Julius Bär

FUTURE HEALTH

SPECIAL REPORT

FOREWORD

By Dr Damien Ng
Next Generation Research Analyst

The healthcare system as we know it today can trace its origins to the beginning of the 20th century. Based predominantly on a sick-care model, the system is essentially one that waits until we have fallen ill before it kicks into action. In other words, acute care sits at the centre of the conventional approach, at the expense of prevention and early intervention. The way medical care is delivered to patients has changed surprisingly little, despite the tremendous progress that has been achieved. The majority of ill people continue to be seen and treated by medical professionals in brick-and-mortar clinics and hospitals.

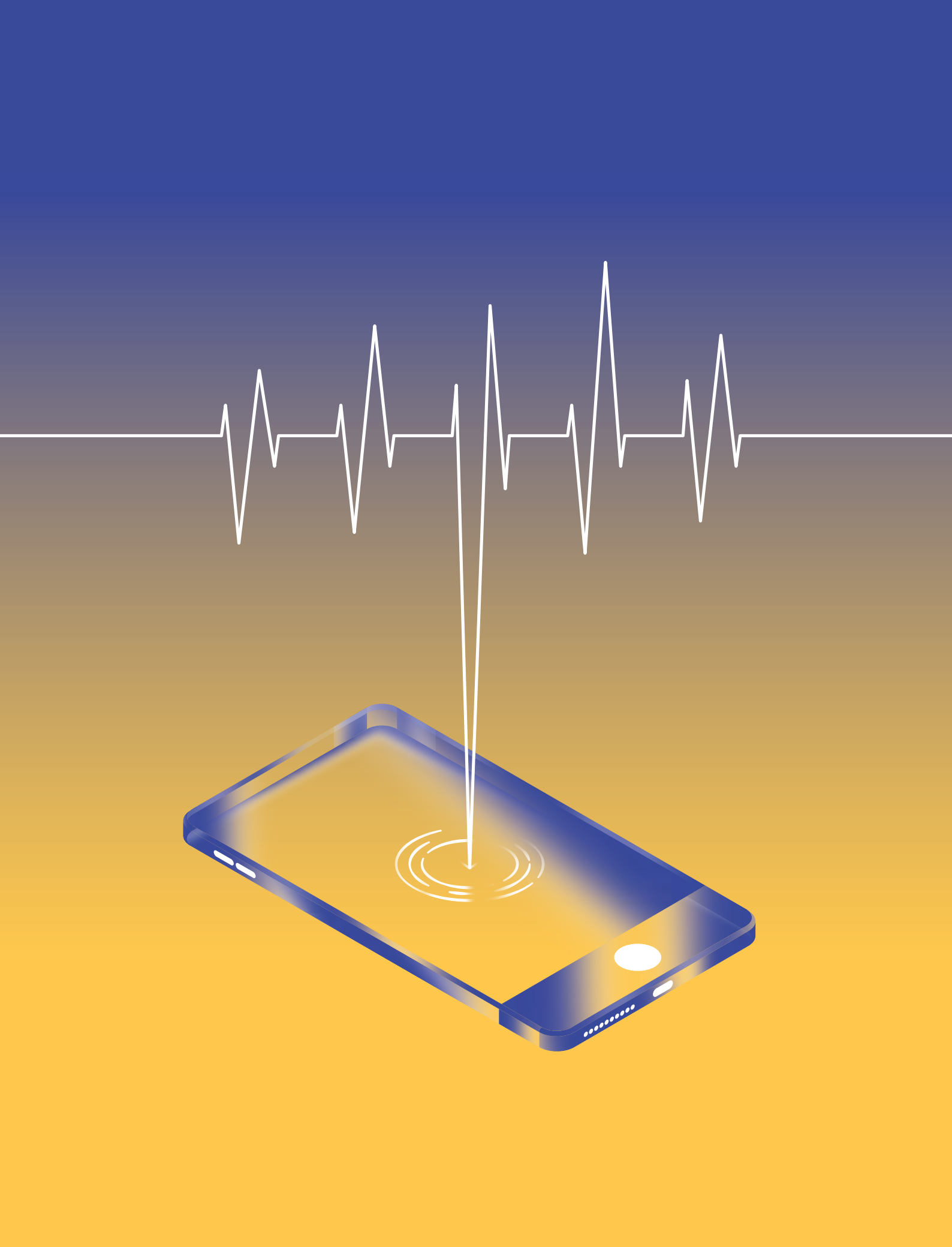
However, healthcare costs have been rapidly rising over the past few decades. This unsustainable increase can be largely attributed to the growth of the human tide in the form of population ageing and a resulting higher incidence of chronic diseases. Together with the advance of rapidly evolving digital technologies and shifting consumer preferences for convenience and affordability, demand for a more efficient delivery model is growing ever louder. One of the major trends presently under way is the transition away from a volume-based care model to a value-based one, in which patients are more likely to receive the best available care from their providers without overpaying. Having an in-depth understanding of the patient through the collection and exchange of data is key for this transition.

The focus of healthcare will gradually shift to a more individual approach. Instead of focusing on sickness, the emphasis will be on the personal experiences and overall well-being of the consumer. This could come in the form of invaluable support for our lifestyle patterns (including eating and sleeping habits) and also more efficient ways to manage all aspects of our health, such as the remote monitoring of blood pressure and the adherence to medication.

Another change will come in the form of genomics. There are still many diseases in the world today that do not have cures. Medical professionals and scientists are increasingly turning to genomics, artificial intelligence, and big data to better predict individuals' risk of contracting certain types of diseases, with the ultimate aim of deriving preventive measures and tailor-made treatments depending on their unique genetic make-up. In the meantime, genomics will also change the way we treat many of these illnesses when they do develop.

With so many new developments in the field and a sharpened focus on the weaknesses of our current healthcare systems following the outbreak of Covid-19, it is clear that the healthcare system of the future needs to look very different from today's approach. The purpose of this report is to explore the ways in which healthcare might change in the coming decades. We start by looking at the situation today before presenting potential routes forward, new technological and medical developments, societal shifts, and the views of industry experts.

Healthcare systems have been slow to change, resisting the disruption that has swept through so many other industries. But now could be the time to accelerate an evolution – if not a revolution – in the way we think about looking after ourselves. So, are you ready for the future of health?



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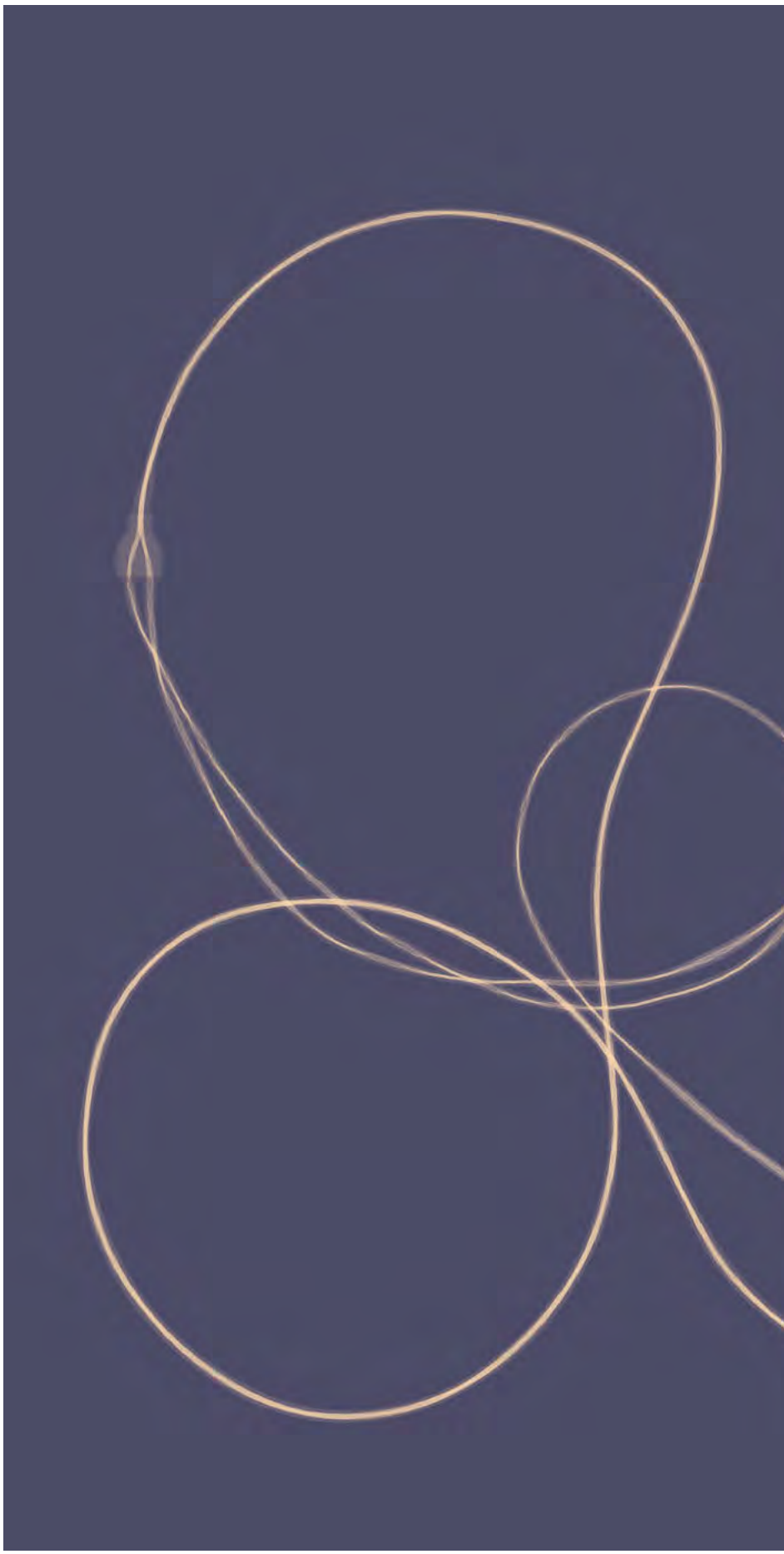
FUTURE HEALTH

By Dr Damien Ng and Emily Rookwood

The Covid-19 pandemic has exposed a number of problems in our healthcare systems that have been bubbling under the surface for years. The good news is that the crisis will help to supercharge the technological progress the industry needs.

> "We are experiencing a perfect storm of outdated, under-resourced infrastructure, and increased demand that has left the failings in our global healthcare systems exposed."



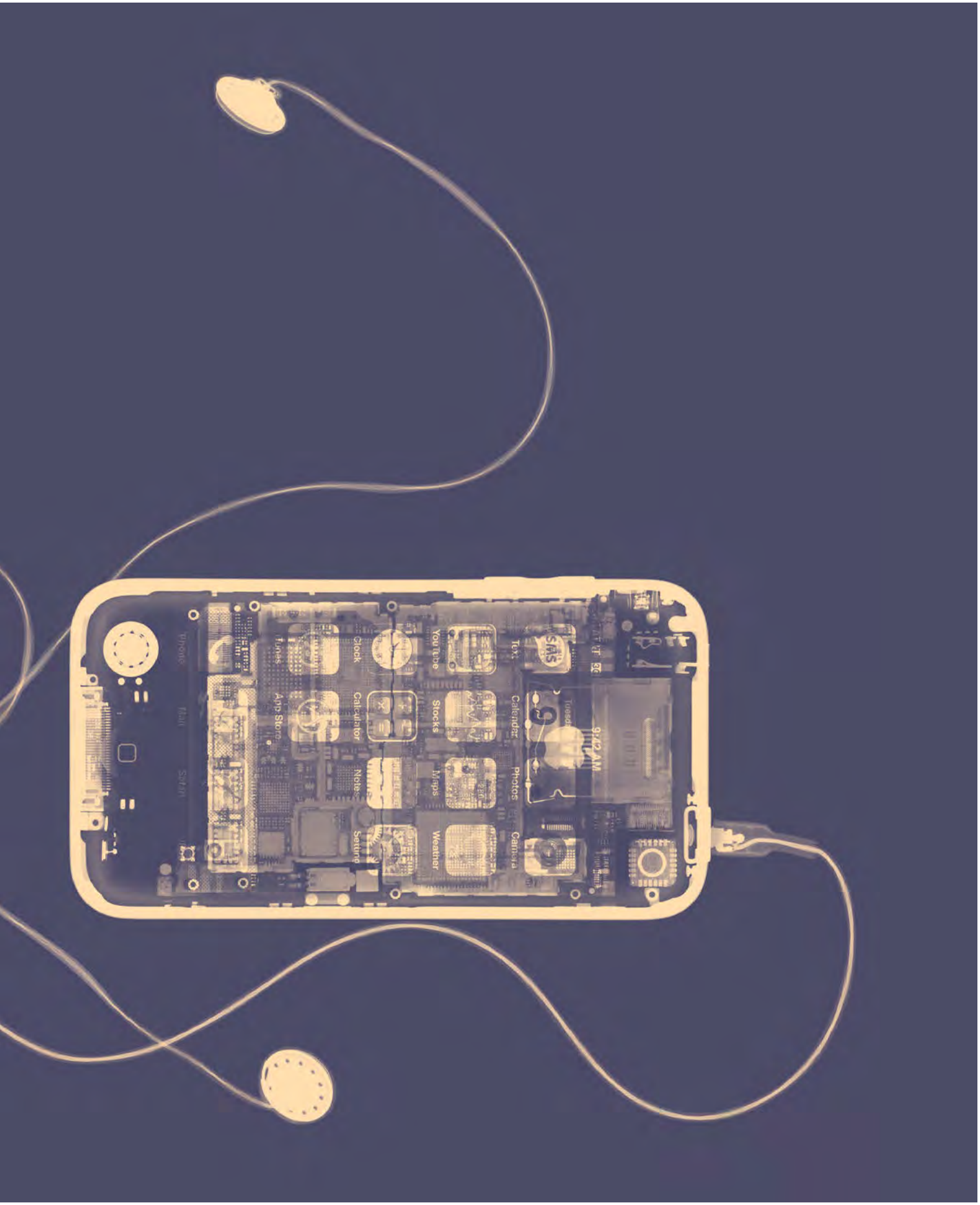
Our healthcare systems have never been in sharper focus than today. Faced with a pandemic on a scale not seen since 1918, medical infrastructure is being pushed to breaking point – and its dedicated staff with it. The signs that our systems are not working as well as they could have been there for decades, but the Covid-19 crisis means it is no longer possible to ignore them.

We are experiencing a perfect storm of outdated, under-resourced infrastructure, and increased demand that has left the failings in our global healthcare systems exposed. This is despite global spending on healthcare increasing at a considerable rate since 1980 because of government policies and lifestyle changes.

There are several reasons why these costs are on the rise. First, life expectancies are increasing all over the world. For the first time in human history, by 2030 the number of people aged 60 and above will surpass those under the age of 10. This global demographic change is putting healthcare systems everywhere under extreme stress as they try to cater to the needs of ageing populations; in the United States, for example, people over 60 account for nearly half the total healthcare costs, despite making up just 22 per cent of patients.

Second, our modern lifestyles have brought about an increase in chronic, non-communicable or 'lifestyle' diseases driven by behaviours such as poor diet, smoking, lack of exercise, and overconsumption of drugs and alcohol. These conditions, once considered diseases of high-income countries, have spread rapidly around the world, correlating strongly with increasing urbanisation and economic development. They have replaced infectious diseases as the leading global causes of death, and the World Health Organization (WHO) estimates that by 2030 total global deaths from non-communicable diseases will reach 52 million a year, exerting extreme pressure on already overworked healthcare systems.

Third, declining fertility rates have led to a shortage of workforce caused by demographic squeeze. This phenomenon has the effect of altering the sustainability of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"Healthcare has improved vastly in the past 50 years, but expectations of what should be provided as standard have increased at a far higher rate."

healthcare systems due to the unbalanced supply and demand of resources in high and middle-income countries. The labour situation is further exacerbated by the waves of baby-boomer healthcare workers who are beginning to retire, intensifying global competition for skilled health workers. According to the WHO there will be a worldwide shortfall of around 18 million health workers by 2030, with deficits already striking particularly hard in low to middle-income economies.

Lastly, our expectations have changed. Healthcare has improved vastly in the past 50 years, but expectations of what should be provided as standard have increased at a far higher rate. As our incomes have increased, we have come to expect an ever-higher level of healthcare – which obviously comes at a cost.

What can be done to improve the situation? Luckily, there are many opportunities and positive developments on the horizon. One of the first areas to consider is the model our healthcare systems run on. In the majority of countries, healthcare is based on the traditional fee-for-service reimbursement model, where the incentives are skewed towards performing procedures rather than making correct diagnoses. However, governments and insurers are increasingly shifting towards an outcome-based model, such as the value-based health care (VBHC) model which is based on the research of Harvard Professor Michael Porter. This model compensates healthcare providers for the health and well-being of their patients, rather than for the services they provide. In a recent study on the adoption of VBHC globally, the Economist Intelligence Unit reported that this model is still in the early stages but countries such as Sweden are starting to align their healthcare with a more outcome-based system.

The Organisation for Economic Co-operation and Development (OECD) and European Commission both produced reports on VBHC in 2019, and consulting groups and medical companies such as Boston Consulting Group (BCG) and Medtronic are highlighting the effectiveness of this new model. One case study by BCG highlighted reductions of up to 30 per cent in unnecessary inpatient stays and up to 74 per cent in the rate of re-operation after complications in breast cancer patients after the hospital group Santeon introduced a VBHC approach.

Another model that could significantly improve availability and efficiency of global healthcare systems, and is currently proving valuable in the battle against coronavirus, is telemedicine. Switzerland began exploring the potential of telemedicine in 2003, and today many health insurers provide telemedicine services as standard.

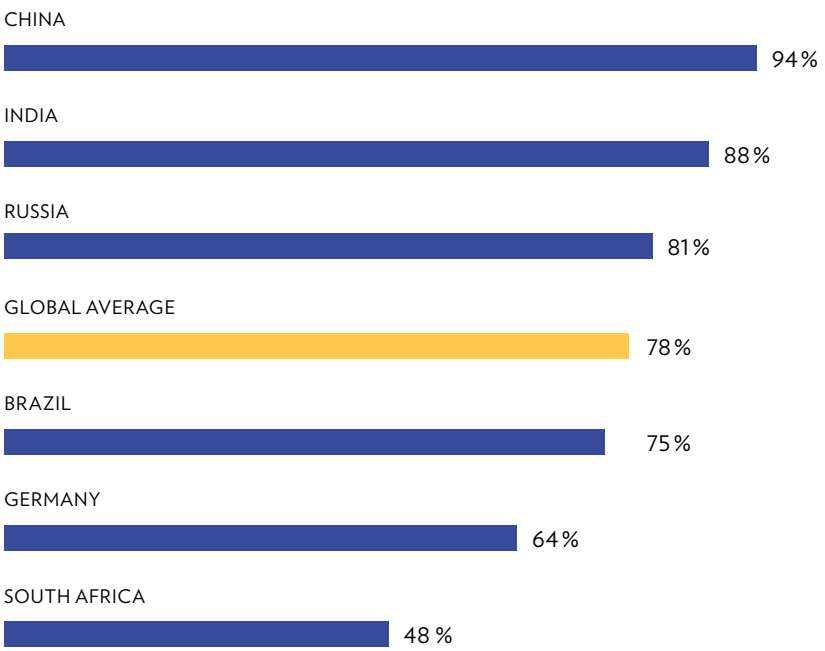
Tests have also begun of video medicine and smart self-measurement devices that patients can use in their own homes. In China, telemedicine has been promoted by the government since 2014, and Ping An's Good Doctor application is now the world's leading online healthcare platform. As well as offering telemedicine, it works with pharmacies and hospitals as a hub for medical services. Although Europe has been slow to adopt such services because of patient and regulatory reticence, the use of telemedicine is increasing: in 2018 the European Commission estimated that the global market would grow to EUR 37 billion by 2021, and the current crisis is likely to accelerate that growth.

Which brings us to the broader topic of technology. New developments could hold the key to many healthcare improvements and offer a number of exciting opportunities for patients and investors, with digital data helping to build robust systems that deliver value-based care. While you might assume that developed countries such as the US, Germany, or the UK might be leading the way, in fact China, India, and Russia are adopting the most revolutionary approach when it comes to incorporating technology into medicine. The 2019 Philips Future

Health Index revealed that 94 per cent of Chinese, 88 per cent of Indian, and 81 per cent of Russian healthcare professionals use some form of digital health technologies or mobile health apps, compared with a global average of 78 per cent. This is compared to 75 per cent in Brazil, 64 per cent in Germany and only 48 per cent in South Africa (see chart below). Following the Covid-19 crisis, the already booming medtech sector has ramped up its developments at a phenomenal pace (read more about telemedicine and the medtech boom on page 10).

These technological developments are not the only positives to look forward to when it comes to future health. Longevity science is becoming a multibillion-dollar industry (see more on page 34) and the breakthroughs coming out of this sector mean that we can live not only longer, but healthier, fuller lives. A boom in life sciences driven by global hubs such as Geneva's Campus Biotech, the European Medicines Agency in Amsterdam, and the Life Sciences Institute in Singapore are exploring myriad ways to improve our health, from AI support for stroke patients to unlocking new developments in genomics.

USE OF HEALTHCARE TECHNOLOGIES BY HEALTHCARE PROFESSIONALS, 2019



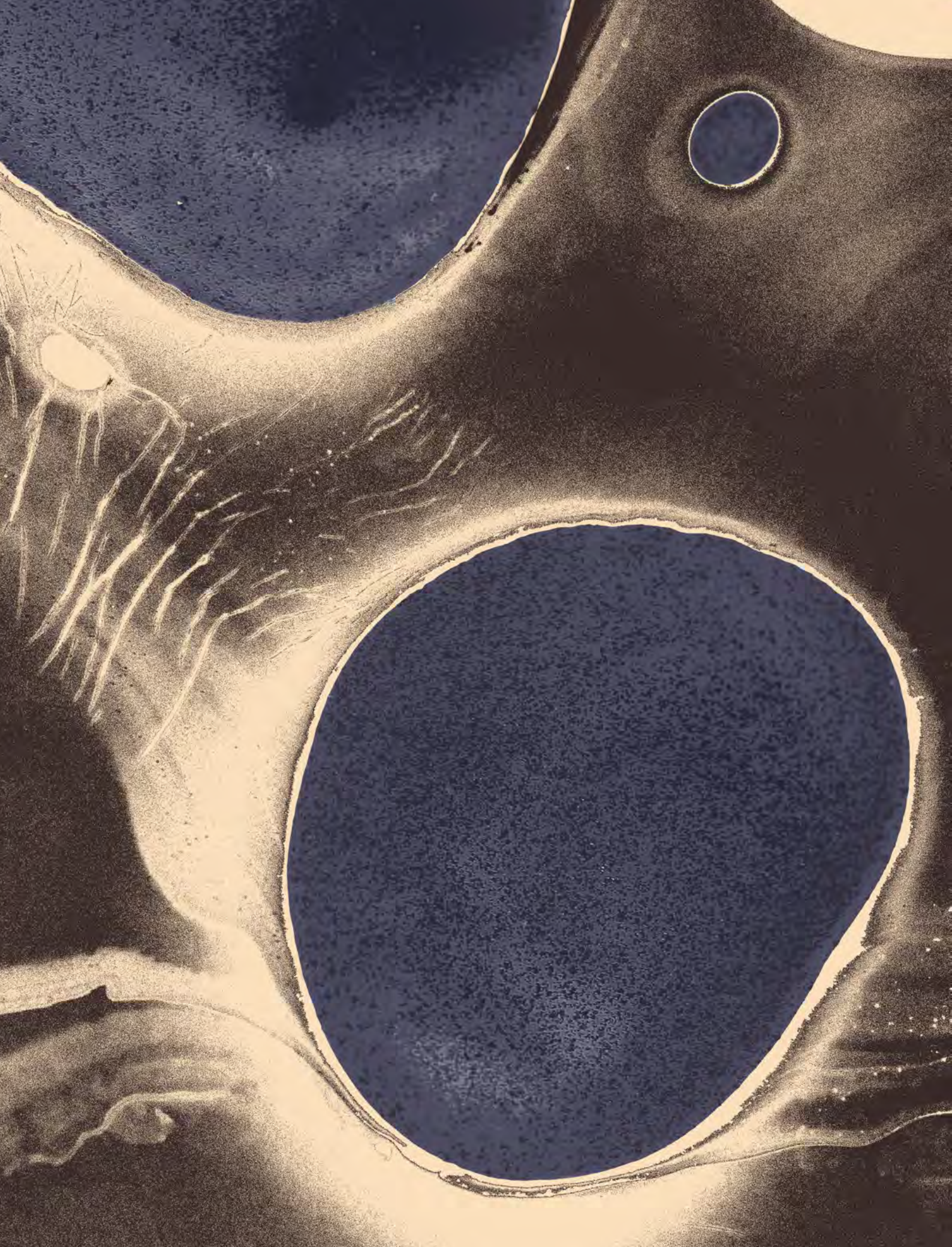
"Switzerland began exploring the potential of telemedicine in 2003, and today many health insurers provide telemedicine services as standard."

On a more personal note, new research showing how good relationships can boost our health is helping to drive a social health revolution. One recent report from Harvard Medical School says: "Social connections…not only give us pleasure, they also influence our long-term health in ways every bit as powerful as adequate sleep, a good diet, and not smoking." Governments, non-profit organisations, and communities are coming together to boost intergenerational exchanges, from nurseries in retirement homes to mentoring schemes for young entrepreneurs run by retired CEOs. Efforts to rebuild the sense of community that had all but disappeared in many areas have doubled since the enforced isolation of the recent pandemic, and have highlighted the medical concerns associated with loneliness. As we look to the future of health and healthcare it is clear to see that we, the community, have a very large and important role to play as we take more responsibility for our wellbeing.

Last, but not least, we turn to the medical profession. The one unequivocal strength of healthcare systems around the world is their staff. The coronavirus outbreak has pushed the profession to its very limits, but day after day, doctors, nurses, porters, and all manner of medical workers are risking their lives to help others. While there are many areas of our systems that need to improve in years to come, one thing that we hope remains a key feature is a dedicated workforce who really put the care in healthcare.

NEXT GENERATION RESEARCH

We are currently experiencing a significant shift in global lifestyles. Around the world people are living longer and the proportion of elderly citizens is increasing year on year. This is having a significant effect on our healthcare systems and how we manage our health on a daily basis. Digital health, longevity, genomics, and global health awareness are all key components of the 'Shifting Lifestyles' megatrend, one of five megatrends currently covered by Julius Baer's Next Generation Investment approach, which identifies the structural trends that will shape the world in the coming years.



GOING VIRAL

The Covid-19 pandemic has fast-forwarded the spread of health tech. Once distinctly different areas – telemedicine, wearables, smartphone apps, and the Internet of Things – are converging to revolutionise the way we think about healthcare.

By John Arlidge

> "The Covid-19 crisis is acting as a catalyst for the whole digital healthcare and telemedicine industry."

Big shocks change things dramatically overnight. Take 9/11. It transformed security, government surveillance, and air travel in a heartbeat. The Covid-19 pandemic is doing the same in health. It has prompted the most rapid and radical innovation in long-distance, tech-based public healthcare the world has ever seen. What tech evangelists have spent years lobbying for has been approved almost overnight, creating unprecedented growth and investment opportunities.

Following the outbreak in the UK, the notoriously slow National Health Service (NHS) chose 11 suppliers to provide video consultations in just 48 hours. More than 7,000 doctors' offices were ordered to conduct as many video and phone consultations as possible. The proportion of NHS healthcare delivered through video calls or text messages increased from a meagre 1 per cent to 5 per cent in a matter of days, according to the Digital Health Council, a trade body. Previously, online consultations were practically non-existent.

Over in the US, health-privacy legislation has been amended to allow companies such as Apple, Google, and Microsoft to facilitate virtual doctors' visits through FaceTime and Skype. Microsoft also plans to launch a new booking tool for hospitals and doctors, who already use its Teams collaboration software to video-call patients. Hospitals everywhere are testing out Microsoft's HoloLens technology to reduce the number of doctors exposed to patients with Covid-19. A doctor wearing the augmented-reality goggles can broadcast images and audio from a patient examination back to colleagues outside the room using the Teams app. This minimises the number of healthcare workers who are exposed, reduces the amount of protective equipment needed, and helps patients get better access to specialists, who can dial in remotely.

The telemedicine revolution has not come a moment too soon. For an industry of its size – global healthcare is worth an estimated USD 11.9 trillion – it has been remarkably slow to exploit new technology. Although some countries have well-established telemedicine services – notably Switzerland and China, where Ping An's Good Doctor offers more than 300 million users access to remote consultations as well as a number of other medical services including appointments, referrals, and prescription delivery – the majority still rely almost exclusively on the medical practice approach. That's largely down to regulation and concerns for patient privacy (see panel). The Covid-19 pandemic has forced governments around the world to rethink radically their approach to telemedicine. It is no longer a 'nice to have', but a 'need to have'.

Med-tech firms can scarcely believe their good fortune. "The Covid-19 crisis is acting as a catalyst for the whole digital healthcare and telemedicine industry," says Luke Buhl-Nielsen, vice president of business development and operations at Kry, a leading telemedicine operator based in Sweden. "Legislation is moving at breakneck speed," adds Joost Bruggeman, co-founder and chief executive of Siilo, a Dutch communications tool for medical professionals. "It usually takes 12-18 months to convince middle management to approve innovations. Right now they're saying, 'Give it to us, we'll figure out the contracts later.'"

Telemedicine isn't simply about real-time interactions. It also includes mHealth, which covers the use of emerging technologies to create a new virtual health space for both patients and telemedicine providers. mHealth taps into the Internet of Things, such as environmental sensors, wearable devices, and mobile apps, for tracking and measuring patients' health and well-being conditions.

This is where the tech giants are trying to get in on the game. Apple has launched Health Kit, which integrates

> "Over in the US, health-privacy legislation has been amended to allow companies such as Apple, Google, and Microsoft to facilitate virtual doctors' visits through FaceTime and Skype."

MOBILE (PHONE) HEALTH

Since the coronavirus first began to spread, smartphones have become vital tools in tracking the spread of the disease. Some developments are aimed at helping individuals to identify first symptoms of the illness. The fertility tracker app Natural Cycles, for example, has added in new vital signs monitoring options. More general apps have been updated to monitor and analyse user behaviour in an attempt to slow the spread of the virus. These range from apps like WeChat and Alipay that now share personal data with the Chinese government, to the use of anonymised mobile data to monitor population movements during containment.

In the short term, these measures are proving invaluable in the fight to contain the pandemic. But there's a big 'but', which Dr Tehilla Shwartz Altshuler, head of the democracy in the information age programme at the Israel Democracy Institute, puts well. "We can use any technology to fight this horrible disease. The question is, who will supervise it and who will promise that after this is over, we won't become a surveillance democracy?"

Privacy advocates worry that the current measures already represent too great an intrusion into our private lives. Hong Kong uses phone apps and smart bracelets that show where citizens and visitors are. Spreadsheets and lists identifying people living in or returning home from Wuhan, the Chinese city where the virus first took hold, have been circulating on social media in China. Singapore's health ministry has posted information online about each coronavirus patient, often in great detail.

Such personal information can have major implications for an individual's safety and economic and social well-being.

"One of the things we have learned over time is that something that seems anonymous, more often than not, is not anonymous, even if it's designed with the best intentions," says Matt Blaze, a professor at Georgetown Law who specialises in computer science and privacy. "It's not to say you should never collect or use data – only that you should be very humble about what assurances you offer about privacy."

The potential and the pitfalls are very well illustrated by the controversy around efforts by Apple and Google to create a Covid-19 track-and-trace app to help to ensure that there is no second spike in infections. The upside is clear. Here are two usually bitter Silicon Valley rivals cooperating with each other for the common good.

However, privacy activists and many of the firms' customers say that plans to share with governments the location and health data the app generates are an unacceptable invasion of privacy. Apple and Google have come down on the side of privacy, which means the app will not be much help in combating a future outbreak.

Health authorities in some US states, as well as in countries such as Canada and Britain, urged the two firms to give them more control over the kinds of information their apps can collect. So far, that has not been forthcoming. Some governments have reacted by trying to create their own apps but the problem is, they don't work very well on Google and Apple handsets because they have not been designed by Google or Apple. And round and round the debate goes.

The key question is: what's more important in an emergency – privacy or the state? It's not an academic question any more. It's a matter of life and death.

"We need to have a discussion on how Silicon Valley is increasingly taking over the job of a nation state," said one German official. "But we don't need to have it amid a pandemic."

data from wearable devices, including the Apple Watch, to enable care teams to spot – or even predict – illness. The latest Apple watches have ECG sensors that can alert users if they have potentially dangerous irregular heart rhythms. The Cupertino giant is also rolling out its Health Records feature, which is designed to make it easier to store and use medical data on iPhones. "If you zoom out into the future, and look back and ask the question 'What was Apple's greatest contribution to mankind?', It will be about health," says the firm's CEO, Tim Cook.

In Seattle, Amazon is working on something inevitably dubbed Amazon Prime health, which will have more of a supporting role for healthcare providers. It starts with Alexa, the firm's voice-controlled virtual assistant. 'She' has begun using US government information to answer health queries. Ask her what your symptoms mean and she'll tell you. She can even call 911 in an emergency. Facebook is trying to do something similar, creating a tool called Preventive Health to encourage users to attend check-ups. Users can book appointments on the Facebook platform and opt to receive personalised preventive healthcare recommendations and check-up reminders, including routine health exams, mammograms, flu shots, and blood pressure screenings.

What other trends are emerging? Remote health monitoring technology for hospitals looks set to boom. Many hospitals, notably in the US, are already using it to treat Covid-19 patients with milder symptoms in their homes. Most are giving patients wearable devices that are worn 24/7 to track vital signs. Artificial intelligence establishes a baseline reading for each patient and data from the wearable is transmitted to the hospital, where doctors can quickly spot anomalies, such as a decrease in oxygen levels.

New tech – and the global race to develop a Covid-19 vaccine – will also accelerate clinical trials, a market that is worth USD 65 billion according to CB Insights. The trial process can take an average of 7.5 years and cost up to USD 2 billion per drug, according to the research firm.

"If you're a physician working on a clinical trial, your experience is probably no different than 20 or 30 years ago," says Gary Hughes, chief executive of Teckro, a software platform that tries to make the process of participating in trials easier for doctors and patients. "It's still a people and paper process." Ireland-based Teckro has raised USD 25 million from investors, including Peter Thiel's Founders Fund. US biotech firm Amgen is using artificial intelligence to improve trial planning so that it does not waste time and money setting them up in places where there will be few participants.

One thing is certain. As telemedicine spreads, we will all spend less time in germ-filled waiting rooms. And even the most confirmed Luddite would agree that is progress.

TECH'S HEALTHY FUTURE

By Rhymer Rigby

Artificial intelligence was already becoming a key part of healthcare in the 21st century even before the Covid-19 pandemic made technological advances more urgent.

The coronavirus pandemic means that healthcare is at the top of everyone's minds. Governments, healthcare providers, and businesses are focusing as never before on doing more, faster, and better. This often means using new technologies, one of which is artificial intelligence.

When we think of artificial intelligence, we tend to think of highly intelligent robots or computers that would pass the Turing test – that is, you cannot distinguish them from a human. This is sometimes called 'Strong AI' and is decades from becoming a reality. The good news is that lesser forms of AI such as machine learning and deep learning are here now and being used in healthcare.

In fact, AI recognised the coronavirus epidemic very early on. The AI platform BlueDot spotted and flagged a cluster of 'unusual pneumonia' cases on 30 December last year, nearly a week before any official announcements were made. BlueDot takes its data from thousands of sources, ranging from airline ticketing to public health announcements. Indeed, this is one place where AI comes to the fore – the ability to take unimaginable amounts of data in different formats.

"Martin Ciupa believes there are four main areas where AI will improve medicine: productivity, quality, personalisation, and discovery."

In the US, a project involving organisations such as Microsoft Research, the National Library of Medicine, and the Allen Institute for AI is under way to mine useful information and gain insights from around 30,000 research papers on the novel coronavirus and its wider family.

Other AI applications are also being mobilised in the fight against the virus. Examples include facial recognition systems that can detect the symptoms of fever, sophisticated monitoring equipment, AI chatbots for online consultations, and software for pandemic modelling. Israeli company Nanox has developed an easily portable digital X-ray system that connects to cloud-based AI to diagnose infections and help prevent future outbreaks.

But what about healthcare more generally? What possibilities does AI hold for a healthier world once we get through the current crisis?

Martin Ciupa is an expert in AI. He is CEO of the start-up Mental Imagery, CTO of Kimbocare, a blockchain-enabled tech platform, and has served as chief AI officer at Mindmaze, a Swiss unicorn that builds intuitive human machine interfaces. Recently, he was also elected leader of the American Association of Precision Medicine's Data Science Coronavirus Taskforce. He believes there are four main areas where AI will improve medicine: productivity, quality, personalisation, and discovery.

The first, productivity, is about making healthcare more efficient. "AI can relieve pressures on healthcare and also augment people, allowing them to do more work in a given day," says Ciupa. This is a potentially huge development. To take the first statement, according to the 'Harvard Business Review', labour is the single biggest cost in US healthcare. Moreover, productivity has been declining for decades and it is estimated that of the USD 3 trillion spent annually on healthcare in the US, a third is wasted.

This wastage is often most visible in areas such as poor bed allocation and other administrative inefficiencies. But it also manifests itself in having expensive people such as doctors doing administrative or mundane medical tasks, the kind of things AI excels at. Use it to replace people and not only do you save money, but also doctors can spend more time with patients.

When it comes to productivity, it is worth remembering that healthcare is very different from other industries. In healthcare systems across the world, demand consistently outstrips supply (or affordable supply). Thus, if you can provide more service for the same expenditure you are likely to have a healthier population, not greater numbers of unemployed doctors or nurses. People will 'consume' more healthcare and the world will be a better, fitter place for it.

The second area is quality. "An example of this is examining X-rays and MRI scans," says Ciupa. "Deep learning is really good at looking at medical images and already performs at similar radiological levels to human experts."

In late 2018, Stanford University announced it had developed a new algorithm that could read chest X-rays as well as radiologists. Crucially, this algorithm was reading them for 14 different pathologies, not just one, representing huge potential efficiency gains. Technology could even lead to digital consultations; med-tech company Babylon has claimed its chatbots can already surpass doctors in terms of the accuracy of diagnosis.

The benefits of automating routine tasks such as initial consultations range from vastly reduced waiting times in the developed world to access to medical services for the first time in the developing world. Huge strides are already being made with telemedicine in Africa.

"AI can relieve pressures on healthcare and also augment people, allowing them to do more work in a given day."

The use of AI to digest huge amounts of data could result in other discoveries too. "There's a trial at London's Moorfields Eye Hospital where AI is being used to look at thousands of eye scans," says Kim Nilsson, CEO of Pivigo, a data science marketplace and training company. The scans are compared and cross-referenced with an individual's medical history to see if they can show that patients are at risk of other conditions. "For instance, does your scan indicate you are at risk of diabetes?"

Nilsson adds that the use of AI to analyse and interpret huge amounts of data will become ever more important as the Internet of Things takes off and smart devices proliferate. With wearables that constantly stream information on your health, people could be monitored in real time and AI could pick up problems such as heart conditions while they are minor and easily treatable – and even before any conditions develop.

While AI can discern patterns in the data of millions of patients, it can also make treatment on an individual basis much more personal. This will result in better outcomes and lower costs because people receive treatment tailored specifically to them. In a recent note, Giulia Besana, an analyst at IDC Health Insights, wrote: "European healthcare providers are betting on AI to support greater personalisation of healthcare services."

What does this mean in practice? "If you think of current healthcare as Healthcare 3.0, it's set up a bit like one of Henry Ford's factories," says Ciupa. "You come into hospital and get on a production line. You are given a standard battery of tests until the hospital discovers what is wrong with you. However, AI will result in Healthcare 4.0. This, like Industry 4.0 more generally, will mean greater automation, cyberphysical systems, data exchange and proliferation of AI."

For patients this will deliver a far more tailored, personalised service from the word go. The business of healthcare will become more efficient, and far more factors will be taken into account during consultation and treatment. "For example, a person who has Alzheimer's may also have depression and anxiety," says Ciupa. "At the moment these often cannot be taken into account when treating it." Nor is it just the obvious stuff. AI might mean tailored, virtual reality physiotherapy, for example. Again, this would be likely to deliver better, faster, and cheaper results.

The last and perhaps most exciting area where AI will be a game-changer is the discovery of new drugs. "Developing a new drug can cost USD 1 billion," says Nilsson. "AI could cut that in half." It can do this in all sorts of ways. The obvious ones, perhaps, are sequencing the DNA or RNA of new viruses and mapping them to suggest which treatments are likely to be most effective. Others include screening and monitoring participants in medical trials.

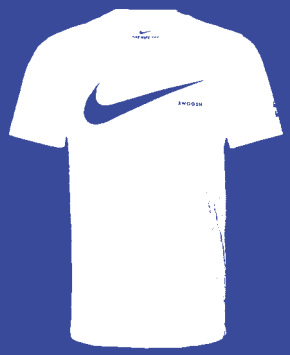
One of the most promising possibilities is repurposing existing drugs to treat new conditions. AI's ability to find needles in haystacks of data is key here. Existing drugs do not need the same sort of clinical trials; their side effects are known, they are already FDA or EMA-approved, and they are cheaper and more efficient. "You might look at an existing drug for arthritis that also has possibilities for treating high blood pressure," says Nilsson.

Ultimately, the future that AI and associated technologies hold for medicine is one of vastly more data and vastly more useful knowledge gleaned from that data. "You will go about your daily business while wearing your watch and your smartphone," says Ciupa. "The data from these devices will allow AI to detect problems and recommend personalised treatments before you know anything is wrong."

You will suffer from fewer illnesses and you will recover quicker. Indeed, some, such as Babylon's Dr Ali Parsa, have predicted that AI and associated technologies will be so revolutionary for healthcare that in a decade or so the issue of funding will no longer be a problem.

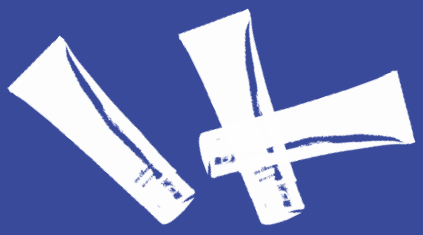
But all this is some way in the future. Right now, all energies are focused on the coronavirus. And here, AI does have an important role to play. It won't stop this pandemic but, by crunching vast amounts of data, it may speed up the race to find a vaccine and help predict future outbreaks.

INNOVATION IN THE TIME OF CORONA



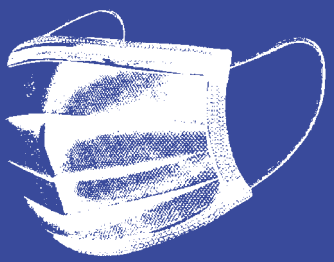
COMPANY Nike, US
PRINCIPAL OUTPUT Sporting goods and clothing manufacturer
PIVOT Repurposing existing elements used to produce Nike trainers to make face shields
PRODUCTION Distributed across Oregon, Massachusetts, Tennessee, Missouri, Ohio, as well as Belgium, Netherlands, China

COMPANY Sharp, Japan
PRINCIPAL OUTPUT Electronics manufacturer
PIVOT Pivoted a TV plant manufacturing LCD display panels to produce face masks for Japanese population
PRODUCTION From 150,000-500,000 a day as production ramps up



COMPANY Beiersdorf, Germany
PRINCIPAL OUTPUT Skincare product manufacture
PIVOT Simultaneously producing medical disinfectants alongside skincare products from brands including Nivea and La Prairie
PRODUCTION 500 tonnes to be distributed across Europe from production sites in Germany and Spain

FACE SHIELD



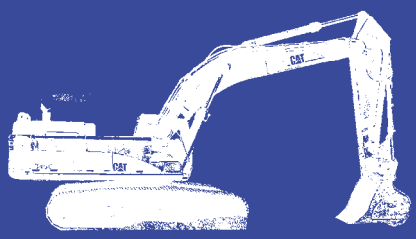
FACE MASK

SANITISER

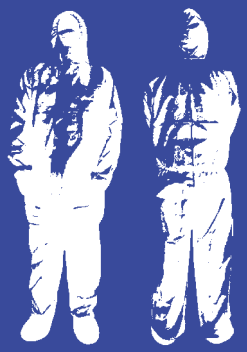
Need is one of the most powerful drivers when it comes to innovation. The urgent need for medical equipment and supplies caused by the Covid-19 pandemic has led to an unprecedented response not only from the medical sector, but also from myriad other industries. From hospitality and motoring to cosmetics and luxury fashion, businesses have come together to bridge the gap between supply and demand in a remarkable show of global solidarity. While hotels and restaurants have been supplying accommodation and meals for medical staff, industries with manufacturing capabilities have transformed their production lines to make medical equipment, such as ventilators and CPAP (continuous positive airway pressure) machines, and PPE (personal protective equipment), including face shields, masks, and gloves. Here we illustrate some of the innovative pivots that companies around the world have made in their drive to contribute towards the relief efforts.

COMPANY Prada, Italy
PRINCIPAL OUTPUT Luxury fashion manufacturer
PIVOT Diverted production to medical overalls and masks for hospitals across Tuscany
PRODUCTION 80,000 medical overalls, 110,000 masks produced at the factory in Perugia

COMPANY LVMH, France
PRINCIPAL OUTPUT Luxury goods conglomerate
PIVOT Perfume production lines of Dior and Guerlain switched to producing hand sanitiser in 72 hours; jeweller Bvlgari turned its factory in Lodi (Italy) from producing perfumes and hotel amenities to hand sanitiser gels
PRODUCTION 12 tonnes of sanitiser to 39 hospitals in France, plus expansive global response; hundreds of thousands of sanitiser gel bottles distributed in Italy and the UK

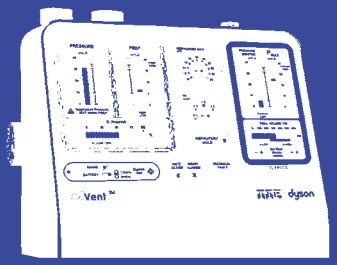


COMPANY JCB, UK
PRINCIPAL OUTPUT Manufacturing equipment including earth excavators and diggers
PIVOT Producing steel casing for emergency CoVent ventilators designed with Dyson
PRODUCTION 10,000 initial order from UK government, now no longer required due to specification changes



MEDICAL OVERALLS

SANITISER



COVENT VENTILATOR

HOME DISPENSARY

By 2023, it is estimated that the global pharmaceutical market will exceed USD 1.5 trillion, with key growth coming from ‘pharmerging’ markets. But medicines are not just mere commodities: they offer an insight into differing behaviours and cultures around the world.

Photos by Gabriele Galimberti

By 2023, it is estimated that the global pharmaceutical market will exceed USD 1.5 trillion, with key growth coming from ‘pharmerging’ markets including the BRIC countries, Mexico, Turkey, Thailand, and South Africa. The higher-income countries, however, maintain the highest per capita consumption of pharmaceuticals, and as new treatments become available this continues to rise: global medicine use has increased by 3 per cent a year since 2014, and by 2019 global defined daily doses stood at 1.822 billion.

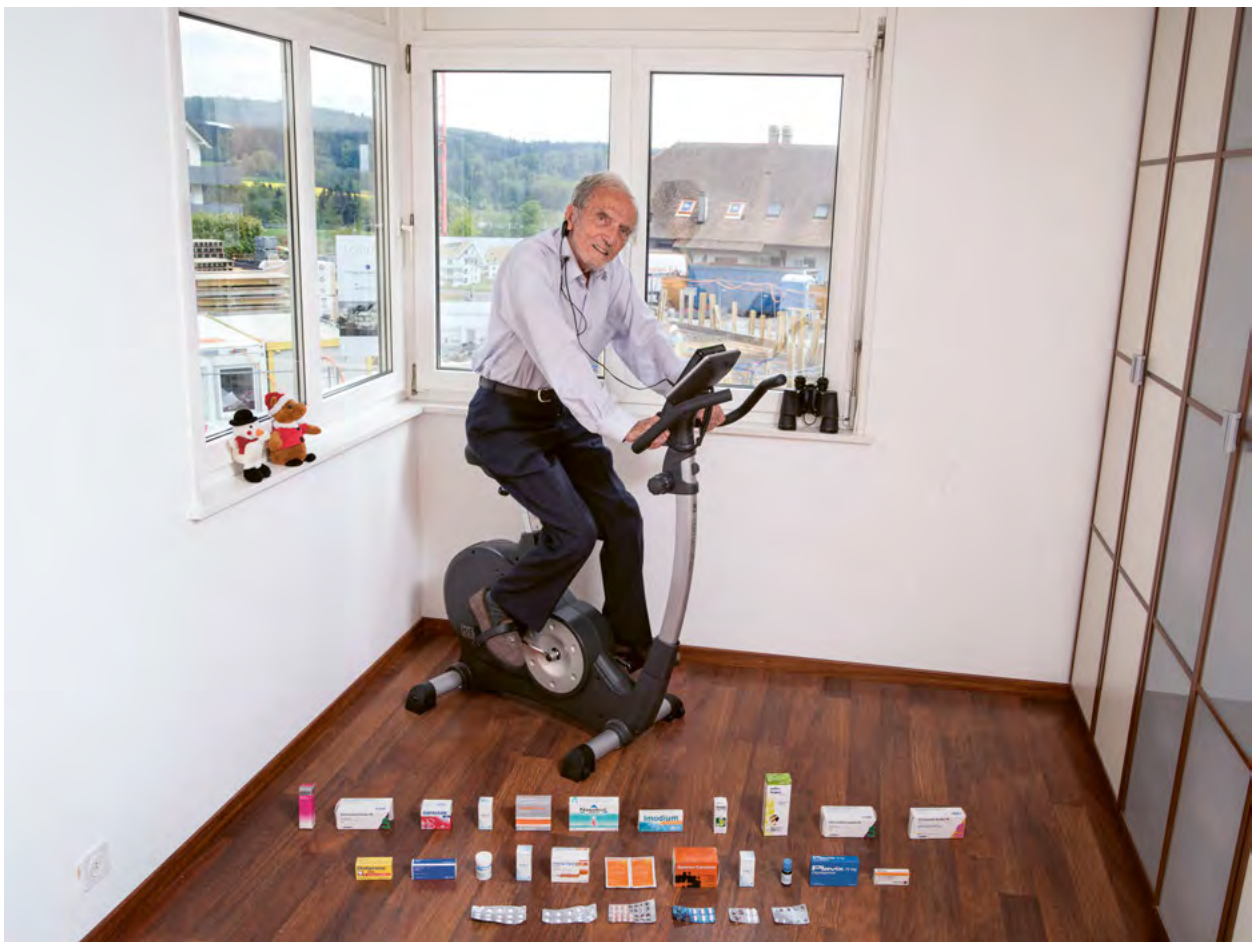
Medicines are not just commodities; they offer an insight into differing behaviours and cultures around the world and speak to wellness and lifestyle trends among the global population. As a much broader approach to health – one that encompasses our diet, fitness, lifestyle, and overall wellness – is increasingly adopted, the use of immune boosting supplements as well as integrated traditional and complementary medicine is on the rise.

Photographer Gabriele Galimberti’s ‘Home Pharma’ series offers intimate portraits of the personal and cultural differences in medicine consumption across the globe, while reinforcing the fact that whatever your approach to health and lifestyle, medicines are a part of everyone’s daily life.

Arnaud Brunel and his wife Candelita in their house in Lausanne, Switzerland. Arnaud is CEO of Tectona. He is also an avid collector of photography and supporter of various photographic institutions. In the photograph, some of the works he owns are visible, including by Richard Avedon, Andres Serrano, and Vik Muniz.

Marco Segato, 47, Vittoria Ruzzi, 30, Gherardo, 4, and Pietro, 1, are Italians but live in a high-end condo in Miami, USA. Marco is an agent for luxury yachts built in Italy, while Vittoria is an architect. They travel, often to exotic destinations, both for pleasure and work. Many of the medicines in their house come from Italy where, in contrast to the USA, there is a single-payer healthcare system.

Susan Fisher, 35, is a yoga teacher and has a popular yoga studio just under her apartment in a trendy area of Zurich, Switzerland. She does not use allopathic medicines, only homeopathic remedies. She also uses Ayahuasca wine, which can be seen in the red jar at the centre of the photo. Ayahuasca is a traditional brew of leaves and roots consumed as a spiritual medicine in ceremonies among the indigenous peoples of the Amazon basin. Its effects include hallucinations, spiritual revelations, and vomiting, considered to be an essential part of the experience as it represents the release of negative energy and emotions. It has become increasingly popular among Westerners.



Henri Caillet, 92, getting some exercise in his home in Bretigny, Switzerland. Henri was a manager in a factory in the German part of Switzerland and a very keen player of pétanque. He is in very good health and does not have many medicines in his home. The only one he regularly uses is syrup for catarrh, since he used to smoke heavily.


scottie

Yasumasa, 70, and his wife Nobuko, 66, in their bedroom. They live in the Honatsugi district of Tokyo, Japan. They are both retired and have two sons, who visit with their families at weekends. Yasumasa has a heart condition, for which he takes multiple daily medicines (seen in the small transparent sachets in the photo). Nobuko takes calcium for osteoporosis and aspirin for her heart.

Noorjaha Sagri, 56, her husband Abbas Ali Sagri, 67, and, from left to right, their children Faisal, 24, Heena, 17 and Rafiq, 22. They live in a one-room flat in the Dharavi slum of Mumbai, India. At night they pull out a mattress and all sleep in one room. The parents do not work, while the children do sporadically and are the only source of income for the family. Abbas has suffered a stroke, so most of the medicines visible are for his use.

Arunas Andriejauskas, 53, and his wife Aliona Andriejauskaite, 52, in their home in Preila, Lithuania. Arunas is an engineer and Aliona teaches science. They deeply believe in the curative powers of nature and do not use industrial pharmaceuticals. Instead they produce their own remedies, foraging in the woods around their house for herbs, mushrooms, and berries and harvesting from their vegetable garden and honey production. They have a large selection of essential oils that have specific applications for different ailments.

Isidro Flores Gonzales, 48, and his son Adrian Flores Mendoza, 25, in their house in Xochimilco, a borough of Mexico City. Isidro is a biologist and founder of the conservation group Santuario del Ajolote, which tries to protect the axolotl, a rare kind of salamander that lives in the nearby lakes.

Paola Agnelli, 62, and Roberto Galimberti, 68, with their cat Nina in their apartment in Castiglion Fiorentino, Italy. They are both retired: Paola was a schoolteacher and Roberto a surveyor. Roberto suffers from a weak heart, for which he takes enalapril and Xarelto every day, while Paola has had three operations to remove cancers and has to take Femara (an anti-tumour drug) daily and Dibase twice a month, to counteract the negative effects of the anti-tumour drug.

WHO WANTS TO LIVE FOR EVER?

By Rhymer Rigby

Advances in technology mean life expectancy is growing rapidly – but are we all prepared for how living to 150 will transform and challenge society?

"How long would you like to live if you were healthy – if you had the anatomy and physiology of when you were 25?"

When people talk about longevity, they tend to focus on the exciting scientific and social side of things – technologies that enable people to live to 150 or even 250. Multiple careers. Families with eight living generations. But what about the business side of things? What is it like to be working in the longevity field, and what are the prospects for longevity businesses?

Juvenescence is a global biotech company that develops therapies to treat diseases of ageing and increase human longevity. Dr Greg Bailey, its CEO and co-founder, says he sees the commercial opportunities as being largely in improving old age.

"The goal of our company is to modify ageing," he says. "We are less concerned about increasing your lifespan than we are about improving your health." The point, he continues, is to increase your 'healthspan' – your healthy lifespan. The average lifespan in the developed world has increased enormously in recent decades, but the average healthy lifespan has not. In fact, in many countries it is decreasing. We live longer, but with more years of ill health.

"Nobody wants to live to 120 if for the last 60 years of that you are in a wheelchair or have Alzheimer's," Bailey says. "So the question we're asking at Juvenescence is: how do you live healthily? How long would you like to live if you were healthy – if you had the anatomy and physiology of when you were 25?" Huge leaps in longevity technologies are happening now, he adds. We are learning about the genes that control ageing and how to manipulate them, we are learning to regenerate tissue, and we are developing better drugs. "This is going to take place so much faster than people think." We are, he believes, at an inflection point.

He means this in a business sense too. "For the first time, people are recognising that this is real and capital is beginning to flow into this sector – and the more money that flows into the sector the faster the technologies are going to develop. If anyone had told me that we would raise USD 168 million in two years, I would have said you were crazy – that it just doesn't happen in biotech for early-stage assets."

This feeling of change in the sector has been helped by well-known individuals ranging from serial entrepreneur Peter Thiel to Amazon CEO Jeff Bezos either investing in longevity-related businesses or making significant donations to research foundations. As Bailey says, "This is going to come as a big surprise, but ultra-high-net-worth individuals want to live longer – who'd have thought it?"

Juvenescence's own investors include everyone from family offices to financial institutions; there are roughly 120 in total. Although a doctor by training, Bailey has a long track record in the industry. This is his fourth senior biotech company. Others include Medivation, which was bought by Pfizer for USD 14 billion, and Biohaven, which trades on the New York Stock Exchange and currently has a market capitalisation of more than USD 4 billion.

The Bank of America has said it expects longevity to be a USD 610 billion industry by 2025. In a 2019 statement, two of its analysts wrote, "Medical knowledge will double every 73 days by 2020 vs. every 3.5 (years) in 2010, and genomic sequencing costs have fallen 99.999 per cent since 2003. This has enabled a new frontier in precision medicine to further extend life expectancy, heralding a 'techmanity' [technology meets humanity] revolution."

The predictions for what an extended lifespan might entail vary hugely. At the moment, the world's longest-lived outliers max out at just over 120. But change is coming. Professor Sarah Harper of Oxford University recently said that a baby born today would be looking at an expected lifespan of 104 years.

We are also seeing increasing gains in lifespan, the coronavirus notwithstanding. Between 2000 and 2016, according to the World Health Organization, global expectancy rose by 5.5 years – the greatest increase since the 1960s. This opens up a tantalising prospect; that the rate of medical advance means that if you can

make it to, say, 2050, you may be able to live more or less indefinitely. The biomedical theorist Aubrey de Grey has suggested that some people already born will live for up to 1,000 years.

"I disagree with Aubrey," says Bailey. "But I think 120 to 150 is on the cards for most people and that means we have to sort out things like Alzheimer's and Parkinson's and arthritis or it's not going to be viable. Right now, we're working on the prevention of Alzheimer's because I think that's more likely to be successful than treatment." Alzheimer's, he adds, is a difficult one because it has multiple causes, so a cure or treatment for arthritis is likely to be found earlier.

Juvenescence, however, is not just about the type of medicine found in hospitals. "Juvenescence is pursuing standard pharmaceutical products and IP-protected supplements or medical foods based on rigorous science," explains Bailey. "We have a division that is creating young stem cells frozen in a simple syringe that could be used for someone who damages their lungs or for spinal cord regeneration, but we will also sell products that are validated scientifically to protect your brain or your heart, for example, directly to consumers." However, he adds, the science behind these supplements will be based on proper placebo-controlled clinical trials. "Our reputation is everything. We would pull a product if we found out the science wasn't strong, even if it was making GBP 100 million a year."

But what about the social implications of all this ageing? There's a perception – perhaps aided by the interest of Silicon Valley billionaires in this area – that longevity is a luxury good. In fact, this is unlikely to be the choice. "My first company made a prostate cancer drug, and 240,000 men in Europe will get prostate cancer – but 400 million Europeans are going to age, so it's a completely different proposition," says Bailey. "If the drug can be made for 5 pence, I don't need to charge more than a pound because the patient population who can afford a pound a day is probably a billion people globally, which of course would translate to USD 365 billion per year, thus the Bank of America number. But it will not be one drug; it will be a cocktail, probably unique to that patient or person."

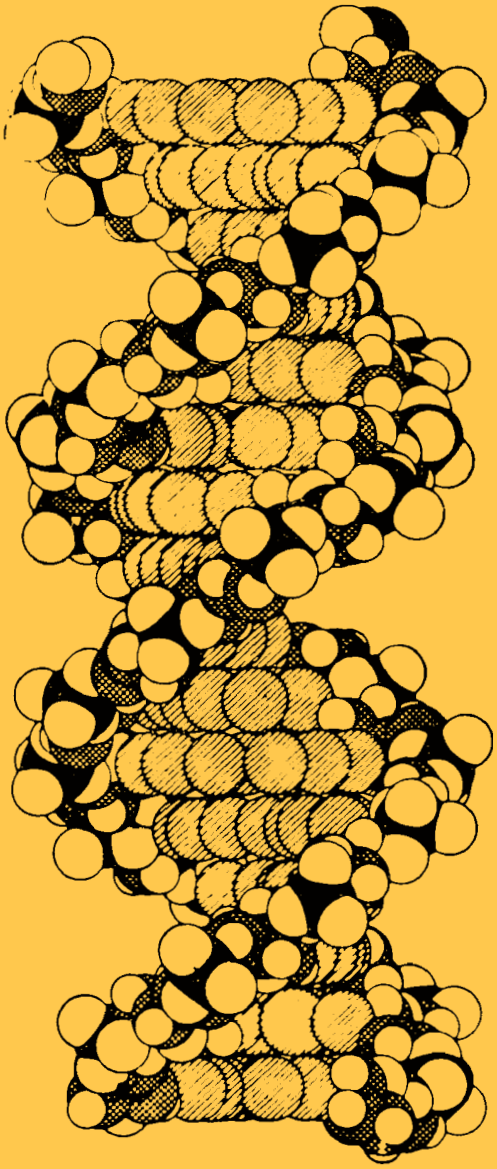
The sheer breadth of what ageing and longevity cover is often surprising too. "We licensed a new technology out of a university in January and it's based on the fact that if you're under the age of seven and you lose the tip of your finger, in a significant number of cases it will spontaneously regrow," says Bailey. "I think in perhaps

"We are less concerned about increasing your lifespan than we are about improving your health."

10 years' time, we will have unravelled this ability to turn on the switch in the body that allows you to regrow a limb or an organ."

The possibility this holds out is of people over 100 living as if they are much younger because their worn-out parts, such as kidneys, have been replaced. These parts will also be 'young' – you will be getting a one-day-old kidney even if you are 80. Humans, like cars, would be able to run indefinitely as long as spares were available.

As for the wider business implications of millions of healthy centenarians, these are almost limitless. It will affect everything from human reproduction and pensions to property and food production. "The key takeaway from this is that what we have all thought of as crazy science fiction is happening now: science fiction has become today's science," says Bailey. "It's going to have a huge impact on a variety of industries, people's lives, and government policy – all in all it's going to be very disruptive but equally incredibly exciting."



A HEALTHCARE REVOLUTION

Technological advancements are having a profound effect in the world of life sciences, with new therapies across a range of areas promising to change healthcare dramatically.

By Janet Anderson

Life sciences are revolutionising healthcare by providing solutions where traditional medicine is failing or simply too expensive. From neuroscience, biotech, and medtech to smart digital solutions, life sciences cover a burgeoning new field with enormous potential. Take neurosciences as an example. New therapies for age-related brain diseases and conditions such as Alzheimer's and Parkinson's are already entering the market and revolutionising treatment. Claude Clément, President of BioAlps, an association that supports life sciences in Switzerland, has been directly involved in the rapid emergence of the sector. "When you think that our understanding of the brain today is at about the same level as our knowledge of the heart 40 years ago, this can only be the beginning of the revolution," he says. To find out more, over the next four pages we explore one of the world's leading life sciences hubs...

LIFE SCIENCES IN WESTERN SWITZERLAND: MORE THAN THE SUM OF ITS PARTS

Switzerland has emerged as the European leader in life sciences in terms of scientific research output, biomedical patent activity, presence of biomedically focused venture capitalists, and availability of human capital. Since the early 2000s, Western Switzerland has witnessed the convergence of biotechnology and medical technologies to form what is today known as the Health Valley.

Thomas Bohn, Executive Director of the Greater Geneva Berne area (GGBa), the official promotion agency for Western Switzerland, has been closely involved. “This initiative was spearheaded and promoted by political authorities and industry support organisations, as well as academics and philanthropists,” he says. “Their vision and dedication have enabled Western Switzerland’s life sciences ecosystem to become one of the most advanced and most diversified in the world in just over 15 years.”

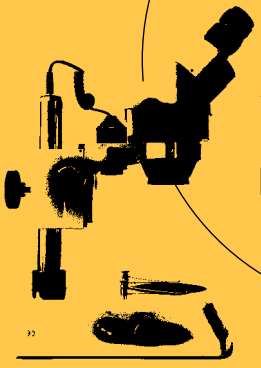
"At BioAlps we try to understand the globality of health and anticipate what is coming next and prepare to be leaders in it. The future will be less about new drugs and more about digital solutions, smart devices in the shape of wearables, mass data-driven understanding of trends, the development of tailored treatments, and the prevention of diseases on a global scale. The life sciences have the potential to deliver health improvements across the globe."

Claude Clément — President, BioAlps

1,000
INDUSTRY MEMBERS
varying in size
from one-man start-ups
to multinational
conglomerates

BIOALPS
BioAlps brings together
start-ups, universities, and
industry through regular
networking events.

SECTORS
Biotech
Digital health
Medtech
Science suppliers
Incubators
Investment funds
Nutrition



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INSTITUTIONS
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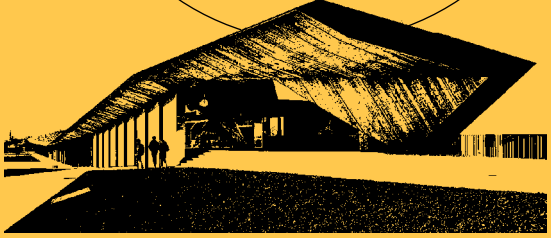
Technical schools
Nursing schools
EPFL



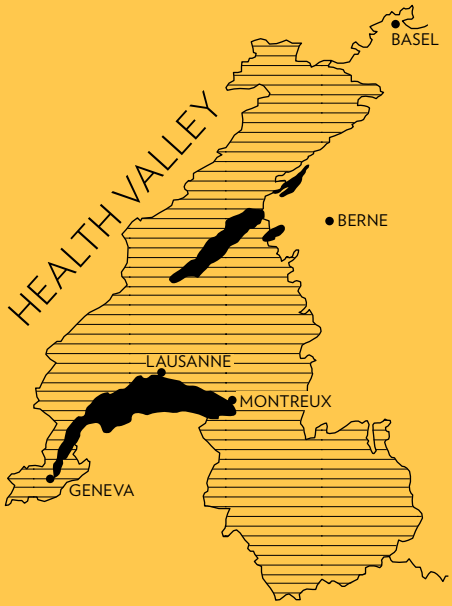
WHAT ARE THEY WORKING ON?

Biotherapeutics

CSL BEHRING
Different from chemical-based pharmaceuticals, CSL Behring's biotherapy products are based on human blood plasma and treat conditions such as haemophilia and primary immunodeficiency.

Restoring touch and movement sensation

SENSARS
The pioneering neuroprosthetic technologies developed by Sensars improve the lives of amputees and sufferers of nerve damage by allowing them to regain feeling through implants in healthy parts of nerves.



Suppressing Parkinson's symptoms

MEDTRONIC
Deep brain stimulation uses a small pacemaker-like device to send electronic signals to the area of the brain controlling movement, helping to ease the movement symptoms of Parkinson's.

Surgical robotics

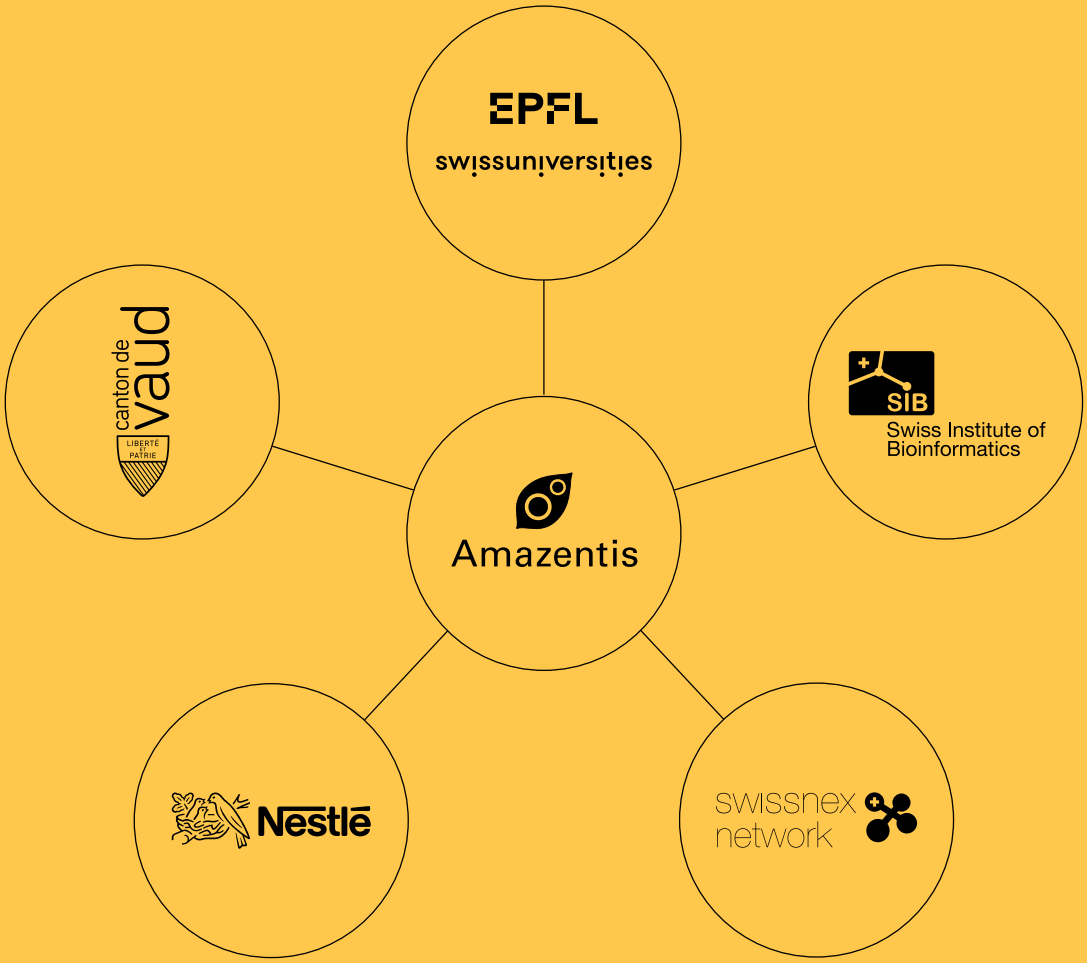
INTUITIVE
By pairing human ingenuity with technology, Intuitive creates robotic-assisted surgical systems and diagnostic tools that allow doctors and hospitals to make surgical procedures less invasive.

"The Swiss Health Valley, stretching from canton Valais to Geneva and as far north as Neuchâtel and Berne, has no equivalent in the world. It is unique in its ability to adapt and develop technologies that were not intended for the life sciences industry and that have been the pillars of Swiss know-how for decades. The watchmaking tradition, for example, has stimulated cutting-edge innovation in medtech."

Thomas Bohn — Greater Geneva Berne area (GGBa) Executive Director

AN ECOSYSTEM AT WORK

Amazentis is a life sciences company working on the next generation of advanced nutrition. Its innovative products use a metabolite of pomegranates that improves mitochondrial function in order to reverse age-related muscle decline.



CANTON AND GOVERNMENT
The Canton of Vaud, with its area known as Health Valley, provides the many life sciences projects and businesses with funding to conduct research.

NESTLÉ HEALTH SCIENCE
With the support and reach of this multinational, Amazentis has the ability to expand and grow internationally.

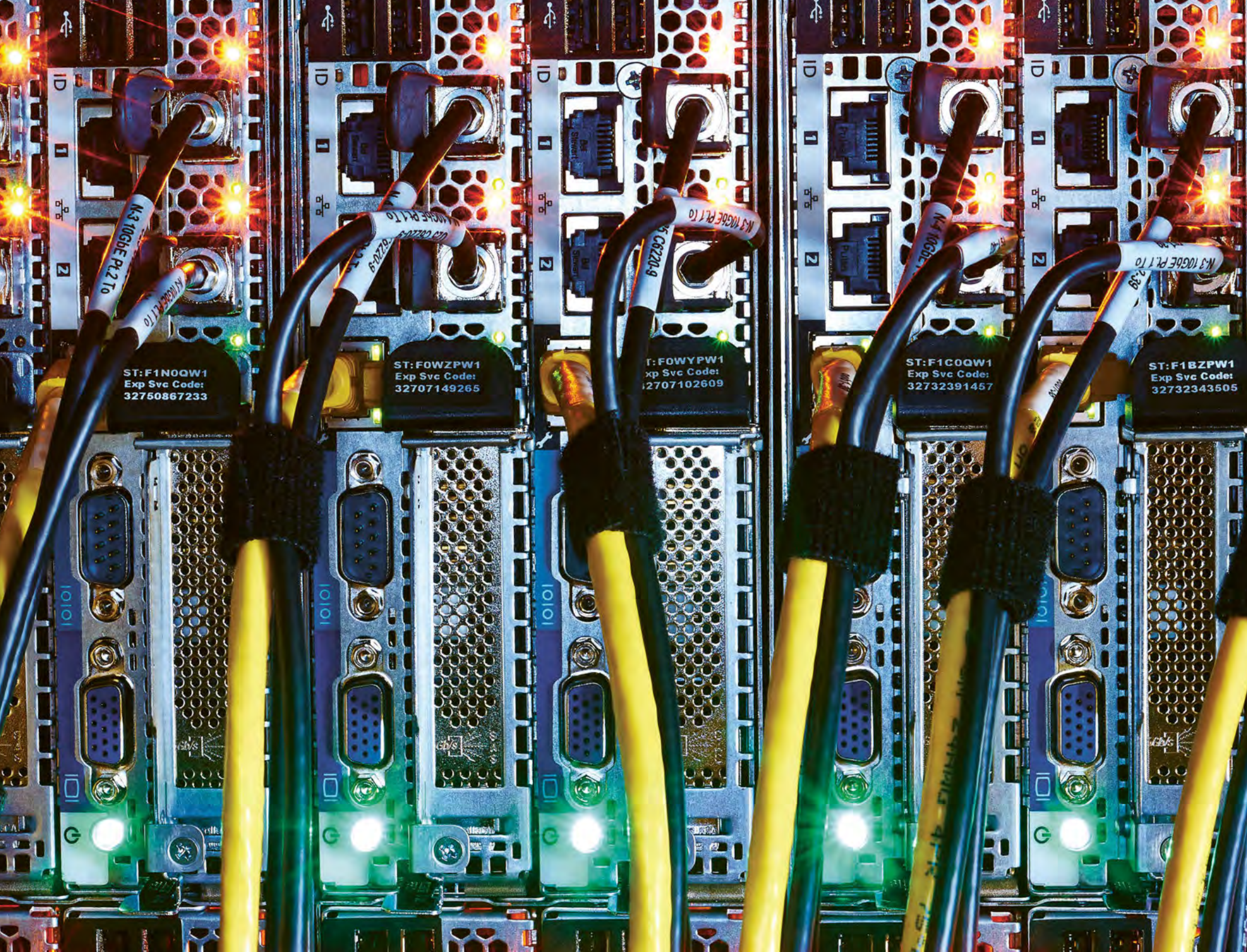
EPFL AND SWISS UNIVERSITIES
Local higher education establishments provide future talent, research and development capabilities, resources, and expertise.

SWISSNEX
The Swiss global network for education, research, and innovation is helping Amazentis to launch its products in the United States.

SWISS INSTITUTE OF BIOINFORMATICS
This academic, non-profit organisation offers support with the publication of research findings.

"We started out as an R&D life sciences company at the EPFL Innovation Park. The location gave us access to the big labs and research resources, the leadership and talent from the Swiss universities. Having Nestlé Health Sciences as a partner is pivotal to our business. And yes, our DNA is very Swiss."

Chris Rinsch PhD — CEO and Co-Founder, Amazentis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BINARY CHOICES

Using information technology to help the medical world is proving to be quite a challenge – but the potential benefits are so great that a revolution in healthcare is inevitable.

By Rhymer Rigby

"We have to learn to work with messy data," says Dominik Aronsky. "In the financial or logistics world, there's no such thing as messy data." These are domains where you can put exact figures on things: the transaction is exactly USD 50,000; the shipment took 11 hours to arrive. But in the biomedical world, the data isn't like this. "You have so much data that doesn't align or may even conflict with each other. You need to learn how to work with medical data."

Aronsky is talking about biomedical informatics. He is Chief Medical Information Officer at Semedy, which uses biomedical informatics to improve the efficiency and effectiveness of healthcare. He is also a qualified physician and his expertise and interests include clinical information systems with an emphasis on clinical decision support systems, knowledge management, and the application of artificial intelligence to support patient care.

The idea that a basket of technologies, ranging from AI to the Internet of Things to virtual medicine, will revolutionise healthcare has been around for decades. What's more, many of the technologies we need already exist and are applied daily in other domains. The question of figuring out how to integrate them effectively in healthcare, though, remains. Healthcare is not like other sectors: it is reluctant to embrace new and disruptive technologies and is resistant to behavioural change. This is why industries from entertainment to records management are already well into their fourth industrial revolution, while healthcare remains on the brink.

Physicians work in grey areas where everything is a balance of probabilities. "You frequently treat patients without having an absolute and definite diagnosis," explains Aronsky. Until 2020, this might have meant looking at someone with symptoms such as a cough and fever and saying they probably had the flu, especially if the illness took place in the winter. Now, though, this has changed. At first, you might have said someone from a city like Milan may have caught Covid-19 from the SARS-CoV-2 coronavirus, while someone from rural France would have a higher likelihood of still having the flu. "But still you're leveraging your probabilities and your knowledge, and need to make clinical decisions while faced with uncertainties."

People on the information technology side, however, are not used to thinking and operating with ambiguities. "There is no probability in computer

> "If you put a computer scientist in an emergency room, it will open up their eyes in a way that explaining the problem over the phone can never do."

science," says Aronsky. "They think in zeroes and in ones, so there's often frustration on both sides when clinicians, nurses, pharmacists, and other health professionals talk to computer scientists. I have experienced many discussions that will often only last five or ten minutes – they just don't understand each other because they don't think alike."

Increasingly, tools that come from the world of ones and zeroes are being put to use in the world of probabilities and uncertainties. It is a genuine clash of cultures. The structure of the biomedical industry is also very different. There is a long history of decentralisation, a lot of autonomy, and individual physicians often function like SMEs (small and medium-sized enterprises). It may take 5-10 years for cutting-edge research published in scientific journals to be accepted and adopted at the hospital or general practitioner level. This bench-to-bed knowledge lag also extends to tools from the information technology side.

How do you knit information technology into systems that are already Byzantine in their complexity? How do you ensure that frontline healthcare professionals such as general practitioners or hospital workers are able to embed them into the clinical workflow – and buy into these disruptive technologies that often require process changes? And how do you bring the technology to the bedside so that patients benefit?

Bringing medicine and information technology together fully is not optional. The benefits are too great and run the full gamut from hugely improving patient care to making healthcare more affordable and efficient. It's a human, social, and economic imperative. It will affect and improve everyone's health.

Fortunately, there are ways forward. One is simply education. Countries with better training programmes for clinicians – especially those with IT tools embedded in the training already – tend to be making faster progress. Another is having a larger number of people who are skilled to work in interdisciplinary domains and bringing professionals from diverse backgrounds together.

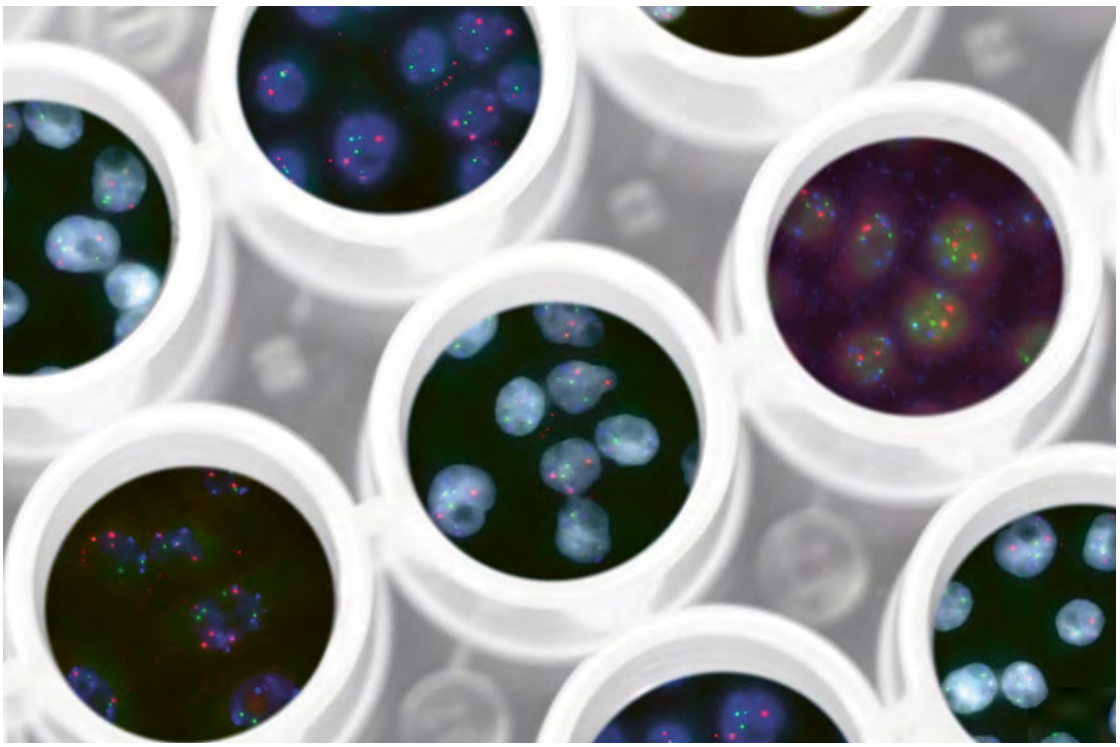
"We need more inter-professional people that are trained in more than one area," Aronsky explains. "If you take my area, biomedical informatics, the people we need include professionals who are dual trained in a biomedical domain and in information technologies. As a clinician it is important to understand and talk the language of computer scientists and vice versa, and have a mutual appreciation for each other's capabilities." A new wave of professionals who operate effectively at the intersection of disciplines would help to bridge the gap between clinicians and information technology professionals – something that Aronsky expects to see in the coming years.

Aronsky's own background is like this – he completed a medical degree, a post-diploma software engineering degree, and a PhD in biomedical informatics. "I'm not saying it's necessary to have an MD or PhD degree, but it surely helps a lot," he says. Having been through medical school doesn't mean you understand exactly what every specialist wants. But it does mean you "have a feel and understanding for what it means to care for patients and work in a hospital or a physician's office". You have a better grasp of how frontline staff or healthcare professionals might deal with, say, IT tools and the frustrations and problems they might face. "In biomedical informatics, the last mile is often the most challenging."

The good news is that some of this is likely to get easier rather than harder. Generational change means recent cohorts of medical staff are much more tech-savvy. "The younger clinicians – and this includes everyone from nurses

DOMINIK ARONSKY

Dominik Aronsky MD PhD earned his MD degree from the University of Berne (Switzerland), spent two years in residency in anaesthesia and surgery, and completed a PhD in Medical Informatics (University of Utah, USA). He was Associate Professor for Biomedical Informatics and Director of Graduate Studies at Vanderbilt University (Nashville, USA). He was CIIO at LifeWatch AG, is currently CMIO at Semedy (Zug) and Clinerion (Basel), and provides consulting in the biomedical informatics domain. He is a fellow of the American College of Medical Informatics and the International Academy of Health Sciences Informatics, and an author on more than 80 publications. As an interdisciplinary physician informaticist, his expertise includes the development, implementation, and evaluation of clinical information systems with an emphasis on clinical decision support systems, knowledge management, applications of artificial intelligence/machine learning techniques, and real-time informatics applications to support patient care.



HIPMap (high-throughput imaging position mapping) accurately determines the position of a gene in the three-dimensional space of the cell nucleus.

and pharmacists to physiotherapists and physicians – are much happier using these technological tools. For them it's normal." Persuading more established clinicians can be challenging – but not without good reason.

"They are in very busy practices – the average time with a patient is about seven minutes – so how can you ask them to spend even two minutes more on the computer? The trouble is, you're slowing them down and letting business needs dictate clinical needs, when it should be the other way around. Yes, in the grand scheme of things the data may help, but it won't help the individuals. The clinicians collecting the data may not be the ones benefiting from it." That is the nature of the challenge here – two worlds competing against one another.

However, there may be ways to ease the digital transition. Improving the efficiency of healthcare processes, including the use of computer-based clinical decision support, may be a way forward. Another way to acceptance may simply be presentational – you explain that the tool can help support the clinician's final decision-making process by presenting the data in a more meaningful way, and that they are tools to support, not tools to take power away. A third and important avenue is sharing knowledge across disciplines, something Aronsky rightly comes back to time and again.

"If you put a computer scientist in an emergency room, it will open up their eyes in a way that explaining the problem over the phone can never do," he says. "Once they've been in an emergency room, they suddenly understand that if a software program they have designed isn't working for clinicians, it's a major barrier to caring for patients and it needs to be sorted out in an hour, not tomorrow. For a computer scientist, 30 minutes of software inoperability is a blip of time; in an ER setting where 50 patients are being cared for concurrently, 30 minutes can represent an eternity and lead to problematic and potentially dangerous situations. Spending time with the clinical staff using the software provides recognition and appreciation of how these tools are actually used in a busy clinical setting."

A great deal can be learned from other fields too. Aronsky points to the aviation industry, which has decades of experience of how to deal with sometimes conflicting data in a coherent form and is also very good at error reporting and learning from errors in a non-punitive environment. "The aircraft industry is at the forefront of human factors engineering – very little exists yet in the biomedical field."

Finally, of course, there's money. A stark example of this is how implementation of these technologies varies enormously by country: "I may have a biased view, but there are a few countries that are a long way ahead of other places," says Aronsky. This is largely down to how much these countries are prepared and willing to invest. "While there are many countries that do a lot with much less money, there are a few countries that put in billions of dollars and they're not afraid to fail."

Healthcare's fourth industrial revolution has started and we are already seeing the benefits. It's likely that the current pandemic will accelerate change too, such as the sudden acceptance and skyrocketing use of telemedicine. But even so, change in healthcare will be slower and harder than the rapid disruptive revolutions of other industries. If we can successfully change the industry, though, the effect could quite simply be transformative.


TERRA MASIA

BETTER RELATIONSHIPS, BETTER HEALTH

By Eric Johnson and Emily Rookwood

A growing body of research shows that having good friends and strong family ties boost your well-being, health, and longevity. Although people today are better connected than ever before, isolation is on the rise. How, then, do we build a future of greater companionship and better health?

Maintaining social contact can boost our health tremendously, particularly among over-65s.

"Put family first, treasure your friendships," said your grandmother, probably after telling you to eat your greens. It turns out that Grandma was spot on, health-wise. It is becoming increasingly clear that people with good relationships live longer, healthier lives than those without.

According to a report from Harvard Medical School, "Social connections…not only give us pleasure, they also influence our long-term health in ways every bit as powerful as adequate sleep, a good diet, and not smoking." Dozens of studies in recent years have shown that people who have satisfying relationships with family, friends, and their community are happier, have fewer health problems, and live longer.

There are numerous reasons why this is the case, one fairly obvious: social people cope better with stress because they can get help from, or at least blow off steam with, companions. Another is that people who feel needed feel more compulsion to take care of themselves. Think new parents or those caring for relatives; they live less riskily, more often avoiding smoking, drinking, partying, unhealthy eating, and inactivity. They even heal faster when injured. Why? Because they know acutely that their health matters to someone else. And for most people, deep relationships are the purpose of life. The means and the end of living well are the same thing.

In our ultra-connected world, we tend to think everyone has a strong network of friends, family, and acquaintances even if they live alone. However, according to a 'Loneliness across Europe' survey sponsored by the European Commission, this is not the case. All told, about one-fifth of European adults are at least somewhat lonely, and that figure is rising.

Seniors are often assumed to be the group most in need of greater companionship. Retired, relocated, widowed, or simply less sprightly: all make for increased likelihood of social isolation, with 15-20 per cent of European over-65s saying they are 'mostly to always' lonely. Yet, surprisingly, the EU study says the 26-45 age group is more frequently lonely than the over-65s. Despite their constant connectivity, their increasing reliance on technology over face-to-face interactions, coupled with changing social conditions (leaving the parental home to live independently, raising children as a single parent, over-work, and non-social working hours), is leaving many feeling isolated.

Even families can struggle to spend quality time together, with many passing it 'non-interactively', i.e. watching a film or TV, and six in ten families polled in the UK said they struggled even to eat together. Only four of a possible 21 meals per week are taken communally, and even those are rushed, as children (and surely many parents) are anxious to get back to their gadgets.

Left unaddressed, the situation is likely to get worse because longevity is increasing and the number of

There are various ways in which societies can alleviate loneliness and encourage social interaction. These include bringing different generations together, designing buildings to enable more contact between neighbours, and harnessing technology in order to form new friendships and get the best out of existing connections.

OLDER AND WISER

One way to give retirees more sense of purpose is through mentoring. In Germany, for instance, 2,500 retired workers advise an equal number of young apprentices through the Senior Expert Service. The old help the young, especially in soft skills: how to deal with difficult customers or an unreasonable boss, or how to map out a career. In neighbouring Switzerland, a programme called Seniors@Work teams seniors with young businesspeople and students: a pensioned finance specialist recently helped a part-time researcher to complete a thesis in economics.

MIXED LIVING

Physical integration is another way to build community. An idea hatched in 1970s Japan is to put children together with the elderly. In Seattle, nursing home Providence Mount St Vincent hosts a kindergarten of five and six-year-olds amid its over-80s residents, to the delight of both age groups, say observers. “We wanted this to be a place where people come to live,” a home administrator told the Seattle Times, “not a place where people come just to die.” Young and old can even live together. In the Netherlands, some university students live rent-free with older landlords (or in nursing homes) in return for companionship and light chores. ‘Inter-generational settlements’ are springing up all over. In Switzerland’s Gattikon, for instance, one building hosts 15 flats that are smaller than normal but are compensated by multiple common rooms and kitchens, meant to inspire neighbourliness. Of course, we will have to wait and see how Covid-19 impacts such schemes but in theory they offer an ideal: a family of unrelated people.

FRIEND FINDING

Social prescribing is growing across Europe: it might be better defined as matchmaking for friends. In several national healthcare systems, doctors and nurses are told to diagnose the lonely and to ‘prescribe’ friendships. Befriending networks have been set up, such as the Circle of Friends in Finland, with similar initiatives in England, Germany, Ireland, Italy, Scotland, and Switzerland. Then there are social networks: both the old-fashioned kind – social/sport clubs and churches – and the new, such as social media platforms. Although the latter are often accused of destroying the former, online networks can promote new friendships and deepen old ones, says a Connected Society report published by the UK government. Success comes, the study says, if the inter-networks are used not as a substitute for real-life interaction, but to complement it. One example would be friendship apps. These are similar to online dating services, but for companionship rather than romance. Numerous testimonies can be found online for Bumble BFF, the so-called ‘friendship mode of dating app Bumble’. Want a new friend? Just swipe right.

IN-TOUCH TECH

Internet technology could lift companionship, even for technophobic seniors. In Finland, for example, it has enabled several dozen virtual lunch clubs. Five to ten retirees eat alone in their homes while simultaneously videoconferencing with each other. In Spain, a nursing home has developed a virtual social network, using technology from YouTube, to help residents connect with each other, with staff, and with family. “Smartphone and tablet proliferation,” say the organisers, “empower people to interact…independent of time, space and impairment…and provide new forms of joyful entertainment.”

> "In our ultra-connected world, we tend to think everyone has a strong network of friends, family, and acquaintances even if they live alone."

one-person households is growing, while conventional 'befriending networks' (offices, clubs, churches, even public houses) are on the wane.

Such findings have touched a nerve, and the enforced self-isolation required to tackle the pandemic has brought the issue of loneliness into sharp focus. Not only does isolation damage our well-being, it is also detrimental to society and the economy. A recent attempt to quantify the impact of loneliness in the USA placed the cost of treating the associated health problems at nearly USD 7 billion per year, and a recent study by the New Economics Foundation estimated that loneliness costs UK businesses around GBP 2.5 billion each year. Hardly surprising, then, that nearly every EU member state now has some sort of strategy or policy related to improving our relationships and communities. No country yet has a 'Ministry of Companionship', but the UK government, which has appointed a Minister for Loneliness, stated in 2018 that loneliness "is an issue of increasing interest to policymakers at local and national levels as well as internationally".

Non-governmental organisations and businesses have also joined the efforts to tackle the situation and to make the most of community. From carefully planned building projects such as Kalkbreite in Zurich, which combines residential with retail, office, medical, and daycare spaces to foster a vibrant and sustainable community, to a boom in mentoring schemes for young entrepreneurs run by retired CEOs such as Senior Expert Service, projects that build social interactions – especially across generations – are increasingly popular. (Don't miss our look at some of the innovative responses to loneliness on page 53.)

While these schemes help, a broader response is needed, as Michelle Lim, a loneliness expert at the Iverson Health Innovation Research Institute and clinical psychologist, explains. "Loneliness is not caused by one factor and so there is no one solution for everyone. We need to work together across different levels to reduce loneliness – from thinking more deeply around how we can address loneliness in a non-stigmatised way and the changes we can make for ourselves, within our relationships and community, to changing policies on a societal level to facilitate the development of more meaningful relationships."

In recent months, we have all come to appreciate just how important our social interactions and relationships are to our general well-being. It turns out that Grandma was right: you really should eat your greens – and nurture your relationships. Society is finally starting to recognise the enormous cost of ignoring loneliness and is working to find better, more systematic solutions to tackle what is a silent but global problem. The hope is that we can now work together to build a more companionable, joyous, and healthy future.

LONELINESS IN NUMBERS

15–20%
of European over-65s saying they are 'mostly to always' lonely.

26–45
This age group is more frequently lonely than the over-65s.

USD 7 BILLION
A recent attempt to quantify the impact of loneliness in the USA placed the cost of treating the associated health problems at nearly USD 7 billion per year.

GBP 2.5 BILLION
The New Economics Foundation estimated that loneliness costs UK businesses around GBP 2.5 billion each year.

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ART DIRECTION AND
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PROOFREADING
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Head Office
Bahnhofstrasse 36
P. O. Box
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Switzerland
Telephone +41 (0) 58 888 1111
Fax +41 (0) 58 888 1122
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