely suppressed, you would not transmit the infection to another person, thereby preventing new infections.”

This is a particular concern in the Kalangala islands in Lake Victoria, the next target of an intervention from Johnson & Johnson. The team is developing a drone system to deliver antiretroviral drugs to the fishing communities of the islands, who suffer from the highest HIV infection rates in the country: 30 per cent of new infections compared with the mainland’s 6 per cent.

Call for Life is also being deployed with tuberculosis patients and has been adapted to help locate incoming travellers who may have Covid-19. At first, the ministry of health sent out a nurse to monitor people in their homes for 14 days, which was expensive and logistically challenging. It also endangered the nurses’ health.

Using Call for Life meant returning travellers could receive phone calls asking: “This is a message from the ministry of health. Do you have a cough? Do you have a fever? Are you suffering from shortness of breath? Do you have a sore throat?” Positive responses are flagged, and a medical worker is sent to swab the patient. If recipients answer no to all questions, the voice responds: “OK. Thank you so much. Please stay in self isolation, we will call you tomorrow.”

Patients report feeling comforted by the calming automated voice on the phone
Madagascar benefits from internet speeds that are typical of Europe rather than Africa thanks to its location near a sub-sea cable connection.
The race to fill the not spots

As Africa waits for improvements to its poor network coverage, resourceful medical services are using 3G and even 2G signals. By Nic Fildes
Two years ago, the small township of Mthatha in South Africa’s Eastern Cape province was the site of a communications breakthrough. An expectant mother had visited a midwife in a local community centre with concerns that she was too large to be only seven months pregnant.

Using a satellite link that had been established to highlight the need for better communications infrastructure, a paediatrician in a hospital in the city of East London, more than 200km away, was able to tell the expectant mother that she was going to have twins.

Also in the room that day was Kyle Whitehill, who recalls a euphoric atmosphere. “I was hugging people I’d never met,” he says. “It was extraordinary.”

At the time, Whitehill was chief executive of Africa’s Liquid Telecom and had high hopes that the event would demonstrate the need for infrastructure investment in a part of the country that lacks a fibre backbone for fast internet and mobile services.

Two years later, there has been little progress in delivering on the promise of that one successful call.

Whitehill, now running British satellite company Avanti, which beams all over Africa, says the economics of rolling out connections to the most rural parts of the continent presents a hefty challenge for the hopes of many in the telemedicine world. “If mobile can’t do it then you have got a big problem. It is not going to happen based on terrestrial networks,” he says.

Data compiled by M-Lab, an open source project backed by Google and various universities, shows that Madagascar is the only African country with broadband speeds anywhere close to those available in Europe and Asia, as a submarine cable lands on the island.

Most other African nations rely on 3G and 4G signals, or long-distance WiFi technology Wi-Max. Six of the 40 African countries included in the M-Lab data connect at average speeds of less than 1 Mbps compared with 54 Mbps in the UK.

One of the biggest selling points of 5G networks three years ago was the potential of the new wireless standard to revolutionise the world of medicine.

Ericsson, the Swedish telecoms equipment maker, collaborated with King’s College London to describe a world going well beyond the realm of remote diagnosis — as was seen in Mthatha — to one of robotic surgery where doctors could perform operations on patients in the next room or hundreds of miles away over 5G networks.

Diagnosis could also be enhanced with 3D CAT scans sent across the world for analysis in a way that is not possible over existing wireless networks. Ericsson and the university demonstrated a “haptic feedback glove” that, alongside a virtual reality headset, would allow a surgeon to operate on an external patient using robots.

Such technology cannot be delivered over connections of less than 1 Mbps.

Outside wealthy cities such as Johannesburg, Whitehill says many African governments are unlikely to spend the hundreds of millions of dollars needed to fill such gaps. Using satellite services. “Connectivity is the right thing to do but if the mobile operators stop rolling out [to very rural areas] then it is hard yards as the economics don’t work,” he says.

Michele Mackenzie, analyst with the consultancy Analysys Mason, says that the vision of the medical and technology industries often runs ahead of what is deliverable over existing networks. “A few years ago there was huge hype around telehealth solving everyone’s problems in the developed and developing world. It hasn’t happened,” she says.

Slow connection speeds and “not spots” — areas devoid of mobile coverage — are significant barriers for telehealth in the developing world. Regulation and problems transporting data over wireless networks designed for public use also pose problems. “Who is responsible if it goes wrong? Most operators will not want to go there,” Mackenzie says.

There is an added complication with the quality of the network and the device being used. If a doctor is trying to diagnose whether a blemish is a skin cancer, the image must be high-quality, she says.

Satellite coverage across the continent would cost governments tens of millions of dollars.
Initiatives such as Project Loon, Google’s plan to beam high-speed internet signals to Africa’s “not spots” via hot air balloons, aim to fill in the gaps in connectivity that could solve many of the continent’s problems. Kenya recently approved a plan to allow the launch of the balloons to help combat the spread of coronavirus.

Satellite coverage across the continent can reach certain areas but would cost governments tens of millions of dollars. Alternatively, a new wireless technology called SpaceMobile promises to connect low-earth orbiting satellites to mobile phones rather than bespoke terminals.

Abel Avellan, chairman and chief executive of AST & Science, which has raised $128m to develop the technology, says the satellite system could fill the gaps in existing mobile networks but have a deeper impact in remote areas. “It will also help the world’s most underserved communities to access the latest mobile services much sooner than predicted,” he says.

In some remote areas there are those who argue that existing 2G and 3G services can have a meaningful impact with the right backing and approach. Mezzanine Ware, a South African technology start-up, uses existing networks to provide mobile services tailored for sub-Saharan markets. Those include phone-based registration of caregivers and vaccination data, as well as tracking stocks of medical supplies. Other initiatives include the monitoring of population movements using basic location data, which are analysed alongside health data and used to combat the spread of diseases such as Ebola and malaria.

Another idea was inspired by the British television show *Embarrassing Bodies*. Vodafone Ghana launched a programme featuring doctors answering questions on screen that became a top three show in the west African country. Andrew Dunnett, head of Vodafone’s charitable foundation, says that the use of what developed nations now consider to be basic communications services — such as texting and money transfers — can have a profound effect in parts of Africa. M-Mama, a decade-old programme, uses M-Pesa, Vodafone’s basic mobile money transfer service, to fund bus tickets for the transport of fistula-suffering women in rural Tanzania to Dar es Salaam for treatment. It was expanded five years ago to pay for taxis to local hospitals.

Backed by $15m from USAID, the US development agency, the programme has helped more than 8,000 women in the rural lake zone of the east African country since 2015, and has been expanded to Lesotho and Ghana.

The contrast between the quasi-ambulance service using local taxis and the vision of the “smart ambulance” that was presented by British telecoms companies launching 5G services could not be starker. In that yet to be fulfilled vision, the ambulances are equipped with video conferencing services to connect to doctors in the hospital as well as 5G tablets and high-end imaging equipment.

Dunnett says that the existing infrastructure can make a huge difference. “The simpler the application, the more meaningful it can be in terms of lives saved.”
S

tarting their period can come as a shock for girls in the developing world; many are so ill-informed that they fear they are dying.

“If you’ve never been told about menstruation, you think the worst,” says Gerda Binder, regional gender adviser for east Asia and Pacific at Unicef, the UN agency for children. “Girls in these regions...find it particularly hard to know who to go to for support and advice, the subject is surrounded by so much secrecy and taboo.”

Rose Caldwell, chief executive of the UK arm of Plan International, the global charity for children’s rights and girls’ equality, agrees: “The stigma and shame that often surround menstruation are both a cause and consequence of gender inequality. Worldwide, girls are missing out on school because of their period; in rural India, for example, 20 per cent of girls leave school after they get their first period.”

These fears may soon be assuaged in Mongolia and Indonesia by a Unicef app — Oky — which helps educate girls about their bodies and understand their symptoms. The app includes a predictive algorithm for tracking periods, a visual data summary and a searchable repository of girl-friendly, evidence-based information on topics such as period hygiene, puberty and myths.

Designed to be simple to use, Oky has a game-like feel. “It provides a daily diary where girls can use emojis to log their moods, body symptoms and activity,” says Binder. This might include whether they socialised, exercised and what they ate. “Girls can also write this up in a more personal way as if it was their diary,” Binder adds.

Oky was developed and tested in collaboration with 400 girls in Mongolia and Indonesia, both remotely and in face-to-face workshops. The pilot showed that girls have less experience of digital devices than boys — navigating an app and swiping are not second nature for them, says Binder. “They learnt how to follow a menu bar, but you couldn’t assume they already knew this.”

Oky takes up minimal storage space as girls in developing countries typically have low-end phones with little room for large apps. It also works offline, because internet connectivity can be poor and data costs prohibitive. Phones are often shared, so password protection is essential, while personal information remains in the girls’ private accounts on the phone.

Unicef collects anonymised data to track how often and for how long the girls use the app and whether they improve at answering quiz questions.

The app will increase knowledge about menstrual patterns, says Binder, adding: “There is scope to inform the public health and commercial sectors about what support is needed and how policies, products and services should be shaped.”

Oky is targeted at girls aged nine to 15, and can be accessed without signing up — a feature aimed at providing general information for fathers and brothers, Binder says. "We hear a lot about boys and men wanting to understand more about what is still too much of a secret, so that they can provide more support."

Among the social taboos girls face are that menstruation is dirty, impure and that women should live outside the family home for five days (Nepal), and should not go out (Philippines). In Cambodia it is customary to keep the first sanitary pad, and in Indonesia girls are told not to
eat pineapple, eggs, peanuts, beansprouts and sweet, sour or spicy food. One 14-year-old was told that while on her period she should not pray, fast or wash her hair.

Some girls who have helped test Oky have reported realising that periods are normal and losing their sense of shame about menstruation.

Binder says that girls have suggested enhancements for the app including suggestions on what kind of clothes to wear and what food and drinks to consume during their periods. Another potential addition is a chatbot to provide personalised advice in response to questions on intimate topics. “The chatbot would be like a private conversation, using AI to help it understand what girls are asking,” says Binder.

Oky will be free to download on Google Play and users will not require an email address. Coronavirus pending, the launch is scheduled for May 28 on Menstrual Hygiene Day, a global initiative aimed at raising awareness and changing negative social attitudes towards periods.

Unicef hopes commercial, non-profit and public sector partners will develop Oky in countries such as Kenya, Tajikistan, Brazil and Pakistan, possibly alongside programmes on health, education, water and sanitation.

Oky is written in open source software so that it can easily be adapted and integrated with other apps.

“Menstrual health, education and dignity are critical if girls around the world are to live their lives and attend school without shame or insult,” says Caldwell. “We must end the stigma and taboo around periods, and ensure girls have the information they need to feel in control of their own bodies. This app should make a welcome contribution to both of these areas.”
Gulf war syndrome was once blamed on the methanol produced when aspartame — an artificial sweetener found in a number of fizzy drinks popular with US troops — is heated past 29.5°C. The theory, thought to be behind the spike in medically unexplained illnesses among returning veterans, was soon debunked.

But while it might not matter whether a bottle of Coca-Cola warms up en route from the factory, precision is critical when transporting vaccines.

Most vaccines must be kept between 2°C and 8°C to remain potent, “but the bigger risk right now is freezing”, says Ben Hubbard, chief executive and cofounder of Parsyl, a software company that monitors how sensitive goods are moved and stored in order to suggest improvements to supply chains.

It was while Hubbard was working for USAID, the US development agency, in sub-Saharan Africa that the idea for Parsyl was born. “We were moving billions of dollars of essential medical supplies and we always struggled with this question around quality,” he says. According to a 2018 review by the journal Vaccine, 37 per cent of vaccines in low income countries are exposed to temperatures below recommended ranges during storage.

The Denver-based software group places wireless sensors inside refrigerators that carry vaccines from the manufacturer to health facilities in the developing world. Temperature and humidity information is then integrated with other data sets — such as weather and shipping information — to provide two kinds of insights.

“There’s the backward-looking one — what happened to a fridge that registered a drop in temperature, how
bad was it, when did it happen?” says Hubbard. “Then there are the forward-looking insights. What can the data we’ve collected on previous shipments and storage locations tell us about the relative risk from a spoilage standpoint...or the relative risk of different shipping lanes and so on.”

The group can also simulate potential improvements, which Hubbard says “ultimately makes more vaccines available and saves resources”.

The benefits of expanding global vaccination coverage can be measured in financial terms. A 2019 study by Johns Hopkins University found that across 73 countries, every dollar spent on vaccinating a child saved $21 in healthcare costs, lost wages and lost productivity due to illness or death.

Since 2018, Parsyl has been working with Gavi, a non-profit organisation that raises money to immunise children in poor countries, to shine a light on vaccine — or “cold” — supply chains in Uganda and Senegal. In the past 16 months, Parsyl says it has collected more than 15m data points across both countries, and its work is bearing fruit.

“It used to be that a nurse in a facility in rural Uganda would have to check five fridges, three times a day,” says Shamit Shah, chief executive of Freight in Time, an east African delivery company that partnered with Parsyl in 2018. “Now, all of that information is recorded and sent to the nurse automatically via Bluetooth, meaning he or she has more time to actually do their job.”

“The ministry of health in Senegal is finding [Parsyl’s technology] incredibly important — having that data to hand is giving them a lot more confidence that they are managing their supply chain well,” says Seb Meaney, head of UK strategy in resource mobilisation and innovative finance at Gavi. Parsyl covers 55 per cent of Senegal’s healthcare supply chain system and has been given the green light to expand.

The company’s work has taken on even greater significance given the outbreak of Covid-19, as testing kits that rely on temperature-sensitive reagents are in short supply across Africa.

Also of concern is what effect an outbreak would have on existing vaccination programmes. “The last thing we want is to have an outbreak of a vaccine-preventable disease on top of a Covid-19 outbreak,” says Hubbard. “So to some extent it’s heads down and keep doing what we’re doing.”

“The more we are equipping countries with data to make improvements now, the more robust they’ll be to handle a Covid-19 vaccine when it becomes available, or a malaria vaccine, or an Ebola vaccine.”

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1 A temperature sensor in a basket of vaccines
2 Data collated by Parsyl can be used to assess the relative risk of different shipping lanes
3 Most vaccines must be kept between 2C and 8C to work
4 Parsyl works with non-profits that vaccinate children in poorer countries including Senegal

‘A nurse in rural Uganda who had to check five fridges, three times a day, now receives the readings via Bluetooth’
Fixing the system

Can technology help to make healthcare universal in low-income countries?
By Chelsea Bruce-Lockhart and Chris Campbell

How health funding affects life expectancy

Healthcare in developing countries is far from being universally accessible. Healthcare spending by governments in low-income countries was just $23 per person in 2016, even after adjusting for the relative cost of living, compared with more than $4,000 in OECD member states.

A lack of funding results in a shortage of resources, while doctors are stretched to meet the needs of a large number of patients. In many countries of sub-Saharan Africa there is not even one doctor for every 10,000 patients; in the UK, there are 28.

“There can be a lot of challenges with getting highly trained [medical] people into rural settings,” says Gina Lagomarsino, president and chief executive of Results for Development, a non-profit organisation. “Most want to be in a big city where their kids can go to a good school.”

Technology can help reduce the pressure on doctors and free up resources. Medical call centres, for example, have taken advantage of the fourfold increase in mobile phone subscriptions in developing countries over the past decade and a half. Patients speak to an operator with basic clinical training, who is supported by an AI decision-making system. If the case is urgent or complex, the individual can be directed to the relevant facility. Otherwise, the call centres can recommend basic treatments which can be accessed at home or a pharmacy.

This approach was adopted by Babylon when setting up health services in Rwanda, in partnership with the government. Babylon’s call centres in Kigali deal with 3,000 patients a day, and while its workers are based in the capital, 70 per cent of its users are outside the city.

Tracey McNeil, Babylon’s vice-president of clinical governance, says healthcare capacity has been increased by “shifting to triage being done by machine learning, by chatbots”. But countries with low doctor-to-patient ratios also have poor mobile phone penetration because devices and mobile data remain unaffordable for many.

In these circumstances patients can be connected via a community health worker. Symptoms and readings such as blood pressure and temperature can be shared electronically with a doctor for a diagnosis. In simple cases, AI systems can make these diagnoses without further intervention, and medication can be dispensed locally. As McNeil puts it: “You’re putting a doctor’s brain into the hands of healthcare workers.”

If these electronic record systems were scaled up and integrated with others to build a complete record of patients and their medical histories, diseases could be more proactively managed at a national level, experts say.

“Suddenly you’re getting real time information on symptoms,” says Lagomarsino. At an aggregated level, this data can highlight flare-ups in infectious diseases such as tuberculosis or respiratory infections, which are still big killers in low-income countries. Treatments can then be better targeted at those in high-risk areas.

Lagomarsino adds: “A strong electronic medical record system is crucial for creating any kind of system of the future for healthcare.”

DATA
People living with stretched health systems also poorly connected

Cost of mobile internet is improving but still unaffordable for many low- and middle-income countries

Cost of 1GB of data as a share of GNI per capita in 2019 (%)

While infectious diseases have been significantly reduced in developing countries in recent years, they are still a big killer

* Equivalent of ‘healthy’ years lost due to illness, disability or premature death. Aggregated DALYs can measure the gap between a country’s actual and ideal health status, where the entire population lives to an advanced age, free of diseases and disability

Source: Alliance for Affordable Internet

Source: World Health Organization
Lessons from South Africa

The country has yet to match its ambition for a data-fed, unified healthcare system with investment in skills and infrastructure. By Malebona Matsoso

While technological advances and mobile phone penetration offer the potential to reduce inequalities and improve health outcomes, South Africa’s approach offers useful lessons for policymakers elsewhere.

Despite great promise, telemedicine projects in the late 1990s failed to improve access to health services for rural communities. One reason was the complexity of trying to merge 14 different manually operated administrations into a unified national health system.

Poor connectivity limited applications to uses, such as teleconferences, rather than functions, such as giving rural radiology services access to urban facilities for interpretation and clinical guidance. Informatics and technology skills were also scarce in the health sector.

The projects were costly but did not deliver an integrated and interoperable national health information system as rapidly or effectively as intended.

South Africa took a first step in 1996 with the District Health Information System. It has since been embedded in health facilities across all provinces for routine data collection, collation, integration, storage, analysis and utilisation for decision making. It is now web-based, which improves data quality and reduces input errors.

There have since been many significant innovations. For example, South Africa has become adept at utilising the GeneXpert test to accelerate the diagnosis of tuberculosis, facilitating rapid collection and collation of results using the cloud. The technology has since served as a platform for diagnosis of other diseases, including Covid-19.

Mobile technology has also helped improve antenatal care. Using text messages, MomConnect (see pages 44-46) allows pregnant women to access maternal health and education services, providing advice and avoiding long waits in clinics. But the journey has not always proved easy, as highlighted by the insufficient integration of different systems. A study in 2011-12 identified 42 disparate health information systems across South Africa. Individual patient data could not be produced nationally because the systems did not interconnect. Files were duplicated, queues were long and administration poor.

There has since been greater focus on the need to synchronise systems. The District Health Barometer has transformed data into usable form, aiding decision making. It has strengthened district-level health planning, informing evidence-based and data-driven health plans.

A plethora of electronic systems flooded the market in recent years, with no easy way for them to function together and no consistency or assurances over security. Although South Africa requires interoperability for such systems, the level of compliance to standards varies in different hospitals, especially where interconnectivity with medical equipment and devices is needed. It is going to take time to achieve full implementation.

Valid, consistent data has also been a concern. Successful implementation only ever remains as good as the user who inputs it and the managers who interpret it. Accurate capture requires understanding of health indicator definitions. Reports submitted from peripheral facilities tended to be overestimated. Prior to the creation of the Health Patient Registration System (HPRS) — designed to improve patient data collection — there were instances of headcounts being duplicated.

One outstanding issue is poor connectivity — health systems need more equitable access to high quality telecoms infrastructure. This has been a particular difficulty in remote areas. People’s technology skills must also be improved.

The next stage is system consolidation using the HPRS as a base to create electronic medical records. Links to laboratory systems will be followed by connecting this data with radiology, pharmacy and clinical information.

Until now, integrated electronic systems have been largely confined to private sector health providers. Those in the public sector have been mainly focused on compliance, although there are initiatives under way to introduce robotics and e-prescriptions. There is potential to do more to monitor stock levels in pharmacies using mobile technology, expand logistics to improve patient care for people on chronic medication, and provide virtual prescriptions and electronic dispensing.

South Africa’s experience shows that digital technology has considerable scope to transform health for the entire population, as long as it is done in close partnership to ensure fairer and co-ordinated access for all.

Malebona Matsoso is a former director-general of health in the South African government
CALL FOR EVIDENCE

The Lancet & Financial Times Commission wants to hear from you.

The Commission Governing health futures 2030: Growing up in a digital world is calling for evidence to explore innovation and examples on the ground that highlight digital transformation, governance, and health, with emphasis on youth populations and low- and middle-income countries (LMICs).

General call for evidence

Digital and data tools and technologies are fundamentally changing approaches to health and design of health systems. We want to hear from you about how digital technologies and AI are transforming our lives and our health futures.

Areas of interest for the Commission include, but are not limited to, the following:

• Benefits of the digital transformation of health, through AI, machine learning, genomics, and other means, in private and public sector contexts, particularly in LMICs
• Evidence on how digital technologies can support health promotion and community participation, particularly in LMICs
• Evidence of how children and young people are considered in the design and delivery of digital health technologies, particularly in LMICs
• Examples of digital health and AI interventions supporting health workers, particularly in LMICs
• Evidence of barriers to digital health literacy, and what’s being introduced to overcome these, with emphasis on efforts to improve digital health literacy amongst youth.

The COVID response

COVID-19 has accelerated this digital transformation, with urgency and a spotlight on global health and big data. The technological responses provided today are dramatically shaping our global landscape in unbeknownst ways, with real-time disease surveillance and data modelling that will influence decision-makers in the midst of a global pandemic. Questions of appropriate governance of these technologies, especially in order to protect human rights and without stymying innovative, life-saving results, are arising.

Areas of interest for the Commission include, but are not limited to, the following:

• Examples of how the public and private sector are working to develop digital health responses to COVID-19
• How private and public sector are partnering for COVID-19, ranging from diagnostics to vaccine response, with consideration of ethical research protocols and flexible IP arrangements
• How tech companies are facing governance and human rights challenges, including data privacy, digital surveillance, misinformation management, and the right to health
• Private sector solutions to breaking data silos and sharing health data as a global public good.

If you can provide us with evidence or examples that seek to address these topics or related topics, please contact us at governinghealthfutures2030@graduateinstitute.ch.
SUPPORTED BY

The Commission is supported by Foundation Botnar, CIFF, and Wellcome Trust. For this publication, we asked them why they support the Commission.

Fondation Botnar

“Digital technology and artificial intelligence provides a significant opportunity for global health and improving the well-being of the next generation; however, this is only possible if critical issues around health data governance are urgently addressed. As part of our mission to build a better future for young people, Fondation Botnar is proud to support this landmark joint Lancet and Financial Times Commission to examine the issues central to this transformation. Through this, we hope we can ensure digital technology aids global health equity, particularly for young people, as we together strive to achieve universal health coverage by 2030.”

CIFF

“During the past few years, recent advancements in technologies have given the development sector opportunities to explore innovative last mile health solutions. Pioneering digital technologies and AI are viewed as some of the most promising opportunities in helping achieve Universal Health Coverage and the Sustainable Development Goals. However, public-private collaboration and standards, including adoption and applicability of digital tools in low- and middle-income countries, need further alignment. Assessing the technology landscape and the potential it has in reducing inequalities whilst providing common guiding principles is essential in pushing forward the global agenda. The Lancet & FT Commission is well placed to achieve these goals.”

Wellcome Trust

“In 2019, we announced our five-year, £200 million commitment to transform how we understand, fund, prevent, and treat anxiety and depression in young people by creating a mental health priority area. Our vision is a world in which one is held back by mental health problems.

Achieving this vision requires us to do things differently, including how we think about the role of digital technologies and health. The Lancet & Financial Times Commission is an exciting opportunity to explore how digital and data tools could be used responsibly to improve health outcomes.

We are pleased to support the Commission and its focus on those furthest behind, especially children and young people from low- and middle-income countries. It is our hope that the work of the Commission will increase our understanding of the global digital health agenda and that its recommendations drive equitable progress.”

Where to find us:

• www.governinghealthfutures2030.org
• @GHFutures2030
• Governing health futures 2030: Growing up in a digital world