

# The AI Journal

AI IN HEALTHCARE:  
PERSPECTIVES ON A  
CHANGING SECTOR



# CONTENTS

Foreword .....	3
Why we Need AI in Healthcare Now .....	5
How to Become an Augmented Leader Embracing AI .....	8
AI in Healthcare: Navigating Uncharted Territory .....	10
From Life Sciences to Life Services .....	12
Why AI Should Also Mean All Inclusive .....	14
How AI is Changing the World of Healthcare .....	16
Endless Applications: The Potential of AI .....	18
The Power of Conversational AI in Delivering Self-Service Solutions to Health Professionals, Patients, and Consumers .....	20
A Strategic Approach to AI in Health .....	22
AI: A Catalyst for Transformation in Ear Health .....	25
Primary Care's Three Issues: Capacity, Capability, and Scale .....	28
Health Self-Management: How AI Can Enable Happier Lives .....	30
How AI and Emerging Technologies are Affecting The Healthcare Sector .....	32
What Next for AI in Healthcare? .....	34
Contacts .....	35



# FOREWORD

2020 has been far from what people were expecting, with industries, businesses and individuals all facing new challenges as a result of the global pandemic. One of the sectors that have been put under unforeseen pressures and stress tests is healthcare.

In our last report, *AI in a Post-COVID-19 World*, I highlighted how I'm a firm believer that from challenges rise opportunities. The global pandemic has shown how agile, compassionate, and optimistic the world can be, with key workers and their respective businesses being quick to figure out how to overcome the new logistical challenges.

Healthcare systems had to rapidly shift their operating models to deal with the huge influxes of infection cases and deaths, and putting in effective preventive measures against the virus spreading. All while dealing with existing patients with other illnesses, conditions, pregnancies, and urgent treatments.

AI-enabled technologies have shown the impressive results that can be gained from a business and consumer point of view. Whether it is speeding up business processes through

intelligent automation, lowering businesses' customer acquisition costs through data-driven marketing, or enabling seamless collaboration between teams, the power of AI is growing at a scale that looked unachievable five years ago.

We wanted to show how AI is being put to work in the healthcare sector to save time and give the core team members on the frontline more solutions to save a loved one, get effective treatment to more people at scale, and understand how a hospital can free up budget while not losing quality to make the operating model more efficient.

As a result, we felt the urge to provide you with the valuable insights in this report from experts known for recognised projects in the healthcare sector. Our aim is to show the opportunities while also highlighting the progressive advancements that are being made with AI-enabled technologies in relation to the healthcare sector.

In this report you will hear from renowned names at brands that are shaping the future of healthcare for countries, businesses, doctors, administrative personnel, carers, patients, and all the other vital roles in the healthcare sector, by

implementing AI and emerging technologies.

After you've taken the consideration points from experts in their field, we have provided a summary where we leave you with questions to consider on how AI can further become a benefit to the healthcare sector and the general public's wellbeing.

At The AI Journal, we want to contribute towards a positive future for AI; to be a voice for the community; to create informative and results-driven debates; and to enable businesses to make informed decisions to add increased value to its customers.

It's for these reasons that it gives us great pleasure to share with you insights from 13 highly regarded experts, providing an inside look at how AI can benefit the wellbeing of your loved ones and the wider community.

On behalf of The AI Journal, I want to thank everyone who took the time to give their valuable insights, and to everyone working in the healthcare sector and wider supporting industries who are helping their respective countries to overcome the challenges brought by COVID-19.



**The AI Journal**

**Tom Allen, Founder, The AI Journal**



# WHY WE NEED AI IN HEALTHCARE NOW

Amy Molten, Director of Medicine, Buoy Health

Pre-COVID-19, the healthcare industry was treading a slow but sure course toward digital transformation and AI. These days, it seems that healthcare (and many other sectors, for that matter) is sprinting in that direction – lunging to keep up with the lightning pace of emerging tech and equipping providers and patients with vital tools for public health and safety.

Dizzying as these tech shifts might feel at the moment, they are opening our eyes to AI's potential and promise for the ever-evolving healthcare sector. Innovating at rapid speed and scale, AI capabilities are already bringing dramatic changes to the way we 'do healthcare' – not least when it comes to the advancement of care diagnostics.

Using a patient-centred, AI-powered chatbot illustrates these opportunities up-close. When deciding next steps in care, patients often find themselves making important decisions on their own amidst difficult and confusing access points. During a pandemic, fear can make some of these decisions even more challenging. But imagine a world where a bot can analyse symptoms much like a clinician does when trying to consider a diagnosis for the individual, and educate them in ways that helps them make better care-seeking decisions. The bot's ability to gather and cross-factor relevant information in real time through the analysis of text, images and video – whether that's a person's history, medication, risk factors, or emotional state – empowers patients to present the broadest possible picture of his or her state of health in the diagnostic and triage process. Every bit of this information is relevant for care diagnostics. We are just at the beginning, and the road ahead is exciting.

“

*As it turns out, AI's power to aggregate data, distil findings, and educate the healthcare industry has already manifested itself in tech's response to the pandemic.*

”

The field of medicine driven by AI will celebrate not only the individual clinician's knowledge and accomplishments, but the collective knowledge that tech, i.e. health-oriented bots, can share with us by distilling billions of patient data points and revealing patterns in human illness that remain undiscovered. Currently, a traditional diagnosis as we know it primarily relies on a single provider, or perhaps a small team, interacting with a patient. As such, it is wholly dependent on the individual training and focused experiences of these clinicians. While we are each trained to be careful, comprehensive and maximally knowledgeable, this method is, by nature, limited in scope to the finite number of prior studies and patient interactions, and potentially biased in both education and practice.

As it turns out, AI's power to aggregate data, distil findings, and educate the healthcare industry has already manifested itself in tech's response to the pandemic. Simple adjustments to AI infrastructures made a pivot toward something as serious and pressing as COVID-19 relatively straightforward. By layering in symptom, testing, self-isolation and triage guidance, AI has been able to support our nation's targeted mitigation efforts to minimise spread, preserve health system functioning, and protect healthcare personnel.

Both during and beyond COVID, however, AI confronts health providers with some sobering implications and reflections for medical ethics. Our creativity in this moment will be a useful contribution to a layered approach to healing our suffering health

system. But to build a brighter healthcare future and effectively trailblaze its AI-driven tech path, we must use our moral imagination while rigorously reinforcing and protecting our ethical standards.

Some specific ethical considerations that come to mind are patient confidentiality, the role that the bot may play in the diagnostic journey, and the risk of potential biases in the data used by machine learning algorithms.

The bias issue, in particular, cannot be overstated – if a bot lays its diagnostic foundation on biased data points, it can exacerbate already intolerable public health disparities that exist in the medical field. Human cognitive bias in clinical medicine is a well-described phenomenon, but algorithmic bias can have untoward consequences at exponential scale. If we set the foundation correctly now, we can create an irreplaceable tool for new and valuable insights.

Thus, AI provides the healthcare industry with an incredible opportunity – it reminds us to identify and dismantle current biases so that, through the power of data and machine learning, we can visualise and eradicate future injustices and blind-spots from the healthcare system.

Promise and potential aside, patients and their healthcare providers still wonder if AI will really be able to match the quality and personalisation of care provided by humans. Of course, AI will never be a substitute for the human interaction that is so critical to the healthcare journey, but insofar as AI is used as a tool to bolster the doctor-patient



relationship, it will actually improve the personalisation of healthcare, not diminish it.

There is so much more to quality and personalisation in healthcare than we think.

*Patients don't just want a doctor to listen to them (although this is critical). They want a doctor to really understand them...*

...not just in the moment, but as a whole person on a lifetime mental and physical journey. Large-scale adoption of AI tools and analytics can help meet that need, enabling us to see each patient as both a unique, complex individual, and as part of a massive human race that is still only minimally understood. As AI and healthcare learn together, the quality of the patient experience will only improve.



Amy Molten is a paediatrician and the Director of Medicine for Buoy Health, an AI-powered healthcare navigation platform.



# HOW TO BECOME AN AUGMENTED LEADER EMBRACING AI

Eva Martins, Global Head of Innovation, Novartis AG

AI is changing the way we live, the way we do business, the way we take decisions. There isn't a single sector or industry that is not being affected and transformed. So how do leaders need to evolve in order to stay at the top of the game?

First and foremost, we need to understand that AI is a reality and its role is to amplify human genius through intelligent technology. AI is not about eliminating jobs but evolving them and eliminating repetitive and transactional tasks, increasing productivity, fast action and impact. When adopted broadly, AI has the potential to aid leaders and the workforce by augmenting their skills, judgment and fast decision-taking, supported by algorithms that can make suggestions to reach better conclusions than humans alone.

## **Moving from experienced and knowledge-based leaders to data-driven decisions**

Leaders need to embrace a growth mindset, a mindset of innovation that is no longer sustained by acquired experience and past knowledge, but is curious, inquisitive, and responsive. Leaders need to be trained in asking the right questions instead of directing in a known and predictable environment. Letting go of "I know everything, I am the expert" and moving to "I am willing to step into the unknown, to learn, iterate and test new things" is a must. It is no longer about creating an annual plan and executing it perfectly as decided upfront. It is about continuously deep diving into new insights, feedback from end users and, if needed, iterating and acting fast as new insights become available.



This cultural transformation is more likely to happen in an organisation that promotes experimentation, recognising more the learnings instead of failures, creating a safe environment for feedback and personal growth. It requires a cultural shift from being always right, knowing everything, being the number one; from a highly hierarchical top-down approach, with complex and bureaucratic governance systems and processes, to valuing a mindset of enablement, servant leadership, curiosity, asking the right questions, unleashing and empowering the organisation for fast iteration.

It is about moving from rigid structures and complex governance towards more flexibility, agility, responsiveness and adaptability.

The difficulty for most organisations is that their governance is not prepared for agile decision-taking. Quarterly reviews, heavy structures and governances defeat AI in its fast decision-taking ability for constant iteration and evolution. A shift from a top-down approach to 'unbossing' the organisation, empowering the teams to take decisions for fast iteration is a must to fully leverage the power of AI. By supporting, enhancing and augmenting workforce skills, AI can lead to highly engaged teams who realise how it can amplify their impact and results in the short term.

Any leader knows the importance of predicting market change, the impact of a product launch or any other shift, by correlating and making sense of different data points. The computing power of AI can considerably augment those capabilities in making sense of a much bigger database and in a much faster way, outperforming humans. AI has the power to exponentially augment the human genius if fully embraced.

New leaders need to be able to lead technology as well as businesses and teams. AI is no longer just for a few data scientists piloting new experiments.

AI is transforming businesses, changing the way we take decisions, replacing repetitive tasks and giving superpowers to the workforce. It is important to understand that AI applications are not perfect, and we need to learn with historical data in order to create patterns, test and learn, and become smarter with time. As leaders, we should let go of perfectionism and the idea that we need to have everything thought through before starting, as this approach does not survive with AI.

Change is always uncomfortable, but we have two solutions: we resist and do not survive this new era; or we embrace it, letting go of preconceived ideas, letting go of the need to be perfect. Embracing the fact that AI can add computer power to human creativity, curiosity and risk-taking will allow us to test and learn much faster than we have ever done before, increasing the return on investment, impact in the environment, in business and in our lives.

As leaders, it is important that we foster a safe environment that allows testing and learning, fast decision-taking, flexibility and responsiveness to fully maximise the potential that AI brings to business to better serve our clients.



Eva Martins is an international bestseller, speaker, coach and Global Head of Innovation at Novartis AG. She is responsible for driving innovative AI lighthouses to transform the company to better fit in the future healthcare landscape.

# AI IN HEALTHCARE: NAVIGATING UNCHARTED TERRITORY

David Le Penske, Director of Healthcare and Life Sciences, Digital Innovation, Insight Enterprises

AI is undoubtedly changing the healthcare industry, making it more efficient and driving better outcomes for patients. COVID-19 has served as an accelerator of adoption – a catalyst in helping the industry catapult itself forward, taking advantage of the best technology has to offer. Barriers to adoption persist, however, as many applications of AI in healthcare remain uncharted territory.

The vast majority of the world's health systems are not using their data and AI to make helpful predictions that inform decision-making, creating tremendous opportunity to use data and AI to help make more insightful healthcare decisions. But the challenge is in finding common, replicable use cases.

To start, healthcare providers are looking to understand how the disparate clinical data they gather can be organised better into an efficient pipeline that can be used to tap into accurate, predictive data intelligence. By organising or feature engineering the available clinical data regardless of electronic medical record systems, we can optionally combine it with social determinant data into a common data model structure. Once this data is commonly structured, we can then use temporal or time-series machine learning for medical data modelling, to rapidly optimise informed business or clinical decision support.

This level of data gathering and analytics, however, relies upon a well-built cloud architecture. The good news is that cloud providers are intensifying their focus on rapidly evolving services and capabilities to support both the prediction and scale of healthcare. Microsoft recently announced the Microsoft Cloud for Healthcare, a fully Health Insurance Portability and Accountability Act of 1996 (HIPAA) compliant cloud with native solution capabilities geared to leverage AI and facilitate improved care collaboration and communication.

Adopting AI in healthcare does not mean removing people from the equation, but rather fully leveraging your greatest care asset – your data – to drive informed business and clinical support. AI synthesises the data, giving providers more resources for patient care; it also saves valuable time on data entry and analysis.



AI applications aren't limited to direct patient care – they're useful to lab technicians, helping them prioritise which labs to work on first. In recent work with a client, Insight created a system to triage lab tests, thereby shortening patient stays. Simply automating legacy processes through AI can translate to tangible outcomes for patients and a healthcare system's bottom line.

AI, though, is not a 'set it and forget it' technology – models can't be built once and remain useful forever. 'Black Swan' health events like COVID-19, for instance, cannot rely on historical models for accurate predictions because they present unique situations. To solve this, healthcare providers can turn to an AI DevOps model to challenge the system – using some data to train the model, and additional datasets to test it. Outlier events should also trigger an alert for human review.

Given HIPAA regulations, there's a general reticence towards adopting technology where it relates to security and compliance. In recent years, however, technology – including the cloud – has caught up to the security needs of healthcare data, making governance practices safer and more secure. Further, the pandemic has demonstrated the applicability and need for advancements in our healthcare system – and the positive impact greater adoption can have.

The pandemic has served as a timely reminder that we must turn our eyes to digital innovation to help us navigate the changing world. COVID vaccines, therapeutics and clinical trials are all leveraging data, AI and global research collaboration powered by the cloud. It's time for healthcare to speed innovation to improve healthcare outcomes and lower costs.



**Insight.** 

David Le Penske is Director of Healthcare and Life Sciences, Digital Innovation, Insight Enterprises



# FROM LIFE SCIENCES TO LIFE SERVICES

Graeme Cox, CEO and Co-founder, emteq labs

The greatest promise that AI presents to human health is the opportunity to shift to personalised models of care, moving us from discussion of Life Sciences to a focus on *Life Services* – a refocus from cure to prevention, driven by data and putting power in the hands of the individual. By ‘personalised’ I mean both the personalised nature of the service and also the need to get physically close to the individual (e.g. with sensors), delivering a sufficient value to each person receiving care to enable trust, and thus to persuade them to part with fairly intimate data in return.

As such, secure, reliable access to personal data that is consciously and willingly shared by each healthcare system participant is the key requirement of future healthcare AI solutions.

This promise of individually tracked healthcare data will enable us to make decisions and to change behaviours that will drive healthier, happier – and longer – lives, and one key measure in this data will be that of emotional tracking – the quantification of changes in our moods and stress together with data on the behaviours and activities that trigger these changes. This tracking of emotional state as a digital biomarker of health can better inform the medical and health advice we receive, diagnosis of health conditions, and interventions to improve health outcomes.

However, in order for us to experience the benefits that AI-driven personalised medicine can offer, we need to feel empowered by the advice we receive, and not be slaves to technology. And above all else, we need to believe that our data is secure and used for our collective and individual benefits – not primarily for corporate profit. This can best

be achieved by allowing individuals to own their data in perpetuity, not only controlling how and where it may be used, but also to ensure that value – and even revenue – may be generated from it. Healthtech companies that find ways to incentivise patients to share their data will create thriving, transparent networks and encourage innovation.

In developing the technology stack in emteq labs I have found myself at the frontier of a revolutionary field, working with cutting-edge simulation, biometric data, sensors and machine learning to build tools for the quantification of emotional state and response. Whilst we are just starting to understand the applications of these technologies and the behavioural responses that may be modelled, in the future, we hope to build personalised models of behaviour that account for an individual’s own baselines, trends and responses to stimuli. It is my belief that, by developing a standardised methodology for emotion research, we can drive significant improvements, not only in our medical interventions and personalised treatments but also in other sectors such as entertainment and education. In this way, AI



developed in a healthcare setting can be used to help support and upgrade other industries.

For example, personalised grading of stress response could be used to measure the impact of and response to exposure therapy, improving treatment of phobias, reducing the anxiety of social interactions such as public speaking or creating higher resilience in blue-light key workers who deal with stressful and emotionally intense situations. Similarly, better data and understanding of the range of 'normal' responses to existing therapeutic interventions could be a means to developing new treatments for mental health conditions. As we advance the technology and create personalised models, therapies could be specifically designed to resonate more closely with patients than ever before and self-therapy could be made safer and more effective. Virtual reality (VR) could be used to immerse ourselves in a familiar simulation, measure our reactions and progress to provide personalised advice as feedback and advancement.

The convergence of AI and VR opens the door to a deeper understanding of human emotion and behaviour. Read more about the power of AI and VR in the science of emotions in our [White Paper: Measuring What Matters in Immersive Environments](#).



Graeme Cox is the CEO and Co-founder of emteq labs. Graeme studied Computer Science and AI at university and is an AI and high-tech business entrepreneur.



# WHY AI SHOULD ALSO MEAN ALL INCLUSIVE

Jason Mellad, CEO and Co-founder, Start Codon

AI and machine learning are groundbreaking innovations that will help translate the increasingly diverse datasets generated by next-generation biomarkers into improved patient outcomes. These innovative platforms utilise a wide range of inputs such as genomics and epigenomics, transcriptomics, medical imaging, digital pathology, wearable biometrics, chemical structures and metadata to generate valuable diagnostic insights or discover new therapies.

The true promise of AI is to support, not replace, clinical professionals and democratise access to the best care available. Several platforms that have been commercialised significantly decrease medical error rates, facilitate earlier and more accurate disease detection, and enable smarter clinical trial recruitment and patient stratification. For example, Healx uses natural language processing to extract information regarding rare diseases from publications and well-annotated datasets in order to identify novel therapies for rare diseases. PANGAEA Data enables their partners to rapidly identify and stratify patient cohorts based on clinical symptoms and patient metadata recorded in electronic health records and unstructured notes. Congenica's clinical decision support (CDS) platform utilises AI to interpret complex genomic data and identify actionable variants.

Despite the myriad potential benefits of AI, there is an increasingly acknowledged risk that patient populations historically underserved by existing healthcare systems could be further

disadvantaged due to limited access to AI-driven solutions and perpetuated biases. We have already witnessed multiple cases where developers have neglected to factor ethnic and gender diversity into their algorithm development plans, and have therefore produced fundamentally flawed solutions. For instance, a recent study by Ziad Obermeyer et al. revealed that a clinical decision-making algorithm utilised by hospitals across the US was generally more likely to assign lower health risk scores to black patients than to white patients with the same prognoses, contributing to widespread undertreatment and worse outcomes. It is clear that AI developers cannot afford to be 'colour-blind' when it comes to addressing systemic racism in healthcare.

Because AI is heavily dependent on the nature and quality of training data, it is essential that developers have access to diverse datasets that include a wide range of ethnicities, genders, ages and other key variables. For example, apps that detect melanoma through image analysis should be trained and tested on a



*England's recent report on the disparities of risk and outcomes in COVID-19 confirmed the conclusions of other leading studies – people of black or Asian ancestry are estimated to be twice as likely to die compared to white people.*

wide variety of skin tones to ensure accuracy and reduce false negative rates. Similarly, Public Health England's recent report on the disparities of risk and outcomes in COVID-19 confirmed the conclusions of other leading studies – people of black or Asian ancestry are estimated to be twice as likely to die compared to white people, even when you account for socio-economic, geographic, age, sex and other factors. This suggests that comorbidities, which disproportionately impact black and Asian individuals, as well as genetic background could significantly impact COVID-19 prognosis and must be taken into account by researchers developing new CDS algorithms. We cannot allow data gaps to put certain patient populations at greater risk of medical errors when using AI.

Gender bias must also be considered and mitigated. To illustrate, it has been widely reported that women are at significantly higher risk of death from heart attacks than men due in large part to misdiagnosis of their unique symptoms. However, most leading cardiovascular disease therapies and diagnostic tests have been developed from a predominantly male perspective. The collective AI industry must make a concerted effort to ensure that women are not excluded from the new healthcare revolution.

These challenges present new opportunities for ethical innovations and commercialisation strategies that incorporate diversity. At Start Codon, we are committed to investing in the next generation of life science start-ups leveraging AI for the benefit of all. We back founders who embrace diversity across their organisations, from their board composition and management teams through to their product development strategies. Ultimately, AI has the potential to eliminate systemic, long-standing disparities if we prioritise health equity across the industry.



startcodon 

Jason Mellad is a scientist entrepreneur. As CEO of Start Codon, he identifies and recruits the most disruptive healthcare start-ups worldwide, provides seed funding and leverages the exceptional resources of the Cambridge cluster to de-risk and drive their success.

# HOW AI IS CHANGING THE WORLD OF HEALTHCARE

Kyle Giddens, CEO, edgecase.ai

We are living in a world of increasing change and new realities. With the ongoing COVID-19 pandemic fuelling adoptions of new technologies, it is clear that we will not go back to the way we were. One of the prevailing technologies that is currently seeing its time to shine is AI – specifically, AI related to visual recognition of components within healthcare, like identifying breast cancer in mammography imagery or diagnosing health issues like cancerous polyps or other visual indicators.

But before we dive deep into the ramifications of these developments, let's establish a common set of terms so that we are all on the same page:

## **What is AI?**

AI as it is referred to here is based on a fancy technology that is essentially a great 'pattern matching engine' capable of making guesses based on training data or labelled items. Similar to when you see a car and 'guess' that it is most likely a BMW, the AI makes its best guess and provides its level of confidence in the outcome.

If given the correct data, this kind of AI can be trained nearly out of the box. This is done using existing public cloud AI training systems offered by Google, Amazon Web Services (AWS), Microsoft or IBM.

## **What is training data?**

Training data is the imagery or text that you are intending to recognise. This data is manually labelled (or automatically labelled by AI models) with the correct information. For the sake of this brief article, we are going to use non-labelled mammograms showing cancer, and labelled mammograms showing cancer.

## **Why is training data important?**

Labelled data is the 'fuel' that is used to train the AI. Similar to when you teach a small child using examples ("See over there Sally - that is a cat!"), AI is trained by being provided many examples of correctly identified objects.

## **Why is AI being implemented now?**

The main blockers for the adoption of AI algorithms in the clinical setting to correctly identify image-based data from MRIs, to X-rays, to videos is twofold:

1. Access to the data
2. Correctly annotated (identified) data.

Due to justifiable privacy concerns, healthcare institutions are reluctant to share or license their anonymised data for the training of AI - so every company that is seeking to build a mammogram cancer detector (or something similar for oncology, gynaecology, ophthalmology or any other practice) must search and find licensing partners to get the data they need every time.

This data is not 'AI ready'. It is not labelled in a format that the AI can understand, and



“

*What the industry is lacking is open access to data, and a lack of clinicians to annotate this data with appropriate quality standards.*

”

therefore needs to be accurately labelled. What that means in practice is that a doctor/radiologist must clearly label the area where a suspected tumour, is and this will be the ‘correct data’ that will be provided to the AI. Once the AI is ‘fuelled’ with thousands of examples, it is then able to identify objects at a higher level of accuracy.

#### **What is the next step?**

All of this labelled data is then fed to the AI and the algorithm is trained. The accuracy of the AI when recognising tumours in mammograms will depend on the amount of correctly labelled data from the multiple sources you feed it with.

#### **What the industry is not telling you**

The majority of the AI frameworks are open source, and the underlying technology behind visual recognition of objects is in fact a solved industry problem. What the industry is lacking is open access to data, and a lack of clinicians to annotate this data with appropriate quality standards.

#### **What does this mean in practice?**

Within the next decade we will have helpful algorithms filtering and correctly identifying all sorts of pathologies, tumours, and other potential problems from MRIs, sonograms, videos, and images across the entire healthcare domain.

This will result in the changing role of the clinician from diagnostician to adjudicator of algorithms, and then determining the best course of action. Imagine you can send a picture of your sore throat via an app that will diagnose you with strep throat or a common cold, or tell you if your rash is contagious or not. These ideas are no longer science fiction but are an emerging reality.

Moreover, tech giants such as Microsoft, IBM and Amazon are making huge pushes into healthcare, leveraging their technological prowess to go head-to-head against traditional healthcare providers. As healthcare providers are typically geographically locked, these tech companies can have a global offering that is difficult for healthcare incumbents to compete with.

#### **What is therefore needed for the entire industry?**

Our company [edgecase.ai](https://edgecase.ai) has the strong belief that there needs to be a centralised entity to function as a marketplace of clinicians for data labelling, access to the correct tools to conduct data labelling, and access to data that can be licensed for AI in healthcare to prosper. And that is exactly what we build. We are looking forward to helping democratise access to healthcare and making the world a better place for all of us.



 **edgecase.ai**

Kyle Giddens, CEO, edgecase.ai is a Canadian-born, serial entrepreneur focused on building scalable healthcare outcomes for a better tomorrow. You can find him reading great books, hanging out with his family and dog.



# ENDLESS APPLICATIONS: THE POTENTIAL OF AI

Dr. James Somauroo, Founder, somX

It is undoubtable that AI has become ubiquitous to our daily lives, but it's only now that we're starting to see its true potential come to the fore in healthcare.

I'm often asked about the most exciting innovations in healthtech, and my response nine times out of 10 is AI. Having worked as an anaesthetics and ICU doctor, I find it incredible to see AI and machine learning mimicking the learning processes of the human brain; using data to improve clinical pathways, intervention and treatment; and enabling positive changes that make a genuine difference to care. The use of AI in healthcare is also incredibly wide-reaching and varied, with its benefits being felt across specific specialties like radiology, pathology and dermatology; also in clinical processes like decision support, diagnosis, drug discovery and even patient-facing areas like patient engagement and adherence to medication. Its ability to problem-solve and automate processes means that the applications are endless.

The evidence base for AI innovations in healthcare is compelling, with prospective studies now published regularly in reputable journals like NPJ: Digital Medicine and The Lancet Digital Health. However, relatively speaking, we're still in the very early stages of AI in healthcare and, as a result, there is still a great deal of learning we will go through before mass-adoption.

The ethical implications and parameters are only now beginning to emerge, yet are critical areas that need thorough examination and consideration. The algorithms used in healthcare process highly personalised and sensitive

information and, consequently, it is critical that clear guidance and regulation over surveillance and responsible data collection are addressed urgently to keep up with the speed of innovation. The companies that will be most successful are the ones that not only perform well but that are also transparent and robust in their approach to quality management and data protection. I concede that it's not the sexiest part of AI, but, given the speed of its evolution, it could prove to be the most important part.

There are numerous organisations working to address some of these challenges, including the NHS AI Lab (NHSX) and the US Food and Drug Administration (FDA), but one that is clearly trying to write the rulebook is the Institute for Ethical AI & Machine Learning. The UK-based think tank and research centre is made up of volunteers, including machine learning engineers, data scientists, industry experts, policy-makers and professors in Science, Technology, Engineering and Mathematics (STEM), Humanities and Social Sciences, and as an organisation, they work with industry, academia and government. In order to support the responsible development, deployment and operation of machine learning systems universally, they have set out a framework of key principles for ethical AI. I've heard certain areas of healthtech described as the 'Wild West' when new technology breaks through and the good guys don't always win - you can go farther, faster



“

*I'm often asked about the most exciting innovations in healthtech and my response nine times out of 10 is AI.*

”

and get ahead of your competition when you're less concerned about the security and resilience of your technology. A framework like this, however, allows all players in the ecosystem to measure up technology companies against standards and principles - and, to complete the analogy, identify the cowboys.

Another challenge posed by the advent of AI in healthcare is that of increasing inequality and lack of access. I believe it to be important that innovative, personalised high-tech treatments and interventions are available to more than just those who can afford them.

Feebris are a tangible example of how AI can actually widen access and amplify impact through innovative business models. They're able to deploy their platform as far and wide as rural India by creating a system that can be used by anyone who has received training on their devices. This means that capturing reliable and accurate data is not reliant on the presence of a clinician and, as a result, models of care can completely change, healthcare can be scaled and people are able to be monitored remotely across the world in all sorts of communities, enabling earlier intervention and treatment for those who need it.

The final piece of the AI puzzle in healthcare is the workforce. Once upon a time, there were concerns that AI and machine learning would replace clinicians (I'm told that a brave radiologist declared this many years ago at a conference to spark the initial wave of panic), however, that isn't where the sector is headed; in fact quite the opposite. As Eric Topol laid out in the

recommendations of his Topol Review, it's actually about preparing the current workforce for a digital future with new models of care. Whilst there might be a shift in roles and people will have to diversify, become more generalist and/or upskill in the areas that technology demands, I agree with Eric Topol and believe that AI will gift healthcare professionals the time to reconnect with the human side of medicine, rather than the complex processes that often act as barriers to delivering the best possible care.

I have a huge amount of respect for the entrepreneurs building AI in healthcare. While one might argue that the technology is maturing, in healthcare, it is, frankly, still in its infancy. To actually use AI safely and then scale across sites is not easy and, for many, has required brand new business models and a complete rethink of how AI can be adopted in healthcare. That said, the sector has made huge strides and we're now approaching something of a breakthrough in understanding and appreciating the value of AI in improving health and care for people all around the world.



**somX**

Dr. James Somauroo is the Founder of healthtech agency somX, host of the Health-Tech Podcast and a healthtech writer for Forbes.

# THE POWER OF CONVERSATIONAL AI IN DELIVERING SELF-SERVICE SOLUTIONS TO HEALTH PROFESSIONALS, PATIENTS, AND CONSUMERS

Richard Marcil, Chief Customer Officer, conversationHEALTH

Self-service has emerged with abundance in 2020, significantly accelerated by COVID. In every facet of our lives, we want and expect service from our providers, whether for technology, shopping, banking or many other applications. It's always on - 24/7/365 - and always fast.

But that's easier said than done in life sciences, where accuracy matters most, and where there are complex and comprehensive regulations. The bar is high in terms of availability, accuracy and the need for human-like interactions. That's where conversational AI comes in.

Why conversational AI and conversational agents now? First, we need to capitalise on a generational change in technology and user behaviour. The self-service era has been a long time in the making. The web completely changed our ability to access and consume the world's information. Social media and apps are further extending that, building communities of interest, platforms for broadcasting, and apps to consume it all. But it's messaging and conversational AI that simplify information search to a human-like, bi-directional ask and answer interaction, especially powerful in healthcare.

Second, health professionals, patients and consumers want it. They are increasingly expecting digital-first, digital-fast, self-service in every aspect of their lives. In fact, 87% of healthcare professionals want either all-virtual or a mix of virtual and in-person sales rep meetings, even after the pandemic ends, according to the

Accenture Healthcare Provider Survey (May 2020). But, if anything, conversational AI has the ability to reduce complex, lengthy medical information into more consumable bits - with, of course, the ability to still access the more detailed information, as needed.

Third, conversational AI-enabled self-service creates significant business value. In addition to responding to customer needs in real time, life science companies can engage more customers because of digital scale. Whether it's providing clinical trial support, or facilitating the delivery of scientific information, and acting as a virtual sales representative, conversational AI can scale without limitations - unlike humans. And it can do so with consistency and compliance, across geographies and languages. And the data it generates reinforces the business in multiple ways, from customer insights, to what's working, to where there is more need for support.

Lastly, conversational AI-enabled self-service significantly decreases costs. For example, life science companies have extensive call centres staffed with high-value and high-cost medical professionals responding to mostly non-technical inquiries. Conversational AI agents can actually



“

*Customers have the need for speed, convenience, and utility. It is time to take a customer-centric approach.*

”

respond to these non-technical queries with a well over 95% response rate – and 24/7/365 access. This frees these medical professionals to do higher-value work and reduces call centre operational costs drastically. In fact, a large majority of non-technical interactions with health professionals, patients and consumers can be automated in a similar way, allowing life science companies to reinvest in value-creation work, i.e. research and development.

In short, customers have the need for speed, convenience, and utility. It is time to take a customer-centric approach. Those who do this well and fast will grow engagement, share, margin, and profitability faster than their peers – a good place to be.

In sum, the combination of AI models and computer power is allowing us to have human-like conversations at scale in some of the most challenging industries, such as life sciences: something we could not have done five years ago. Regulations require high accuracy and compliance, and medical language is unique, complex, and nuanced. We are now beginning to broadly deploy such conversational AI agents across company lines of business, geographies, and languages, and facilitate the interaction between a company and its customers for better service and health outcomes.



**conversation**  
**HEALTH** 

Richard Marcil is a C-level executive with 20 years of building brands and businesses in start-ups and multinational organisations, in North America and globally.



# A STRATEGIC APPROACH TO AI IN HEALTH

Vivienne Winborne, Director of Communications, Alphasake Ai

“Learning from the past, if we can just meter our excitement and allow for this technology to be developed at a reasonable pace, with realistic goals, it’s possible that we could reach some of the heights we’d always hoped. We need to realise, once again, that nothing in medicine ever comes easy, and all of the intelligence in the world, artificial or not, won’t change that.”

- Jason Moore, PhD, Director of the University of Pennsylvania’s Institute for Biomedical Informatics at the Perelman School of Medicine

There is no doubt that AI and automation will widely impact the health industry. We already see robotics deployed to advance surgical accuracy, computer vision used to assess thousands of medical imaging scans, machine learning to support clinical diagnosis, and deep learning to analyse medical data to extract actionable insights.

Additionally, healthcare is embracing a wave of automation solutions, such as Robotic Process Automation (RPA) and no-code connector platforms that are tackling decades of disjointed data silos and overly manual processes.

But how can we deploy robust, scalable and sustainable solutions?

*The first step is to build a strong foundation of improved user experience (UX), cultural change and watertight ethical data guidelines.*

With these basics in place, we can then look at working towards longer-term goals.

## **Fit-for-purpose solutions**


In the corporate sector, value is measured against the business bottom line. Process optimisation, reducing manufacturing errors or improving customer satisfaction all come back to an improved bottom line.

In healthcare, however, while the bottom line is critical (resources are extremely limited after all), even more crucial is the impact on human life, i.e. the patient outcomes.

The genuine risk to lives is one of the primary reasons that healthcare has traditionally been slower to adopt change. Any healthcare solution to be implemented must have a cost-benefit, improve patient outcomes, and integrate effectively with the current systems. And while many workflows are candidates for automation, with a limited budget, it’s crucial to select the ones that will deliver the most value in the immediate future. Let’s look at some examples.

There is a big push for RPA implementation to complete repetitive administration work at the NHS.





With insufficient funding to hire extra staff for data entry work, it makes sense to use machine learning, natural language processing and computer vision to achieve this, ensuring that patient data will be available in an emergency scenario.

However, suppose you look at India, where they have a population of 1.353 billion people. They have the human resources to get repetitive administrative tasks done without turning to automation. Instead, their focus is on how to deploy care to remote areas of the country. Therefore, their technological investment focuses on telemedicine to deliver a high standard of care across the country.

Royal Brompton & Harefield NHS Foundation Trust took a different approach. They determined they could gain the most value by deploying an RPA bot to transcribe the charts from the intensive care unit system to the DXC pharmacy management solution. This project ticks the boxes of being high value, repetitive, and critical to patient safety, as the smallest decimal point error could be fatal.

While in the longer term, it isn't an either-or scenario, in the short term, organisations frequently need to choose where to channel their resources.



### **The cost-benefit analysis**

Two main challenges need to be overcome for us to progress with next-generation technology in healthcare. The first is that healthcare has always taken a 'prove the cost savings before investing' approach. This approach to innovation is very much fear-based and doesn't take into account any unexpected benefits, which often arise throughout a project.

The second challenge is that healthcare in the UK, and in many countries, has not traditionally been great at incentivising health providers to share learnings and results for the greater good. In effect, health providers end up competing against one another and, when it comes to common hurdles like data interoperability, there is a clear benefit in using consolidated buying power and shared data. But to take advantage of this, there needs to be a change in funding structure and more clarity around budgetary responsibility.

### **Measuring value and optimising innovation**

Finally, we must ensure that health organisations are getting the most value from the implemented solution. On many occasions, project results are not measured, analysed and reviewed to improve performance. Also, key learnings have not traditionally been shared with other healthcare organisations to allow them to benefit from shared experiences, for the greater public good. Finally, we need to improve time to value. In doing so, we can innovate a lot faster, as a further investment can be made in continuous improvement whilst proving value at every stage.

The technology is there and is becoming more advanced every day. Now we humans need to roll it out strategically and sustainably.



**Alphalake Ai**<sup>®</sup>

Vivienne Winborne is the Director of Communications for Alphalake Ai. She is passionate about making the world a better place through healthcare transformation, sustainability and equality.



# AI: A CATALYST FOR TRANSFORMATION IN EAR HEALTH

Krishan Ramdoo, Founder and CEO, TympaHealth

AI is no longer the mysterious technological unknown that it once was. In fact, it is now arguably woven into the fabric of our daily lives. Alexa tells us the weather and puts together playlists based on our music choices, Tesco personalises our shopping discounts using data from previous purchasing behaviours, apps predict menstrual cycles and Facebook serves us ads informed by our browsing habits.

Through effective automation of processes and problem-solving, AI is pushing the boundaries of innovation across practically every industry imaginable, and none more so than healthcare, where its use is already relatively widespread. Spanning drug discovery, through automation of diagnosis to supporting patient engagement and adherence, the potential for impact in the sector is exponential.

With new proven use cases springing up on a regular basis, one particular area that has shown real promise is screening and diagnostics. A study published in the [Nature](#) journal earlier this year highlighted the high potential for human error in the identification of breast cancer via mammograms screening. When AI was then introduced as a direct comparator, the technology demonstrated accuracy that surpassed human experts in predicting breast cancer. At a time when the health system is already bursting at the seams and trained professionals are in short supply,

integration of AI into the diagnostic journey would seem to make good sense.

But it is also important to note that AI should not be viewed as a replacement for the work carried out by medical professionals, but rather an additional tool that is there to enhance their capabilities. In the case of medicine, an AI diagnostic model can serve as an additional layer of support and validation for qualified doctors or nurses, leaving them to focus on other aspects of their roles that an AI machine cannot provide, like quality patient care.

A [collaboration](#) between Moorfields Eye Hospital NHS Foundation Trust and DeepMind set out to find new ways to utilise the power of AI to support clinicians in their care for patients. The resulting programme is now able to recommend the correct referral decision for more than 50 eye diseases with 94% accuracy, matching world-leading eye experts. Here again, AI continues to demonstrate



its potential for the revolution in eye care diagnosis, enabling conditions to be spotted earlier and prioritisation of patients with the most serious conditions.

At TympaHealth, our focus is on the transformation of ear and hearing care. As with many specialisms, the journey to diagnosis for patients can be long, requiring many consultations with numerous doctors across a variety of specialities. Therefore, it's our mission to bring ear and hearing care into the community, and placing better and faster access to diagnostic and treatment services, and AI evidently has an important role in facilitating that.

There has been limited study on the use of AI in the context of hearing and ear care. The use of smartphone otoscopes certainly looks like it can help to develop this sector further. Recent studies, including one that used a smartphone otoscope, have shown promise in the use of the digital otoscope in a learning environment. In many cases Ear, Nose and Throat experience is limited in medical school to just one week as a special study block. The advent of AI would certainly help in recognising conditions of the ear, and streamlining referrals.

Another study, published in Otology and Neurotology in September 2020, showed that machine learning helped to predict post-operative performance of a cochlear implant, as well as identifying the influencing factors. This shows the sector is receptive to this change, similar to specialties such as Dermatology and Ophthalmology.

Building on these studies, at TympaHealth we have a team of machine learning experts to help us embed the technology into our own processes and platforms effectively as a means to improve diagnostic capabilities and ultimately improve patient outcomes. Much like the Moorfields and

DeepMind collaboration for eye health, our existing diagnosis system uses machine learning assistance to identify ear conditions. However, that is only the very start. We're also exploring new ways to harness the power of AI to develop a fully integrated machine learning platform as well as using algorithms as predictors of future ear health deterioration.

In the recent Topol Review, which set out a vision for the future of digital health, Eric Topol reinforced the importance of preparing our health and care workforces for a digital future.

There is clearly a bright future for AI in healthcare, which has proven itself time and time again, especially at a time where technology and digital innovation is beginning to move front and centre in the mission to provide better and faster care. In the UK, our NHS system is already overstretched during normal times, and now with the additional pressures caused by the pandemic, it is imperative that we find new solutions that enable people to access the care they need, whilst relieving the burden on the healthcare professionals.



Krishan Ramdoo, Founder and CEO of TympaHealth, has more than seven years' experience working within the NHS as a specialist doctor and still practises today.



# PRIMARY CARE'S THREE ISSUES: CAPACITY, CAPABILITY, AND SCALE

Dr. Elina Naydenova, CEO and Co-founder, Feebris

There have been sweeping advances in the development and use of AI in healthcare – the main impact has been seen in hospital settings, where advanced algorithms have been increasingly augmenting clinical decision-making to aid the delivery of precision medicine. The development of similar technology for community or primary care settings lags behind, and the COVID-19 pandemic further highlights the limitations of a centralised model of care.

In the UK, there are currently twice as many care home beds as hospital beds and, with advancements in healthcare and a greater ability to invest in personal health, people are living longer. With an ageing population, the need for greater resource and capacity in elderly care has continued to rise and there is now a significant opportunity to more effectively manage disease detection and triage in the community. In order to realise this potential, we need a paradigm shift in the system – capabilities of the community workforce need to grow, and primary care capacity must be increased to ensure that more health issues can be dealt with proactively without the need for hospital admission.

To address these challenges, we have to consider three key and connected issues: **capacity, capability, and scale.**

## Capacity

Primary care was already beyond maximum capacity before COVID-19 hit and, now in the midst of the pandemic, the system is bursting at the seams. Globally, there is an increasing shortage of healthcare professionals (HCPs). In the UK alone, there is an estimated shortfall of at least 100,000 full-time healthcare roles, and without major action, this gap could exceed 250,000 by 2030 (Health Foundation, 2018). This limited capacity is causing an increasingly limited access to healthcare services. For instance, in October 2019, 3.3 million people waited for more than three weeks to get a GP appointment. In addition, almost half of the diagnoses for severe conditions, like cancer, have been reported to arrive too late, costing money (£150m in additional treatment costs and £2.4bn annually paid to cover wrongful, failed or delayed diagnosis) and lives. As a result, the Care Quality Commission spotlighted the issues as the biggest threat facing the NHS (The Health Foundation, 2019; Care Quality Commission, 2018).

Medical training for entry-level doctors takes seven years alone, and there is currently little hope of training enough people quickly enough to address the shortfall. Instead, we must find new ways to solve the problem. AI-driven digital health technologies have an important role to play in helping grow the capacity of primary care in two critical ways: (1) streamlining and automating manual processes; (2) providing critical decision-support to enable task-shifting of certain clinical processes from doctors to care staff.



Feebris was set up to deliver just that. The technology is designed to enable a non-clinical worker, a carer or a health assistant, to capture high-quality measurements with medical sensors, and triage issues to HCPs. Advanced AI-algorithms evaluate individual measurements, providing real-time feedback to the carer to ensure no noise/error is introduced into the data, and standardising the detection of issues. This augments the capabilities of the carer, standardising quality and opening-up an otherwise clinical activity to anyone, ultimately saving clinical time and resource.

### Capability

Social care services increasingly need to play a role in critical decision-making for healthcare issues. From facilitating virtual ward rounds with GPs, escalating a health concern to the hospital, or even confirming a death when a GP is unavailable – social carers are taking on healthcare responsibilities alongside their usual caring responsibilities more and more. However, task-shifting of clinical activities to social care workers is not as simple as providing them with technology and expecting them to absorb these new processes. To truly build up the capability of a community workforce to take on blended health and care responsibilities, effective task-shifting requires three fundamental pillars: (1) coupling decision-support tools with continuous performance evaluation; (2) aligning performance evaluation with upskilling and professional

development; (3) providing change management support for social care settings to restructure their workflows and embed new technologies and processes. Without all three pillars, even the most capable AI solutions will struggle to realise impact at scale.

Feebris has been building up a model of embedding AI-driven solutions in community settings and has validated it in some of the most challenging settings. Originally, the AI-platform was built to upskill an abundant workforce in countries with sparse primary care delivery – community health workers (CHWs). In India, the technology has been used for large-scale health evaluation of childhood illnesses, helping CHWs detect life-threatening conditions such as pneumonia, and to accelerate access to treatment. The AI-platform has also been used in care homes, helping carers perform regular monitoring of health needs, and drive a precise remote clinical response. This has reaffirmed our belief that AI can be both an equaliser for access to and quality of healthcare globally.

### Scale

The Topol Review was clear in its recommendations that AI solutions will have a critical role to play in supporting HCPs to adopt digital health solutions at scale. Whilst digital solutions for remote healthcare monitoring may have slowly become more integrated into healthcare services, the biggest barrier to scale is reliance on the already overstretched clinical workforce who are still

required to interpret each data point and then decide the level of reliability and action to be taken.

There simply can't be any remote monitoring at scale, without clinically validated AI solutions augmenting processes and filtering large volumes of data to help focus critical clinical decision-making. Across health and social care, we need to make infrastructural investments today that help us realise these capacity and capability gains at scale tomorrow.

Feebris continues to respond to these challenges; developing new functionality that enables quality control of data capture in the community, streamlined referral channels and remote decision support for integrated decision making for a multidisciplinary health and social care team.

Together we must create solutions, technologies and services that can be agile and adapt to the capability and capacity needs of our already overstretched health and social care services, at scale.



Dr. Elina Naydenova, CEO and Co-founder of Feebris, holds a PhD in Machine Learning for Healthcare Innovation from Oxford University and created the concept for Feebris whilst interning at the World Health Organization in 2014.

# HEALTH SELF-MANAGEMENT: HOW AI CAN ENABLE HAPPIER LIVES

Oliver Miles, Behavioural Scientist; and Brett Moreton, Insights and Analytics Lead, Ampersand Health

The NHS published its [Long Term Plan](#) in 2019, setting out its plan for changes to the current health structure, to support the transition towards a more efficient, effective model of public health. This plan includes a notable focus on digital health, including AI, machine learning and emerging technologies, as well as behaviour change – particularly with at-risk groups. We see this as a positive move towards embracing new technology that can improve the overall healthcare system, but there have been several barriers to uptake. The COVID-19 pandemic, however, has created a situation of urgent need for solutions that enable remote patient-clinician interaction and patient self-management – two areas that our digital therapeutics address.

As society's needs evolve toward more personalised and proactive healthcare, healthtech companies like Ampersand Health are at the forefront of enabling more effective and efficient patient care. This transition is significant as it marks a move from the current inflexible, episodic model of care, where patients are seen on set dates (when their current health state may not warrant a clinical consultation) to a more flexible and responsive model of care (where patients can be seen by their clinical team when they need care the most).

Ampersand Health's focus is around inflammatory conditions, which are complex, life-long and are characterised by periods of remission (limited disease impact on day-to-day life) and flare (high disease impact on day-to-day life). Flares can be very serious and can lead to extended stays in hospital for treatment and recovery.

The onset of flares is caused by a complex combination of factors; however, there is evidence

to suggest that lifestyle elements, such as stress, exercise and quality of sleep (to name a few) all influence flare frequency and severity.

As a result, improved self-management is routinely recommended by clinicians. Self-management allows those living with inflammatory conditions to take more control over their health and wellbeing, shifting towards patients taking a more active role in their own healthcare. Self-management goes beyond symptom and treatment management, encompassing lifestyle and psychological factors to improve a person's quality of life.

At Ampersand Health, we have created a series of behavioural-science-based digital therapeutics delivered via our apps ([My IBD Care](#) and [My Arthritis](#)) to promote self-management – all aiming for its users to live happier, healthier lives. These technologies integrate seamlessly with smartphones and hospital systems, in keeping with the societal advancement towards the greater use of technology in everyday life and clinical settings,

and ensuring that they are easy to use. For a greater explanation of how we have created Digital Behaviour Change Interventions (DCBIs) for those living with inflammatory conditions, please see our recent [white paper](#), 'Designing Digital Behaviour Change Interventions to Improve the Quality Of Life for People With Inflammatory Conditions'.

One outcome of the societal shift to the digital world is that it leads to data being generated in vast quantities. This data offers many beneficial and positive opportunities for improved patient outcomes and greater use of limited resources. Our digital therapeutic tools are further enabling this by allowing clinicians to view their patient data in real time, improving their ability to target care, and enhancing the quality of their decision making, therefore maximising the use of their clinical capacity when at work.

*As a practice area, Big Data surfaces relationships and patterns that are largely imperceptible to humans.*

The advent of machine learning continues to create opportunities for step changes in the way that care is personalised, delivered and consumed.

We derive a deeper understanding into data through the application of statistical and computational models, revealing insights and identifying relationships between data points that previously went unnoticed by the human eye.

At the individual patient level, this data enables the deployment of [Just-in-Time Adaptive Interventions](#) into our digital therapeutics, recommending

courses to users when they need intervention the most. This responsiveness will potentially allow users to take control and self-manage their condition before the onset of a flare, which will have significant implications on the patient's quality of life.

While acknowledging that data privacy, acceptability and the ethical issues surrounding the use of AI in healthcare (and elsewhere) remain areas of open discussion, Ampersand Health is committed to working with informed, consenting patients to develop new approaches to disease profiling, drug responses and other areas of scientific interest. The use of emerging technology and AI to enable this is key, and we see more benefits than drawbacks in its use.



Oliver Miles is a Behavioural Scientist and Brett Moreton is an Insights and Analytics Lead. Both work at Ampersand Health.



# HOW AI AND EMERGING TECHNOLOGIES ARE AFFECTING THE HEALTHCARE SECTOR

Rudy Benfredj, Chief Executive Officer and Co-founder, mendelian

**Our National Health Service (NHS) in the UK was founded decades before AI health technology became an established field with concrete, viable products. Over the more recent years, it has therefore been somewhat challenging to incorporate AI tech into our existing healthcare processes and clinical practice, and explain the efficiencies, benefits and cost savings to healthcare practices.**

However, one positive outcome of the COVID-19 pandemic is that both the NHS and private healthcare systems in the UK had to adapt quickly and adopt digital solutions, which enabled remote consultations to take place and patients to monitor their health at home, where possible. For many working in healthcare, this has opened their eyes to the advantages of innovative healthtech solutions. The 'heavy door' providing access to healthcare decision makers, which has previously been difficult for many with healthtech solutions to knock on, has now been swung wide open and innovators are being warmly welcomed and their solutions seriously considered.

This is a once-in-a-generation shift in mindset and has hopefully established a long-lasting receptiveness for AI developments that can change various aspects of healthcare and make them more efficient, freeing up time for NHS staff and reducing administrative processes.

Unlike other technology, AI is able to use algorithms based on existing data, and machine learning, to speed up diagnosis of diseases in the healthcare sector. It essentially is able to mimic the learning and development processes of the human brain with whatever knowledge is put into it.

At mendelian, we focus on rare and hard-to-diagnose diseases, which affect one in 17 people worldwide, but many face difficulties in diagnosis, leading to delays in treatment and the disease progressing. We have developed an AI product based on an algorithm that supports earlier diagnosis of rare diseases – the first ever tool that addresses rare diseases as a whole and integrates diagnosis into a national healthcare system. This is a hugely important factor in the rare disease field, particularly as these conditions are, for one, rare, and can also present a range of complex, disconnected symptoms over the course of years.

*The average time to diagnosis for a rare disease is four years in the UK, with some waiting over 20 years, just for a diagnosis.*

Whilst awaiting diagnosis, patients will go through many doctors' appointments, blood and other clinical tests, and try and test a range of medications. Not only can this be exhausting for the patient, but it often doesn't help improve the symptoms of their condition and can cost the NHS thousands of pounds in the process: in the past decade alone, undiagnosed rare diseases have cost the NHS in excess of £3.4 billion. In the meantime, a patient's untreated condition will progress and their symptoms can get worse. Only with a correct diagnosis will their clinicians be able to provide the right treatment for them and put them on an appropriate healthcare pathway.

The clinical community knows that the existing rare disease diagnostic odyssey is inefficient and



expensive for the healthcare system and hinders patients from timely access to correct treatments. However, a working solution that alters this process for the better has not previously been brought to the doctor's table - until now.

Our AI device MendelScan uses state-of-the-art technology, data capture and the latest medical knowledge to enable and improve rare disease diagnosis. We've encoded case-finding criteria for hard-to-diagnose diseases into MendelScan's digital library, ready to apply to any medical record system. This can be used by primary care clinicians, who are often a patient's first port of call for any health issue, to help narrow down the potential reasons for a patient's symptoms and produce a MendelScan report suggesting next steps.

To ensure that our device and its use in practice is suitable for doctors, we have a clinician-led approach and collaborate with internationally renowned rare disease experts, including Professor Phil Beales (Head of Genetics and Genomic Medicine at University College London's Institute of Child Health), Dr. Robin Lachmann (Consultant in Inherited Metabolic Disease at University College London Hospitals NHS Foundation Trust) and Dr. Derralynn Hughes (Clinical Director of Haematology, Oncology and Palliative Care at the Royal Free Hospital London). This ensures that every MendelScan report is backed by decades of clinical expertise.

*Our algorithm is unique and can make a real, positive difference to the rare disease diagnostic odyssey.*

The AI algorithm, which has been based on national guidelines, captures disease features from electronic health records across a patient population from participating doctors' surgeries. The records are scanned through our system, MendelScan, and patients are then matched to published diagnostic criteria for hundreds of rare diseases. Our clinical team and disease specialists then perform an extended medical history review and work with healthcare providers to recommend an efficient diagnostic pathway for a patient suspected of having an undiagnosed rare disease.

Our model is scalable and, using our AI technology, we plan to work with an increasing number of GP surgeries and the NHS to further build up our library of knowledge on rare diseases. We can then build this into the MendelScan, further developing its expertise and expanding its patient reach.

There will always be unmet needs in global health as we uncover more and more of our human biology, and we hope that our company mission can inspire and encourage others to use AI and other emerging technologies to develop solutions for the healthcare sector.



**mendelian**

Rudy Benfredj, Chief Executive Officer and Co-founder, mendelian, is a computer scientist who is passionate about health. He co-founded mendelian using AI and machine learning, which build tools to help doctors find rare disease patients faster and diagnose them earlier.

# WHAT NEXT FOR AI IN HEALTHCARE?

This report has shown that there are numerous opportunities to consider in the future of the healthcare sector. We hope that the report has provided some useful talking points about the future of AI and how helpful it will be as the sector moves forward.

Here are some final questions for you to consider, that we expect will form part of this debate:

What are the pain barriers that healthcare providers will need to go through before they can realise the opportunities?

Will COVID-19 ultimately be seen as a catalyst for the improved integration of AI into healthcare systems, or a missed opportunity?

How soon can the healthcare sector make the necessary investments to advance its infrastructure to be AI-ready?

What challenges must be overcome with regards to data privacy, acceptability and ethics?

What are the ultimate opportunities for conversational AI to handle patient engagement in a way that actually improves on existing relationships with patients?

Which areas of AI for healthcare promise the most compelling cost savings?

What opportunities can be created for healthcare providers to gain better access to data?

Can healthcare providers overcome the potential for inequality and lack of access around AI solutions?

How can the industry as a whole work to mitigate bias around ethnic and gender diversity in AI-driven solutions?



# CONTACTS

## The AI Journal

Tom Allen, Founder

- ✉ [tom.allen@aijourn.com](mailto:tom.allen@aijourn.com)
- 🐦 <https://twitter.com/TheAIJournal>
- 🌐 <https://www.linkedin.com/company/the-ai-journal>

## Buoy Health

Amy Molten, Director of Medicine

- ✉ [Engage@buoyhealth.com](mailto:Engage@buoyhealth.com)
- 🐦 <https://twitter.com/buoyhealth>
- 🌐 <https://www.linkedin.com/company/buoyhealth/>

## Novartis AG

Eva Martins, Global Head of Innovation

- 🐦 <https://twitter.com/Novartis>
- 🌐 <https://www.linkedin.com/company/novartis/>

## Insight Enterprises

David Le Pense, Director of Healthcare and Life Sciences, Digital Innovation

- ✉ [publicrelations@insight.com](mailto:publicrelations@insight.com)
- 🐦 <https://twitter.com/InsightEnt>
- 🌐 <https://www.linkedin.com/company/insight/>

## emteq labs

Graeme Cox, CEO and Co-founder

- ✉ [info@emteqlabs.com](mailto:info@emteqlabs.com)

## Start Codon

Jason Mellad, CEO and Co-founder

- ✉ [info@startcodon.co](mailto:info@startcodon.co)
- 🐦 <https://twitter.com/StartCodon>
- 🌐 <https://www.linkedin.com/company/startcodon/>

## edgecase.ai

Kyle Giddens, CEO

- ✉ [info@edgecase.ai](mailto:info@edgecase.ai)
- 🌐 <https://www.linkedin.com/company/edgecase-ai/>

## somX

Dr. James Somauroo, Founder

- 🐦 <https://twitter.com/jamessomauroo>
- 🌐 <https://www.linkedin.com/in/james-somauroo/>

## conversationHEALTH

Richard Marcil, Chief Customer Officer

- ✉ [hello@conversationhealth.com](mailto:hello@conversationhealth.com)
- 🐦 <https://twitter.com/convershealth>
- 🌐 <https://www.linkedin.com/company/conversationhealth/>

## Alphalake Ai

Vivienne Winborne, Director of Communications

- ✉ [hi@alphalake.ai](mailto:hi@alphalake.ai)
- 🐦 <https://twitter.com/AlphalakeAi>
- 🌐 <https://www.linkedin.com/company/alphalake/>

## TympaHealth

Krishan Ramdoo, Founder and CEO

- ✉ [info@tympahealth.com](mailto:info@tympahealth.com)
- 🐦 <https://twitter.com/TympaHealth>
- 🌐 <https://www.linkedin.com/company/tympahealth-technologies-ltd/>

## Feebris

Dr. Elina Naydenova, CEO and Co-founder

- ✉ [info@feebris.com](mailto:info@feebris.com)
- 🐦 <https://twitter.com/feebris>
- 🌐 <https://www.linkedin.com/company/feebris/>

## Ampersand Health

Oliver Miles, Behavioural Scientist; and Brett Moreton, Insights and Analytics Lead

- ✉ [info@ampersandhealth.co.uk](mailto:info@ampersandhealth.co.uk)
- 🐦 <https://twitter.com/MyIBDCare>
- 🌐 <https://www.linkedin.com/company/amp1/>

## mendelian

Rudy Benfredj, Chief Executive Officer and Co-founder

- ✉ [rudy@mendelian.co](mailto:rudy@mendelian.co)
- 🐦 [https://twitter.com/mendelian\\_co](https://twitter.com/mendelian_co)
- 🌐 <https://www.linkedin.com/company/mendelian/>