In collaboration with ZS

WORLD ECONOMIC FORUM

Scaling Smart Solutions with AI in Health: Unlocking Impact on High-Potential Use Cases

INSIGHT REPORT

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Foreword

Healthcare faces growing worker shortages, widening health disparities and unsustainable spending. AI can help – if we let it.

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In recent years, health and healthcare have seen significant advancement and innovation across various dimensions, including scientific findings, biomedical research and development, digital technology, processes and systems. However, healthcare faces significant mounting challenges, including a severe shortage of frontline healthcare workers, widening health disparities in wealthy and low- and middle-income countries, and all-time-high health spending that has failed to deliver the health outcomes countries are targeting for their citizens.

These issues do not have to be intractable. Artificial intelligence (AI), powered by machine learning (ML) and deep learning (DL) techniques, has been hailed as a potential solution to many of these global healthcare challenges. Use cases exist today that are both feasible and hold massive potential for impact – if responsible and ethical approaches are fully considered in their implementation.

Delivering on the promise of AI to alleviate pressure on healthcare systems and contribute to greater, more sustainable and more equitable global health will require collaboration across sectors, boundaries and corporate walls. This joint strategic report by the World Economic Forum and ZS aspires to serve as a primer on high-priority use cases for public-private collaboration to accelerate impact. It sets out a call to action for stakeholders from healthcare and beyond to unite around a common vision and set of tangible actions to unleash the full potential of AI, bringing about real and lasting change to global health and healthcare.

For this report, more than 400 attainable AI examples and applications have been synthesized, with the potential to change global health outcomes. The collaboration involved over 50 experts from biopharma leaders, healthcare providers, insurers, technology firms and innovators, government, academia, and non-governmental organizations to gain insights on the enablers of adoption. The body of work presents promising use cases for AI in healthcare, identifies barriers to implementation and provides supporting principles for acceleration.

Executive summary

AI offers hope for early disease detection, combating outbreaks and achieving breakthroughs in medicines. Collaboration is crucial to achieving this.

Over the past decade, healthcare and technology industry leaders, public officials and researchers have placed high hopes on harnessing advances in artificial intelligence (AI) and machine learning (ML) to transform healthcare. What's been lacking, however, is a way for multilateral stakeholder coalitions to unite around a common vision for the most attainable solutions that can build trust and confidence in providers, patients, policy-makers and business leaders.

Why AI depends on multilateral cooperation

Today's global health and healthcare stakeholders face a perfect storm of systemic challenges. Healthcare consumers live in an era of worsening well-being and physical health due to the increasing burden of mental health conditions and chronic illnesses, putting serious strain on systems due to greater demand. At the same time, healthcare inefficiency, worker shortages and physician burnout are placing pressure on the supply of care, creating a vicious cycle, pushing costs to new heights and skyrocketing global healthcare expenditures estimated to have totalled $12 trillion in 2022.

AI, defined by the World Economic Forum as "systems that act by sensing, interpreting data, learning, reasoning and recommending the best course of action", represents an intelligent, scalable system to support healthcare leaders, decision-makers and practitioners in their quest to solve these challenges – if used safely and ethically. Yet, healthcare has been relatively slow to adopt AI-driven tools and solutions due to a growing tension between the incredible things AI makes possible and the human trust needed to put them to use.

As such, the Forum has begun engaging stakeholders from across the Centre for Health and Healthcare to explore the transformative power of AI and ML against the backdrop of the digital transformation of health and healthcare, including by cultivating public-private collaboration to accelerate the responsible application of AI.

This report aims to:

- Create a shared taxonomy to express the breadth of healthcare applications for which AI is being used.
- Identify use cases that are attainable now and have the greatest potential to improve global health outcomes through sustained public-private investment
- Define the enablers most critical to AI's responsible widespread adoption and scale-up in healthcare.

Key takeaways

- Three factors are driving the adoption of AI in healthcare: the exponential growth of medical data, a healthcare provider shortage (exacerbated, but not caused, by the COVID-19 pandemic) and advances in what AI technology is capable of.
- Top use cases for sustained multilateral cooperation are in the areas of AI-driven diagnosis and risk stratification, clinical trial optimization, and outbreak intelligence and prediction.
- Several additional areas, including administrative, workflow and training solutions; automated triage processes; supply chain and manufacturing; and drug discovery also deserve greater exploration and may hold equal promise.
- To maximize the impact of AI in healthcare, data must be plentiful, useable and representative (to minimize bias); design must aid adoption by being transparent and inclusive, and applications must be seamless and scalable.
- Even with sustained public-private investment, strong data foundations and thoughtful, ethical AI policies must be implemented to build trust and accelerate adoption in an appropriate way.

Acting on this report's recommendations will require coordinated effort between public- and private-sector leaders. Creating change in health and healthcare requires multilateral partnerships across health systems, consumers, governments and civil society. These technologies will transform how care is defined and delivered – but only if stakeholders can solve underlying issues with data foundations, refocus efforts towards scaling rather than experimentation and give providers, patients, policy-makers and business leaders the confidence to use them.

Introduction: AI in health at a turning point

Intelligent health risks passing through a scrapyard of successes.

Not long ago, drivers relied on the humble printed map to get from point A to point B. GPS changed everything. While the public might not have fully understood satellite-based radio navigation, it didn't need to. The technology wasn't perfect, but it improved the status quo and so was quickly and broadly adopted once made available to consumers. Contrast this with self-driving technology, the adoption of which faces greater headwinds given its complexity, life-or-death stakes and the prerequisite that it works everywhere and in all conditions.

In this sense, AI in healthcare more closely resembles autonomous vehicles since the data and assumptions used to build algorithms are complex and often obscure. The consequences of an inaccurate algorithm can be grave, and many new processes and controls must be implemented. In addition, for solutions to transform health and healthcare, they must work at scale.

While some AI-driven healthcare solutions have proven their value, many others have struggled to achieve their promised impact. While these disappointments have many causes, they can be summarized as an excess of experimentation at the expense of focusing on how to scale successful experiments. As one technology leader at a global pharmaceutical company quipped, healthcare companies currently have "more 'pilots' than the airlines do". While testing and experimentation drive innovation, companies are advised not to launch a pilot unless they've seriously considered how it will be scaled if successful. Without this guardrail, AI in healthcare risks becoming a scrapyard of small successes – a motley collection of powerful tools that add up to less than the sum of their parts because, for one reason or another, too few people use them.

In 2019, Gartner predicted that, by 2022, only a fraction of AI projects would be successful across sectors.[1] Fast-forward to the present day in healthcare and, as interviews were conducted for this report, the evidence speaks for itself: While nearly two-thirds of the healthcare leaders polled rated AI as "very important" to achieving their organizations' goals, fewer than one-third said their AI initiatives had achieved their "desired value."

Systemic changes driving the advance of AI in healthcare

To springboard off Bill Gates's famous formulation, healthcare leaders tend to overestimate the promise of AI in the short term while underestimating it in the long term. Three structural trends are accelerating the rate of AI adoption today; ironically, they're simultaneously raising the stakes of "getting it right" in the long term while intensifying the degree of difficulty in the near term.

1. **The data deluge:** While exact figures are hard to determine, by some estimates, the doubling time for medical information in the mid-20th century was a matter of decades. By the 2010s to early 2020s, this estimate shrunk to a matter of years or even months. By 2025, global healthcare data is predicted to exceed 10 zettabytes, which equals 10 trillion gigabytes.[2] Meanwhile, a survey by ZS in conjunction with The Harris Poll, consisting of 1,000 healthcare providers from across the US, UK, Sweden, Germany, China and Japan, indicated that more than 70% said they are overwhelmed by the volume of patient data available to them.[3] At the same time, technology companies are developing new datasets for running large-scale simulations to help improve decision-making. Without the assistance of powerful technology, humans cannot use this data to improve health outcomes.
2. **Health system struggles:** COVID-19 exacerbated existing healthcare problems, worsening an already severe shortage of frontline healthcare workers, testing the solvency of many hospitals and national healthcare systems and more. The World Health Organization (WHO) estimates a worldwide shortfall of 10 million healthcare workers by 2030.[4] Meanwhile, more than half of US

hospitals and health systems expect to operate in the red through at least 2022.[5] AI offers the dual promise of allowing providers to do more with less while simultaneously reducing demand for healthcare by keeping people healthier.

3. **Technological advances:** Deep learning (DL) based on techniques where algorithms are trained on large datasets (such as billions of pieces of unstructured data) can make stunningly accurate predictions. It has the potential to transform healthcare through three broad avenues: it can make predictions about the scientific aspects of human biology and pharmacology, such as the structure of the "protein universe" or which mutations in a tumour sample make it likely to recur. It can make predictions about human behaviour – for example, if and when a person is likely to stop taking their medicine and what specific intervention is most likely to ensure continued adherence. It can also make predictions about human language – so-called generative AI, such as ChatGPT, that can create human-like text with minimal prompting. It is worth noting that AI is not the only solution to healthcare ills. Some challenges can be tackled using simple advanced analytics, as the American Diabetes Association is doing with diagnostic algorithms, which rely on "simple" Bayesian approaches, not deep learning, to drive earlier identification and treatment of diabetes.

> **Not only is the volume of data exponentially increasing, the types of data available are increasing at an incredible rate too. In particular, using unstructured data – whether it is scientific literature, natural language or even text transcribed from video or audio – presents an opportunity to leapfrog the limits of human processing capacity, using huge data volume paired with powerful emerging AI techniques.**
>
> Dan Neil, Chief Technology Officer, BenevolentAI

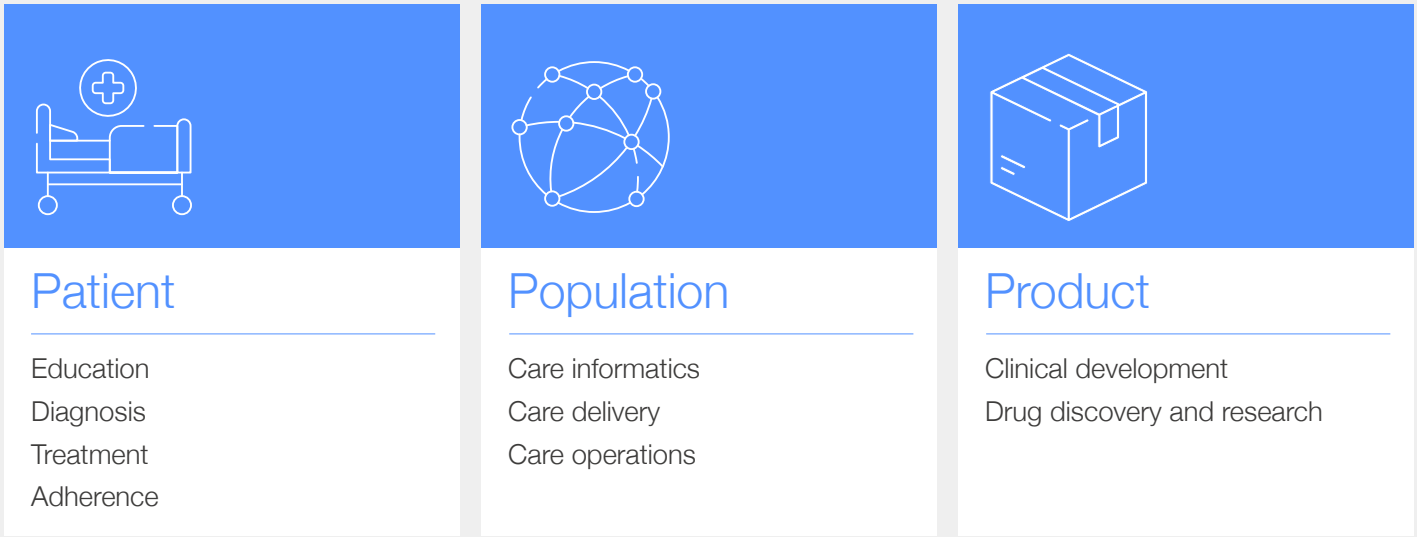
> **There aren't enough doctors for the people who need care, it's really as simple as that. How might algorithms support individuals making their own health decisions, automate clinicians' administrative tasks, and extend the reach of specialist care into all care settings? It's about solving a supply and demand problem for clinical expertise, and AI has large potential.**
>
> Jennifer Goldsack, Chief Executive Officer, Digital Medicine Society

Surveying the landscape of use cases for AI in healthcare

With so many potential use cases for AI in healthcare, it is critical to chart the broad range of possible uses and develop a common language. This allows for a shared understanding across geographies and contexts, which should help healthcare stakeholders make informed decisions about where (and where not) to invest time and resources in AI. Unfortunately, while many taxonomies have been proposed on applications of AI in healthcare, a universally accepted taxonomy does not yet exist. To understand how AI is being used in healthcare today, more than 400 published examples from between 2020 and 2022 were evaluated and placed into three broad categories, as seen in Figure 1.

It is important to note that value can be created and delivered from anywhere within this taxonomy. This report does not advocate for any one area holding more promise than others. Some categories, such as those singled out in Chapter 1, may have more to gain from the sustained public-private collaboration in the near term, which is at the heart of the World Economic Forum's mission.

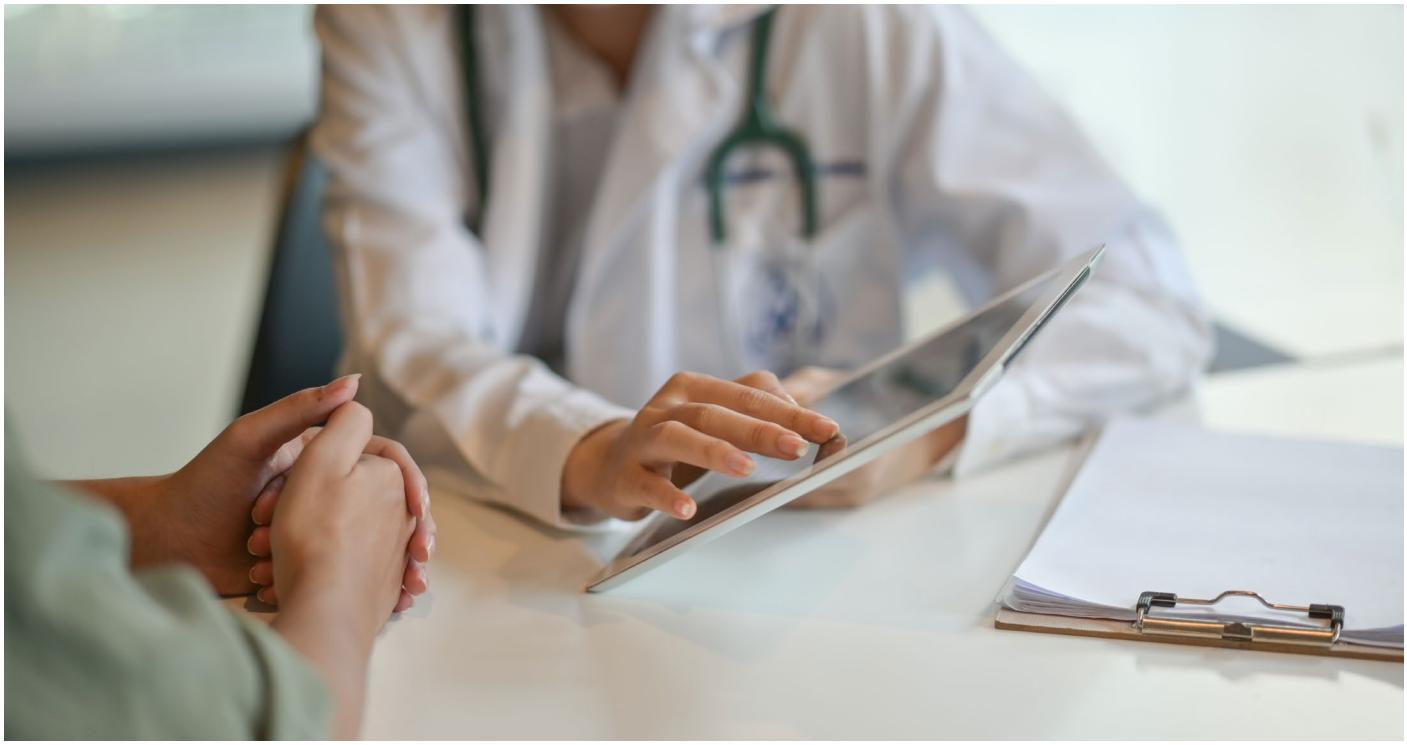
FIGURE 1 **A taxonomy of AI use cases for discussion**



A suggested taxonomy for AI healthcare use cases

Patient-centric: Use cases in this category include AI-enabled tools that can diagnose conditions earlier or more accurately, aid in patient education or increase treatment adherence. Stakeholders from across the spectrum, including non-governmental organizations (NGOs), pharmaceutical companies and governments, have made significant progress here already.

- **Treatment:** Algorithms can predict how an individual patient will likely respond to a specific course of treatment, a key example of how AI can augment – rather than replace – healthcare providers.
- **Education:** Applications using conversational AI can help patients better understand their condition, a family member's condition or take preventive action before developing a condition.
- **Diagnosis:** So far, this is most advanced in imaging, where algorithms have shown promise at detecting cancer and other maladies faster and, in some cases, more accurately than clinicians. New capabilities, such as using the sound of a person's voice to detect congestive heart failure, depression and COVID-19, are being explored.[6] However, many of these applications are still being reviewed by regulators.
- **Adherence:** AI-enabled digital health tools not only help patients with dosing reminders but can also predict the likelihood of patients discontinuing care and suggest appropriate proactive interventions.



Population-centric: This category includes tools that enable care delivery at the population level and tools that enable health system operations. While this area is of primary interest to healthcare providers, hospitals and health systems, given its impact on public health, governments also must act to influence progress and explore integrations with health promotion and prevention activities. Stakeholders must also ensure population level approaches strongly consider responsibility, and propagate health equity rather than biases – to avoid a "digital divide".

Here's how AI is helping or can help:

- **Care operations:** Administrative AI and automation tools can help healthcare providers better predict and prevent fraud and integrity issues and optimize staffing levels, lowering healthcare costs by eliminating waste.
- **Care informatics:** Hospital systems rely on IT and data systems that connect providers with patient populations to manage public health and create interventions. In some cases, multilateral teams are exploring the use of AI on informatics systems to predict disease spread, i.e. pandemic preparedness.
- **Care delivery:** These applications range from robotics-assisted surgery to everyday tasks, such as using conversational AI to triage patients.

Product-centric: This includes tools to assist in clinical research for drug discovery and development efforts. Both biopharma and health tech have invested heavily in this arena, and the public sector has ramped up interest as well to help accelerate medical innovation.

Here's how AI is helping or can help:

- **Drug discovery and research:** AI is being used to sift through millions of known compounds in search of cures and discover new drugs; or even predict the structure and effect of new pathogens and threats before they emerge.
- **Clinical development:** Life sciences companies are using AI to optimize clinical trial site selection and participant recruiting and retention, hoping to accelerate the 17-year average timeline from asset discovery to patient benefit.

1 Use cases for public-private acceleration

Seven impactful use cases prioritize global health outcomes and necessitate public-private partnership across different regions and settings.

> The purpose of winnowing the universe of applications is to spur stakeholders to focus on areas where they are best positioned to make progress and commit to doing so.

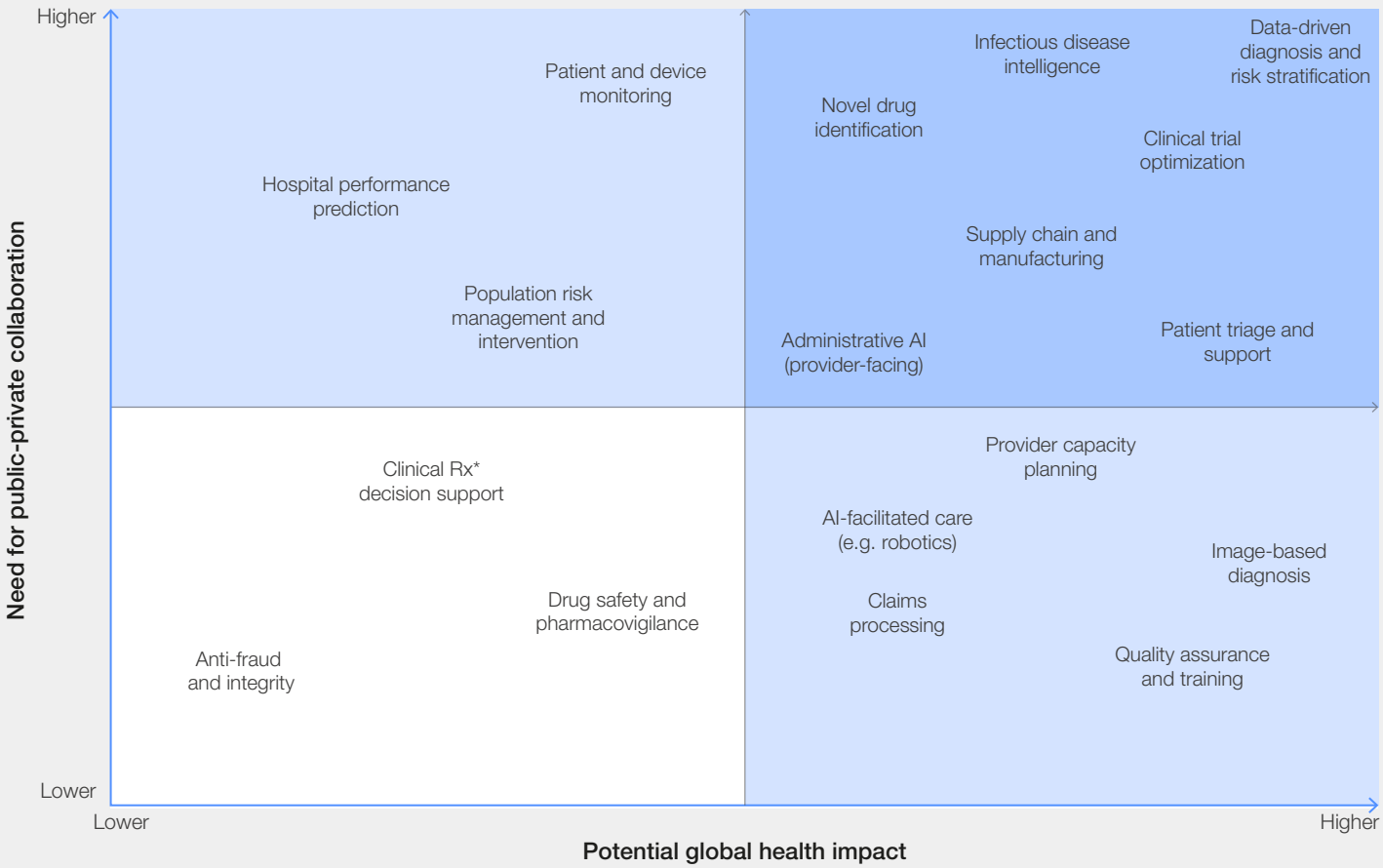
The World Economic Forum was founded on the principle of assembling multilateral stakeholder coalitions to address global challenges that can't be solved by private enterprises or public bodies alone. After interviewing more than 50 leaders from across biopharma, providers, insurers, technology firms and innovators, government, academia and non-governmental organizations, seven use cases rose to the top time and again: three that may be considered most ripe for public-private acceleration and four to be considered for deeper exploration.

The use cases that rose to the top did so because they share two characteristics:

- **Potential global health impact:** What is a use case's potential to positively affect global healthcare outcomes, access and efficiency?
- **Need for multi-sectoral collaboration:** To what degree would it benefit from public-private partnership and focus, with potential across high-, low- and middle-income countries?

Figure 2 plots the most critical AI in healthcare applications in terms of the need for complex collaboration and potential global impact. The purpose of winnowing the universe of applications to those few with the widest reach and highest potential impact is to spur stakeholders to focus on areas where they are best positioned to make progress and commit to doing so.

FIGURE 2 **Prioritizing AI use cases, illustrative exercise**

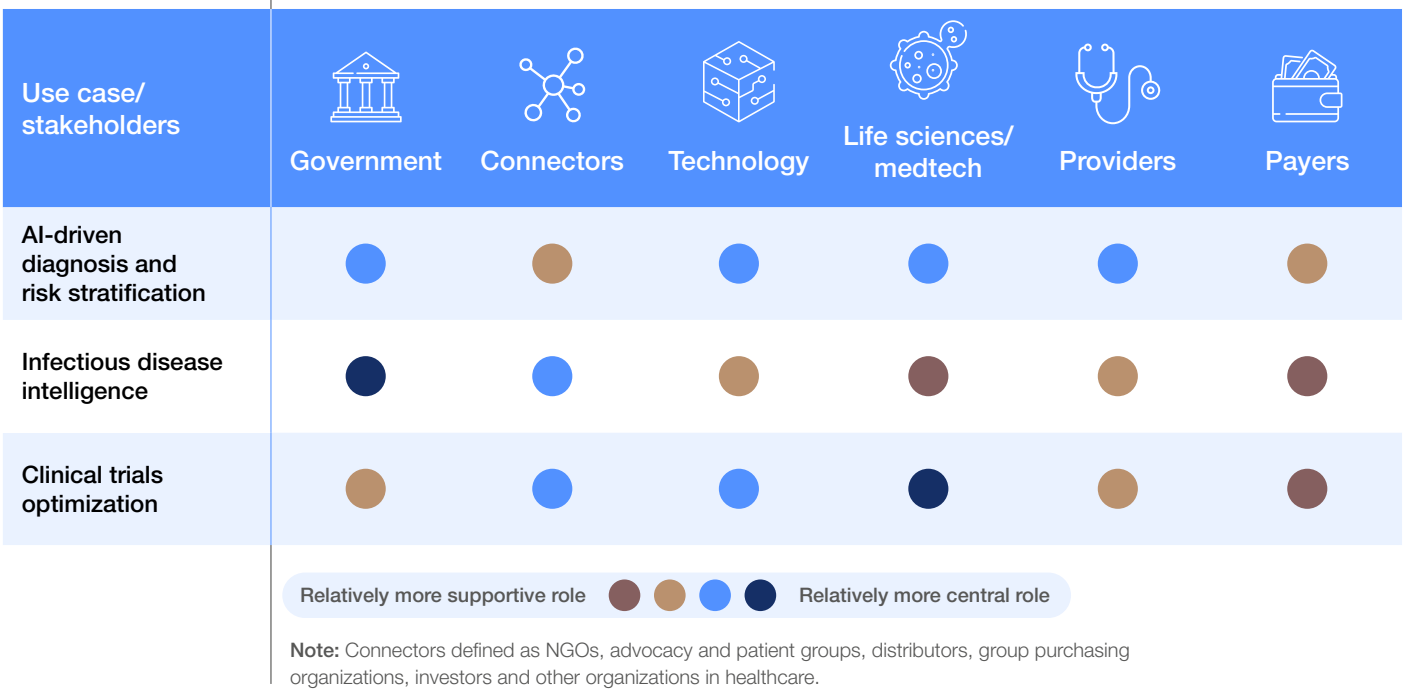


*Prescription

Given the use case taxonomy and criteria for prioritization, experts were asked to rank a set of the most promising use cases. For patient-level tools, the vast majority ranked data-driven diagnosis and risk stratification among their top-two use cases. For population-level tools, a strong number ranked infectious disease intelligence in their top two. For product-level tools, many ranked optimizing clinical trials to speed the impact of novel therapies as a leading AI use case.

In addition to these three use cases, leaders identified an additional four for deeper exploration: administrative AI, patient support and triage, AI for drug research and discovery, and AI for managing supply chain and manufacturing medicines. These use cases, which each hold substantial promise for relieving the health system burden and creating a healthier world, will be discussed later in the report.

FIGURE 3 | **Public-private collaboration matrix for accelerating use cases**



Note: Connectors defined as NGOs, advocacy and patient groups, distributors, group purchasing organizations, investors and other organizations in healthcare.

1.1 Use case for acceleration #1: diagnosis and risk stratification

Why it matters: Research shows that traditional medical care accounts for only 10-20% of overall health outcomes. Genetics and social and behavioural drivers account for the rest. One way to make people healthier is to identify those at risk of becoming sick and intervene before falling ill. In both the US and Europe, however, governments allocate only about 3% of healthcare spending for preventive care, yet a ZS analysis places the ideal share at well over 10%. In a recent survey of more than 9,500 healthcare consumers and doctors from the US, Japan, China, the UK, Germany and Sweden, more than half said they only see a doctor when they are "sick".[7]

Making progress: Given this dynamic, early disease diagnosis – whether chronic or acute – can be a matter of life and death.[8] For example, the deadliest form of pancreatic cancer has a five-year survival rate of less than 10%, but early detection can increase the survival rate by up to 50%. Researchers at Cedars-Sinai, a non-profit hospital in the US, have developed an AI-based tool that can identify early signs of pancreatic cancer from CT scans with 86% accuracy up to three years earlier than doctors.[9] Meanwhile, the German medical devices company Siemens Healthineers uses AI-powered image-reconstruction technology – based on convolutional neural networks – to accelerate brain MRI scans by 70% compared to traditional methods.[10] This improvement means earlier diagnosis and better outcomes on a population scale.

Yet not all diseases are binary. For many diseases, doctors hope to prevent an event, such as a stroke, asthma attack or sepsis. For these, AI is being used to stratify a patient's risk and suggest appropriate interventions to prevent it from occurring. Nearly three out of five physicians predict AI technology will be most useful for fighting chronic disease.[11] One US-based health tech organization, Ellipsis, is using deep learning to analyse voice samples recorded during clinical visits to detect semantic and acoustic patterns that can diagnose depression more effectively than traditional clinician-guided questionnaires. Some authorities warn that doing so at scale will prove difficult given the complexities of depression and multivariate factors that must be taken into consideration.[12] Nevertheless, algorithms are now being trained to flag early signs of diabetes, asthma and other chronic diseases that benefit from prevention measures only possible with earlier signals. Scientists are even modelling environmental factors, such as climate change, to help strengthen earlier detection of diseases such as asthma and those transmitted by mosquitoes.

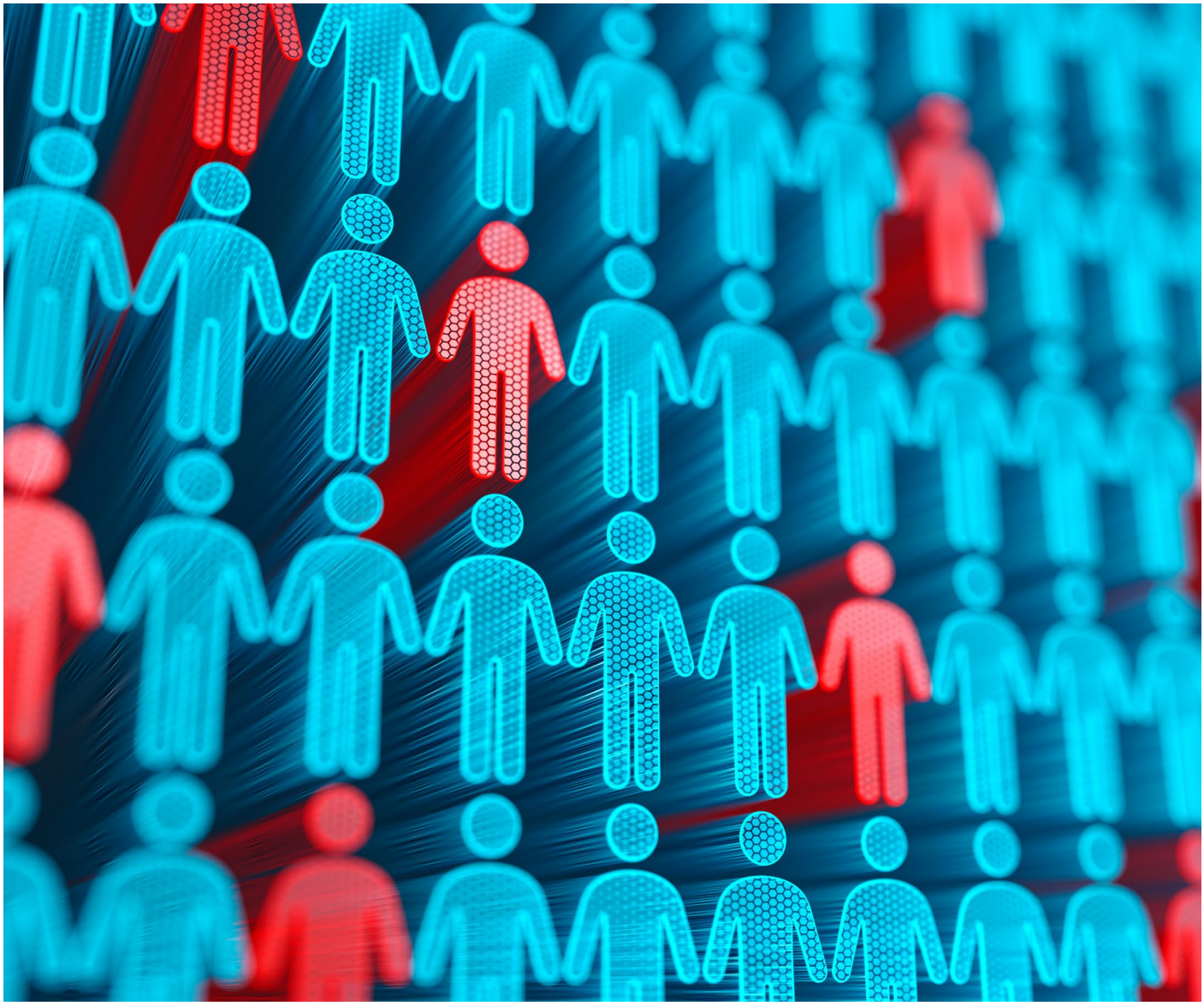


FIGURE 4 | **Public-private matrix for accelerating AI-driven diagnosis and risk stratification**

Use case/ stakeholders	Government	Connectors	Technology	Life sciences/ medtech	Providers	Payers
AI-driven diagnosis and risk stratification	●	●	●	●	●	●

Relatively more supportive role ● ● ● ● Relatively more central role

Note: Connectors defined as NGOs, advocacy and patient groups, distributors, group purchasing organizations, investors and other organizations in healthcare.

Stakeholder roles: Government, tech, healthcare providers and life sciences companies have the most to gain from delivering on AI's promise to detect disease earlier. However, doing so will require these stakeholders to gather and share data, best practices and algorithms across organizations and borders while collaborating to build a baseline level of public trust. The positive public health implications of detecting diseases earlier make it a ripe opportunity for public-private partnership between governments and other entities. Connectors must continue to create awareness of and cultivate confidence in AI-driven approaches to patient risk stratification. Payers must continually evaluate and update their reimbursement policies to reflect new approaches and to incentivize the medical community to embrace them.

CASE STUDY 1

Apollo Hospitals uses AI to assess cardiovascular risk more accurately than established benchmarks and at massive scale

Context

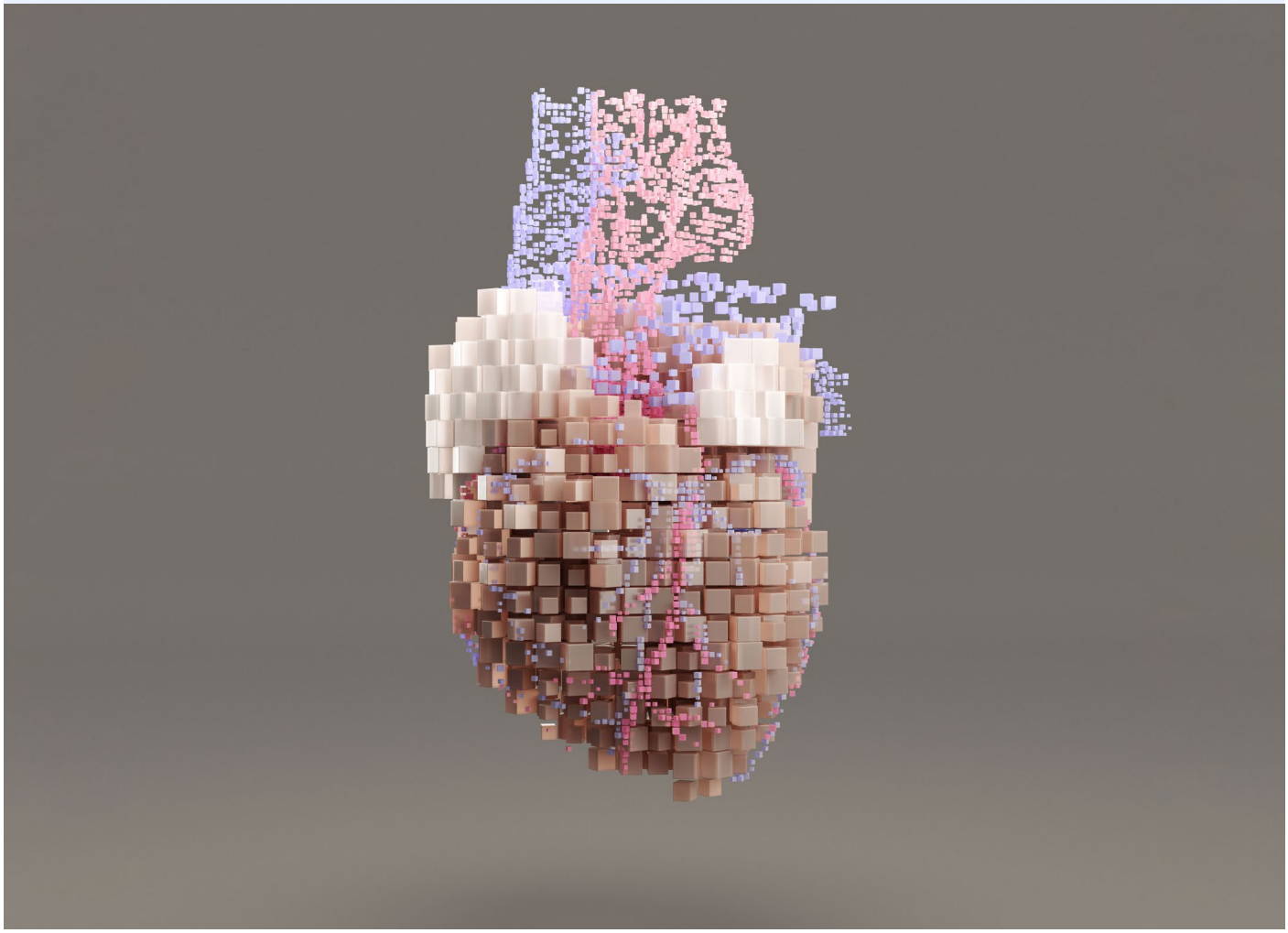
Nearly 18 million people die each year from heart disease, accounting for an estimated 32% of worldwide deaths. This burden is especially high in India, where cardiovascular disease is characterized by early onset, rapid progression and high mortality rate.[13] Apollo Hospitals operates more than 50 hospitals serving more than 300 million patients across India. Given its position on the front lines of the disease, Apollo aspired to create a risk stratification algorithm that would provide a heart disease "score" for any patient in India to be more accurate than traditional risk stratification approaches.

The AI solution

Training an algorithm using 10 years of data from more than 400,000 patients who had undergone health checks and a subset of 60,000 patients later discharged after experiencing a coronary event, Apollo Hospitals developed an AI-powered cardiovascular disease risk tool that assigns every patient a score of either "high", "moderate" or "minimal". Beyond clinical inputs, the tool incorporates data on patient lifestyle, such as tobacco use and diet, as well as physical activity, mental health and other routine vitals. The algorithm places patients in one of three categories and recommends "health actions" for healthcare providers to lower a patient's risk score. Developers have validated the tool using data from a long-term cohort health study from Maastricht University Medical Center, the Netherlands, and King George's Medical University, Lucknow, India.

Impact

Apollo's AI-powered cardiovascular disease risk tool (AICVD) has proven more accurate than conventional risk scores commonly deployed in Europe and India, such as the current standard of practice, the Framingham risk score. Following the most stringent data privacy practices, developers continually recalibrate the tool with data collected from more than 500,000 wearable users. Apollo's AI-driven diagnosis and risk stratification tools, extensively reviewed and validated before use, are now being used in at least eight countries and have been adapted for other non-communicable diseases, such as diabetes, asthma and liver fibrosis.



CASE STUDY 2

Enabling a new data-driven, digitally-enhanced clinician, augmented by Philips AI solutions

Context

As hospitals and clinics race to digitize their healthcare organizations, clinicians are facing a wealth of data but a **poverty of insights**. Organizations face financial pressure to drive operational and clinical efficiency to "do more, with less". Philips equips clinicians with industry-leading tools and workflow-enhancing solutions to manage growing workloads amidst staff shortages and help deliver consistency and speed time to diagnosis and treatment, all while enhancing patient outcomes. Customers have deployed Philips Advanced Visualization Workspace to provide clinicians with a comprehensive suite of AI-enabled algorithms in workflows across multiple specialities (cardiology, oncology, neurology and radiology).

The AI solution

Philips partnered with private and public organizations to bring industry expertise into the hands and workflows of clinicians. The solution provides breadth and depth of expertise to enhance clinical capabilities by including more than 70 clinical applications for clinical insights designed to support AI-enabled workflow and diagnostic confidence.

While the value and impact to healthcare organizations and their clinicians is evident, there are barriers to the adoption of AI that remain challenges for the healthcare industry to realize its full potential. Regulations related to the development and adoption of AI in healthcare continue to evolve, mainly due to the strict privacy rules that vary country by country.

Additionally, customers had to learn to "trust" the model's outputs and understand how to incorporate it in both clinical workflow and clinical decision-making.

Impact

Customers deploy algorithms and AI models, such as:

- **Lung nodule detection (CT)** provides adjunctive information to aid radiologists in detecting pulmonary nodules during review of CT examinations of the chest. The model, developed by Riverain, provides deep-learning-based detection and characterization for all nodule types, including solid, part-solid and ground-glass, enabling clinicians to search 26% faster, and detect 29% of previously missed nodules.

- **Cardiac suite (MR)** provides assessment of cardiac function, anatomy and myocardial tissue health. Functional analysis is enabled by automatic 3D model-based heart segmentation with AI-based slice alignment and boundary detection, resulting in automated analysis of cardiac function on short-axis cine scans for review. By providing left and right ventricle contours with >95% accuracy, clinicians were able to complete their left and right ventricle functional analysis 60%+ faster.

Philips will expand its efforts on cloud-based generative AI applications that will provide clinical decision support, help enable more accurate diagnoses and automate administrative tasks across multiple modalities. In doing so, they aim to enable clinicians to improve patient outcomes.

1.2 Use case for acceleration #2: infectious disease intelligence

$12.5 trillion
COVID-19 cost to global economy through 2024

Why it matters: The COVID-19 pandemic has had a profoundly negative impact on global health outcomes and is projected to cost the global economy $12.5 trillion through 2024.[14] Pandemics stretch the limited resources of national healthcare systems and increase clinical backlogs,[15] leading to more illness and death in both the short term (as surgeries and critical care are neglected) and long term (as fewer ailments are caught early when available treatments are more effective). Pandemic prediction and intelligence suffer from an inherent tension: there's limited individual benefit to mobilizing early against a pandemic. However, the collective benefit is potentially enormous. Given this large downstream impact, governments have invested heavily in capabilities to predict infectious diseases at a population level before they spread so they can better direct public health resources.

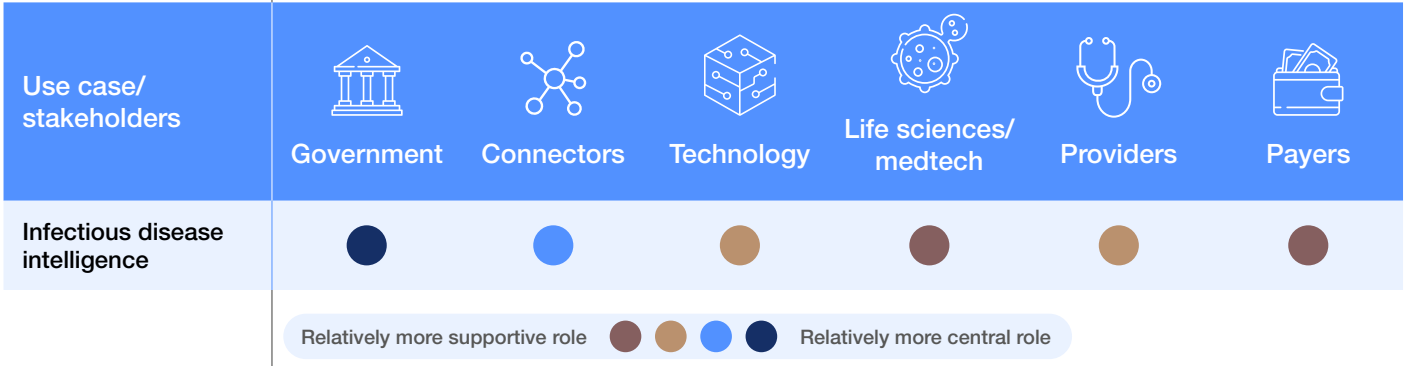
Making progress: National health systems have made progress in standardizing diagnosis reporting. Yet, accuracy and transparency vary by country, and – more importantly – diagnosis reporting is a lagging indicator. Disease monitoring shouldn't just describe disease spread once it's under way; monitoring must anticipate and guide institutions on the best way to act quickly, decisively and effectively. In addition to overcoming data issues, such as availability and interoperability, researchers have focused on three areas for spotting leading indicators: 1) the **pathogen** and its unique properties, 2) the **population** and its movement, and 3) the **environment** and how it can affect the speed at which pandemics progress. As climate change accelerates, the importance of tracking vectors and predicting infectious disease spread will increase.

Analysts can model pathogen spread using data from animal samples, but collection at scale is often very difficult. Companies such as Concentric, a subsidiary of Ginkgo Bioworks, have successfully used natural language processing – which renders human text and speech understandable to computers – to track pathogen spread in human populations by scraping local news for reports of respiratory and gastrointestinal-related illnesses. When surveying the environment, companies such as Ginkgo Bioworks and BlueDot have demonstrated positive results using mobility and climate data to understand and predict mosquito movement patterns to help forecast the spread of mosquito-borne diseases. Using AI to sound the alarm (and even recommend interventions) is critical, but governments must commit the funds, sustain their willpower and focus on the agility to act when the next pandemic or epidemic arrives.

The potential of AI to serve as an early warning system can complement and enhance the outcomes of traditional mathematical modelling and algorithmic forecasting. For example, AI can identify and predict climate-related health risks by collecting multiple layers of inputs, such as temperature trends, meteorological events, population density, vector habitat suitability, and flood- and drought-prone zones. These can be communicated to healthcare providers and communities as an early warning to ensure the supply reliability of medication, hospital equipment and beds and that important preventative measures are undertaken to minimize the event's effect.

Stakeholder roles: Governments are increasingly focused on predicting and controlling the spread of infectious diseases. While this has been a long-standing priority for low- and middle-income countries, it is also of increasing interest for high-income ones, especially in light of the COVID-19 pandemic. Public health agencies should lead in directing resources, but they must partner closely with technology companies, NGOs, providers and other community-based organizations to ensure AI-generated insights lead to timely interventions. Life sciences and payers must have sufficient, timely insights to help focus resources on outbreak prevention, but they should not be seen as primary actors in predicting or intervening against outbreaks.

FIGURE 5 **Public-private matrix for infectious disease intelligence**



Note: Connectors defined as NGOs, advocacy and patient groups, distributors, group purchasing organizations, investors and other organizations in healthcare.

CASE STUDY 3

Detection and deterrence: how Ginkgo Bioworks uses AI to power next-generation biosecurity

Context

The modern tools of biotechnology are paving the way for a thriving bioeconomy that will bolster human and environmental health, food and energy security, and more. At the same time, biology can be a source of risk, whether natural or human-made. Ginkgo Bioworks is building the world's leading platform for cell programming and biosecurity to make biology easier to engineer while enhancing infrastructure to prevent, detect and respond to biological threats.

The AI solution

AI is critical to Ginkgo's work. Beginning in 2018, Ginkgo worked with the US Intelligence Advanced Research Projects Activity (IARPA) on a cutting-edge AI-based computational platform, Engineered Nucleotide Detection and Ranking (ENDAR), which can detect and characterize genetic engineering in biological samples. The platform, which incorporates a human-in-the-loop process for expert review, analyses the genetic content of a sample and identifies whether and how it was engineered.

ENDAR heralds a new generation of AI-based detection tools. Historically, methods for detecting signs of biological engineering have been labour-intensive and limited in terms of the types of samples that could be analysed and the types of genetic modification that could be detected. ENDAR can provide early alerts to anomalous samples, detect a huge breadth of potential genetic modifications, and seamlessly integrate with existing biosecurity infrastructure to collect and analyse complex, real-world biological samples.

Impact

Rapid, reliable and scalable biological engineering detection has long represented a moonshot goal. This capability is critical to appropriately respond to engineered threats and deter biotechnology misuse in the first place. It can also help protect the valuable intellectual property that underlies the burgeoning bioeconomy. ENDAR, when layered with a widespread, persistent biodetection network, represents a critical piece of infrastructure that illustrates the transformative potential of AI for biosecurity.

Ginkgo is continuing to evolve ENDAR as the fields of biotechnology and AI develop rapidly. New bioengineering and synthesis capabilities continue to emerge, such as making more nuanced genetic edits and synthesizing DNA with benchtop devices. These advancements necessitate new biodetection methods to allow biosecurity measures to keep pace. Simultaneously, new AI-based large language models (LLMs) have advanced tremendously, creating vast opportunities for analysing complex genetic datasets. To help unlock this potential, Ginkgo continues to curate large and privacy-minded biological datasets to train such models through its bioengineering Codebase and expansion of its global pathogen monitoring network.

> **AI alone can't necessarily identify the next outbreak, but perhaps by monitoring all the data that's available out there, we could pick up the subtle clues that something is going wrong and refocus attention. It's a warning system.**
>
> Nita Madhav, Senior Director, Ginkgo Bioworks

CASE STUDY 4

Biothreat intelligence company BlueDot uses AI to detect outbreaks earlier and predict their future course

Context

While the world's ongoing COVID-19 experience has underscored the need to strengthen pandemic readiness and resilience through always-on infectious disease intelligence, significant barriers exist. Despite strong intentions and substantial progress, many governments and international institutions often lack the data, analytical capabilities and resources to detect, understand and respond to infectious disease threats in a timely, effective and coordinated manner.

The AI solution

Long before COVID-19, Toronto-based BlueDot understood that international travel, mass gatherings, urbanization, ecosystem disruption, climate change and other global forces were driving outbreaks with increasing frequency and scale. This inspired BlueDot's global surveillance engine, which uses language models and machine learning (ML) to track infectious disease activity worldwide from official and unofficial sources in 132 languages. This engine empowers organizations with around-the-clock global situational awareness of unusual syndromes and high-consequence pathogens without relying on official government sources that can be incomplete and lack timeliness. Sources include media reports, air travel patterns, genomic sequencing, mosquito patterns, social traffic, search queries and even potentially sewer data.

Yet, timely awareness of global threats is not enough. BlueDot draws from an expansive set of global data sources complemented by its in-house subject matter and data science experts to understand local conditions at the epicentre of a threat, including estimating the true burden of disease to overcome incomplete reporting, operationalizing predictive models to forecast domestic and international patterns of spread, and identifying where global population and environmental conditions are vulnerable to secondary outbreaks.

Impact

BlueDot gained international recognition after alerting its public- and private-sector clients of an unusual respiratory illness on 31 December 2019 – one week before the World Health Organization announced the emergence of a novel coronavirus – and for accurately forecasting its global spread in the world's first peer-reviewed COVID-19 study. When BlueDot first alerted Air Canada of COVID-19, the organization launched a series of industry-leading interventions to help keep its travellers and employees safe. BlueDot also partners with public entities, including public health organizations and cities such as Chicago. Other examples of BlueDot interventions include detecting and tracking monkeypox outbreaks in 2022 and recommending actions the public and public health agencies should and shouldn't take. BlueDot continues to model the effects of climate change on mosquito patterns to understand future outbreaks of diseases like chikungunya, dengue, yellow fever and Zika.

> **We just don't have good systems for detecting many diseases in many parts of the world. Building predictive models and validating them is hard work, but what we're focused on now is turning actionable intelligence into real world action. Because we understand that influencing human behavior is the hardest part.**
>
> Kamran Khan, Founder and Chief Executive Officer, BlueDot

1.3 Use case for acceleration #3: clinical trial optimization

Why it matters: Clinical trial participation is a key sectoral challenge in life sciences and medtech. For instance, in the US only about 5% of the population has participated in clinical research.[16] Meanwhile, about 80% of clinical trials fail to meet their recruitment targets (and therefore stall or fail).[17] At the same time, nearly one in three clinical trial participants drops out of their trials, often due to the hassle and inconvenience associated with their participation.

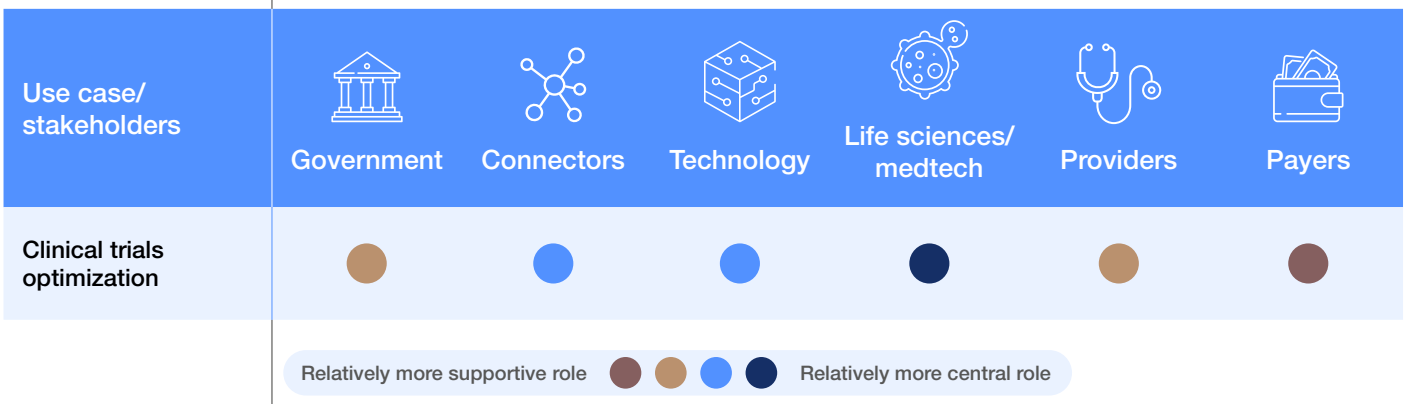
Making progress: Over the past few years, increasing focus has been placed on using AI to improve the rate of clinical trials that lead to an approved drug. Roughly 90% of entities in phase one trials fail.[18] Reducing this failure rate by even a little would lead to getting life-saving therapies to patients faster and reducing clinical trial expenses. While many factors affect how much patients pay for therapies, lowering clinical trial costs would potentially lower costs for patients and healthcare systems alike.

Diversity of patient representation is also a key issue. For instance, in a recent phase two trial of the Alzheimer's drug crenezumab, more than 97% of participants were white, and just 2.8% were Hispanic, even though Hispanic people are 1.2 times more likely than others to develop Alzheimer's, according to the *Improving Representation in Clinical Trials and Research* report.[19] AI can thus also serve as a powerful tool to promote health equity by enabling more inclusive clinical trials in multiple ways, such as by recruiting and retaining more diverse participants through AI-optimized site and investigator selection or even (if needed) by creating carefully designed synthetic data that are more representative to fill in key gaps.

Many life sciences leaders cite organizational initiatives they say will help create more streamlined and representative clinical trials –such as hiring more clinical operations teams and team members focused on diversity, equity and inclusion.[20] AI can enhance these efforts by:

- Designing tailored messaging for the right populations to recruit and retain participants at a higher rate
- Connecting doctors and clinics that are more likely to be able to recruit patients quickly and making them aware of current and upcoming clinical trials
- Predicting when participants are at risk of dropping out of a trial and suggesting interventions to prevent them from doing so.

FIGURE 6 **Public-private matrix for clinical trial optimization**



Note: Connectors defined as NGOs, advocacy and patient groups, distributors, group purchasing organizations, investors and other organizations in healthcare.

Stakeholder roles: Most leaders agree that life sciences organizations are best positioned to lead this initiative. However, they should partner closely with technology companies with purpose-built algorithms as well as connectors (e.g. NGOs) to help with patient recruiting based on their connections and credibility in target communities.

Governments and regulators can also play a role by enacting policies that increase the pace of innovation by enforcing transparency and targets for meeting regulatory approval criteria and timing, while providers (and payers to some extent) will need to integrate optimization approaches into existing care pathways and research processes.

CASE STUDY 5

How AI is advancing clinical trials and driving patient-centric innovation: perspectives from the Janssen pharmaceutical companies of Johnson & Johnson

Context

At Johnson & Johnson, data science and digital health play a pivotal role in reimagining the discovery and development of medicines, aiming to enhance patient outcomes. One area where they have made strong strides is in the clinical trial space. AI and ML, applied to large amounts of real-world and clinical data, make it possible to generate novel insights that help clinical research teams design and execute more efficient, targeted and inclusive clinical trials by identifying the right patients – including diverse patients – and meeting them where they are.

The AI solution

Data science and digital health are transforming clinical trials from end to end, including:

1. **Defining patient populations:** Data science enables a better understanding of disease drivers and identifies the right patient populations for clinical trials. ML was applied to real-world data to analyse the at-risk patient population and define the target patient profile for the investigational vaccine for extraintestinal pathogenic *E. coli* (ExPEC).

2. **Site selection and recruitment:** Using large, de-identified datasets and AI/ML allowed for the identification and location of patients who might benefit from participation in trials – bringing trials to patients rather than waiting for patients to come to the location. For example, in immunology, AI/ML has contributed to site selection and activation, helping to increase trial enrolment. In global public health, the Johnson & Johnson team generated models that can predict outbreaks of dengue fever before they occur, enabling the clinical trial network, reaching some deeply remote regions, to quickly ramp up site sourcing and trial recruitment for the early-stage clinical candidate antiviral for dengue.

3. **Digital endpoints:** AI/ML is also helping to develop more precise clinical endpoints to measure disease and the impact of medicines more accurately and objectively. For example, AI/ML is being used on voice recordings to identify and analyse speech patterns, such as changes in pitch, volume and pauses. This enables the detection of early signs and stages of severity of Alzheimer's disease, supporting clinical efforts.

4. **Trial decentralization:** Using digital health tools, trials can be decentralized by collecting information remotely – lowering the bar for participation and engagement. In a recent immunodermatology study, patients used smartphones to capture photos of their skin over time, helping to generate a fit-for-purpose data set that will enable the development of AI algorithms that can generate more objective measures of disease severity on diverse skin types.

The impact

Janssen is using data science and digital health to advance and accelerate clinical innovation across their entire portfolio, including immunology, oncology, cardiovascular/metabolism, global public health and more. As evidenced by the examples above and countless more, the impact can already be seen. As access to healthcare data increases, and analytical tools continue to grow in sophistication, data science and digital health will undoubtedly continue to be key drivers of inclusive innovation, helping to advance and accelerate the development of new medicines for patients in need.

CASE STUDY 6

H1 helps pharma companies conduct more efficient clinical trials

Context

Even before the explosion of generative AI technologies in 2022-23, AI played a pivotal role in creating more efficient clinical trials. Predictive AI has been used to identify the most suitable trial sites and investigators for recruiting target patient populations. Models can predict the performance of a given trial site or principal investigator by leveraging past performance data of a given clinical trial. Meanwhile, NLP can synthesize vast amounts of medical and scientific literature pertaining to a given disease state, which can help investigators facilitate successful trial designs.

Now, thanks to the rapid advance of generative AI, it is possible to pose conversational queries to LLMs, such as, "What are the optimal locations in Germany to conduct a phase two clinical trial on atopic dermatitis that have not been used by company X, Y or Z, and which align with the inclusion and exclusion criteria, while also ensuring a representative patient population to achieve diversity goals?" Within seconds, AI can produce a list of potential trial sites – work that previously would have taken hours, if not weeks.

The AI solution

H1, a US-based technology company focusing on healthcare, recognizes the indispensable role of AI in various aspects of software product development. The company has helped pharma companies and contract research organizations (CROs) harness the power of its AI solutions to expedite decision-making, reduce site failures and accelerate patient recruitment for clinical trials. One top 10 pharma company came to H1 for help to quickly identify new sites for a clinical trial after its initial selections failed to recruit patients. Using H1's capabilities, the client gained swift access to a list of sites, principal investigators (PIs) and predictive AI models recommending alternative sites with higher patient enrolment potential.

The impact

Rather than having to wait weeks to identify potential new sites and a new PI, the company could pivot in a matter of hours – removing a potentially major kink in the clinical trial flow that would have added time and money to an already expensive and time-consuming process.

2 Additional use cases for deeper exploration

Four additional high-priority use cases have strong value propositions and the potential to significantly improve impact global health.

In addition to the broad use cases above, business and technology leaders cite four additional use cases as high priority for deeper exploration. While they do not currently meet the strict criteria for immediate acceleration (impact potential, global applicability and ripeness for public-private collaboration), they each have a strong value proposition and potential to positively impact global health and healthcare. Many of these use cases strongly leverage emerging generative AI methodologies. As AI capabilities rapidly advance, these use cases should be closely monitored, and strategies for collaborative scale-up must be defined.

2.1 Patient triage AI

AI-powered chatbots and call centres can educate patients and help assess whether an evaluation is needed, especially in low- and middle-income countries.

A key opportunity for lessening healthcare workers' burden is automating triage of patients for follow-up or acute care. AI-powered chatbots and call centres can educate patients and help assess whether an evaluation is needed, especially in low- and middle-income countries with a shortage of frontline healthcare resources.

For example, healthtech organizations such as MyndYou[21] have made progress using AI to automatically assess patient symptoms, decide if a patient needs to see a healthcare provider and furnish follow-up education. However, surveyed leaders agreed these tools need to better integrate with electronic medical records systems, care management platforms and remote patient monitoring systems before scaling is possible. Continued refinement based on dialect and culture presents another roadblock that must be overcome. New applications of generative AI may solve some of these issues, and enable this use case to further scale. Major technology firms are showing strides here, for example Google's Med-PaLM tool, which has demonstrated clinical acumen similar to doctors in some dimensions.

2.2 Administrative AI

> **Identifying redundancy and waste is the most 'boring' application of AI and possibly more impactful than we would give it credit for. Between 40% and 60% of every physician's hour is spent on admin tasks… Easing the administrative burdens on doctors reduces burnout and improves patient care, two really important goals in healthcare.**
>
> Genya Dana, Head, Global Health Policy, Avellino Labs

Employing AI to reduce administrative burden and health system costs has a clear value proposition, especially in high-income countries like the US and those within the EU.

The COVID-19 pandemic exacerbated an already dire shortage of frontline healthcare workers, leading to patient backlogs and provider burnout. In the US, administrative tasks account for roughly a third of healthcare costs and up to half of a provider's time for some specialities.[22] Experts interviewed agreed that administrative AI could automate many repetitive tasks, such as recording patient notes and managing patient coding and billing. Employing AI to reduce administrative burden and health system costs has a clear value proposition, especially in high-income countries like the US and those within the EU, by helping ease healthcare's labour shortage and allowing providers to practice "at the top of their license".

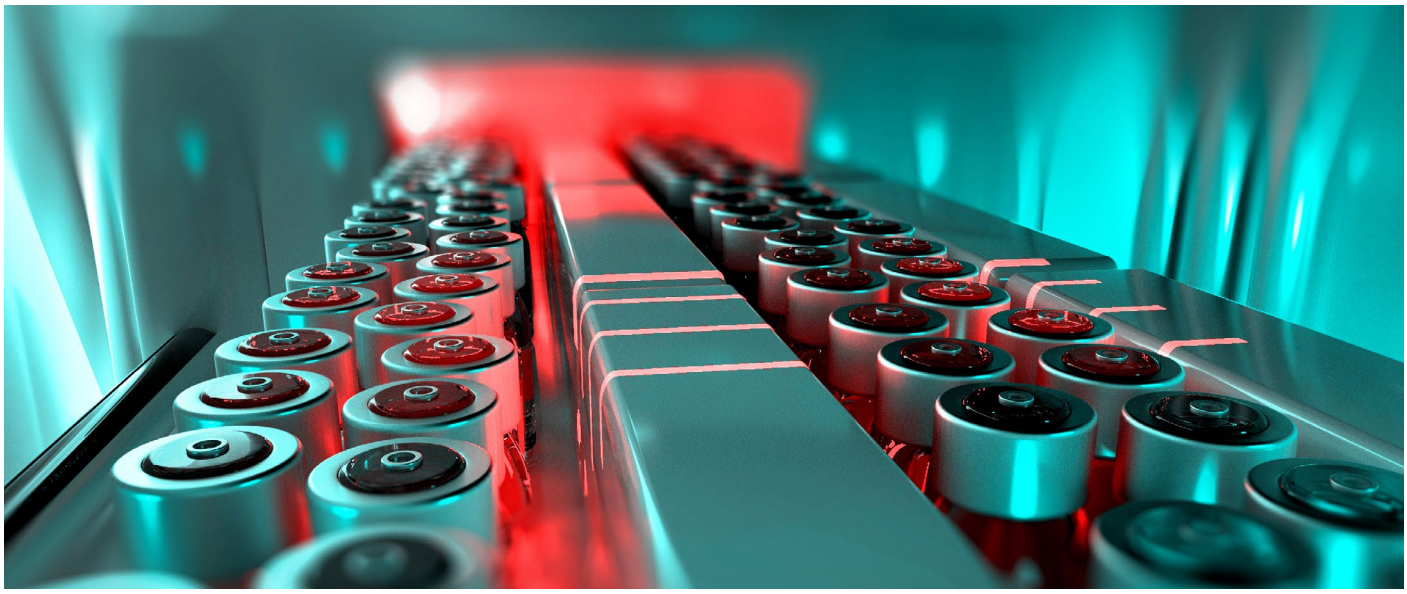
However, leaders cite poor data management of medical records as one of the primary barriers to automation, often making the problem to solve less of an AI issue and more of a foundational systems-and-processes one. Algorithms need data to flourish. Microsoft is making headway using conversational AI during patient visits to transcribe notes and fill in billing and coding information.[23] Automating this process will lessen the heavy provider burden for notetaking, billing, coding and documentation, which can require significant time outside patient care. Microsoft likely will continue making advances in administrative AI with its push into generative AI through OpenAI and ChatGPT; alongside other key technology firms.

2.3 Novel drug identification

Leaders repeatedly mentioned tools based on deep learning that are uncovering novel insights about the mechanisms underlying disease.

As mentioned, the failure rate for new molecular entities is high, which adds time and expense to drug development. In interviews, leaders repeatedly mentioned tools based on deep learning that are uncovering novel insights about the mechanisms underlying disease and identifying new therapeutic assets. While companies such as DeepMind, a subsidiary of Alphabet, endeavour to unlock the mysteries of the protein universe, companies such as BenevolentAI use artificial intelligence to identify patient subgroups most likely to respond to a given treatment.[24]

While interview respondents broadly agreed that this AI capability represents the future of biopharma, they believe these applications are well funded by life sciences organizations, investors and technology organizations, there is still need for acceleration. One promising approach could be data consortia like MELLODDY in the EU, which aims to use decentralized data from 10 pharma companies to train ML models without exposing proprietary information. These approaches warrant further investigation to ensure algorithms are built on representative data sets to avoid bias while accelerating the speed of biomedical research being translated to the market.



2.4 Supply chain and manufacturing

In 2022, the Pharmaceutical Group of the European Union found that more than 70% of pharmacists experienced shortages of cardiovascular, respiratory, nervous system and antibiotic drugs.

Due in part to the lingering effects of the COVID-19 pandemic and other geopolitical and environmental headwinds, the world continues to experience shortages of common medicines. In its survey of EU medicine shortages in 2022, the Pharmaceutical Group of the European Union found that more than 70% of pharmacists experienced shortages of cardiovascular, respiratory, nervous system and antibiotic drugs.[25] A 2020 United States Pharmacopeia (USP) report found that increasing transparency in the drug supply chain using real-time data from pharmacies and hospital systems would provide valuable insight into the demand for medical products, but foundational data issues limit what AI can accomplish.[26]

Given the fragmentation of global supply chains, many experts interviewed said they find this application of AI increasingly complex to navigate and suggested prioritizing other applications. In addition, experts cited improved data connectivity and transparency as the most pressing needs for the supply chain – rather than AI. Despite challenges, NGOs and technology organizations can still help better direct resources, especially for diagnostics. In one example of progress, the EU-based NGO Foundation for Innovative New Diagnostics and US-based software organization Coupa created an AI-based tool to better predict demand for testing services.[27] The algorithms have been implemented in Zambia, Viet Nam, Bangladesh and Burkina Faso. In Zambia, the AI recommendations shrunk the average distance HIV test samples had to be transported by a factor of 11.

Many stakeholders discuss supply chain and manufacturing resilience at the level of individual health systems and entities rather than at the national level, even though risks like climate change may inflict a heavy secondary impact on the energy grid and infrastructure development. Decision-makers should examine the potential to leverage AI-based solutions at a broader scale to mitigate such risks.

3 Four barriers preventing AI from realizing value

To enable the transformation of global health and healthcare, it is imperative to address the barriers that hinder the realization of value from AI advancements.

The innovations described here promise to transform global health and healthcare, but only if their value can be realized. Public and private sector leaders identified four broad barriers to the full-scale transformation of healthcare through AI.

Holes in the data foundation

Of experts interviewed, 75% cited poor data foundation as the primary barrier to AI value realization in healthcare. Algorithms must be trained on data, yet even in high-income countries, inconsistent data collection and lack of interoperability impede the scaling of AI models across organizations and borders. Experts also cited AI's vulnerability to misuse and abuse through privacy invasion, data theft and sub-par algorithms perpetuating bias. Innovative data sharing models have shown promise, including federated learning architectures such as with India's *National Digital Health Mission* (NDHM), or alternatives, for instance proprietary methods from private sector players such as TripleBlind.

Limited trust and adoption

> **Will AI replace humans or act as a partner? Although we may eventually trust what AI tells us, we are not there yet. And in healthcare, decision-making is too complex, and the stakes are too high for us to get there anytime soon. AI will be a partner for the foreseeable future.**
>
> Nassar Nizami, Executive Vice-President, Chief Information and Digital Officer, Thomas Jefferson University and Jefferson Health

Of the experts interviewed, around 80% cited low trust as a significant barrier to realizing the value of AI in healthcare. Drivers of low trust include algorithms that don't integrate with existing workflows, unease with AI replacing clinicians, potential bias in data sets used to train algorithms and lack of transparency into how algorithms perform across diverse populations. Key to building trust, and thus adoption, is empowering a central body or bodies to certify that algorithms have been developed transparently, are free from bias and perform as advertised. The US Food and Drug Administration's (FDA) process for reviewing AI-enabled medical devices has evolved, but experts agreed that stronger guardrails are needed to increase transparency once algorithms are approved.

Lack of scalability and cooperation

Almost half of the experts interviewed attributed AI's slow value realization to the private sector's focus on experimentation at the expense of scalability and a lack of impetus to move innovations across borders. While many leaders lauded pilots their organizations' innovation labs have launched, these same leaders struggled to find clear examples of scaled AI applications emerging from these same initiatives. Reasons for this disconnect include a lack of incentives to scale solutions beyond high-income countries – where public and private funding are more plentiful – and policy differences that inhibit the same. These advances won't benefit the tens of millions of people who need them if there is no greater focus on designing tools with cross-border transferability as a primary goal.

Inadequate technological infrastructure

A handful of those interviewed cited technological infrastructure shortcomings for the slow pace of value realization. While mobile phones are widespread in low- and middle-income countries, just 50% of these countries' populations have access to mobile internet – a significant impediment to the data exchange required for widespread AI adoption.[28] Beyond consumer broadband and mobile access, leaders agreed that government IT and data infrastructure are badly in need of upgrades, and even the IT infrastructure of private organizations (e.g. electronic health records which can be primarily paper-based in many countries) is not ready for the pace of AI's advances, with continued need for stronger cloud infrastructure. However, most agreed that upstream issues, such as low trust and lacking an adequate data foundation, represent the largest barriers to realizing value.

4 Principles for AI acceleration

Overcoming barriers to responsible AI advancement depends on access to quality data, adoptability of technology and ease of scalability.

Overcoming the barriers outlined above to ensure everyone benefits from the promise of AI in healthcare will require sustained public-private partnerships that must be built on three foundational principles:

1. **Useable, representative data:** Experts expressed optimism about solving the most pressing data obstacles. Federated learning, for instance, can train analytical models to solve biased data sets and allay privacy concerns,[29] while data consortia can help eliminate variations in data security, patient privacy and cross-border interoperability.[30] Organizations such as Stanford University are using generative adversarial networks (GANs) to create synthetic patient data that can be used in synthetic clinical trials or biomedical research to speed up the time to market.[31] While promising, these efforts are still in the early stages and will need further validation before scaling. New partnerships, such as data-sharing arrangements led by Mayo Clinic Platform could also help to address this challenge.

> **Data accessibility is a huge barrier for many pure technology organizations. A lot of companies that have know-how do not have data. And those that have data do not have the know-how. Greater partnership is needed for us to extract the value from data that can truly impact health outcomes.**
>
> Sathya Sriram, Chief Executive Officer, Preventive Health, Apollo Hospitals

2. **Low-friction adoptability:** For AI to gain adoption, it must be easy to use and trustworthy. Healthcare providers are more likely to use AI if they see it as an aide – a tool that augments what they do instead of trying to replace them. Unfortunately, it often fails to plug into existing clinical workflows, which helps explain why only 37% of doctors expect AI to positively impact quality of care.[32] To cultivate trust, AI must be deployed (1) **responsibly**, with care to eliminating algorithmic bias, as seen in some COVID-19 algorithms directing care away from Black and Hispanic populations,[33] (2) **transparently**, with regard to what it can and cannot do and how it was built (to mitigate the "black box" challenge inherent with algorithms), and (3) **competently**, such that it works reasonably well at scale. In a world where AI merely augments the work of healthcare providers, it doesn't need to be perfect, as it will be guided and scrutinized by humans. Still, even if providers trust AI, they must also find it convenient. For providers to adopt AI tools, they should integrate into existing processes and systems, not stand outside. New multi-sectoral organizations have formed, such as the Coalition for Health AI (CHAI), which has created a "Blueprint for Trustworthy AI" in healthcare to address some of these challenges and improve trust; the ITU AI for Good initiative is also developing frameworks to ensure trustworthy AI solutions. Meanwhile, organizations like Transform Health and regional digital health networks are bringing in community and patient voices to increase broad trust.

> **The private sector moves faster than policy and regulation. But it is our responsibility as the people who build these technologies to champion high standards like that of evidence, ethics, equity, safety and privacy alongside contributing to the policy design process.**
>
> Ivor Horn, Chief Health Equity Officer, Google

3. **Easy scalability:** By enabling higher efficiency on a larger scale, AI can free frontline healthcare workers from repetitive tasks, allowing them to focus on areas where human expertise surpasses that of AI. To gain provider acceptance, AI must be readily scalable by design by making tasks easier or less tedious or by doing things humans aren't already doing. However, AI innovation can't stay locked inside a few large organizations or high-income countries. Cross-border, multilateral partnerships must be in place share innovations between and across high- and low- and middle-income countries (LMICs). This could be especially valuable in LMICs and present a leapfrogging opportunity – where data infrastructure is nascent, but there are fewer legacy processes and systems to shift. Organizations like the International Digital Health and AI Research Collaborative (I-DAIR) are working to address this by improving access to cutting edge research, with a network of AI and health research centres across the Global South.

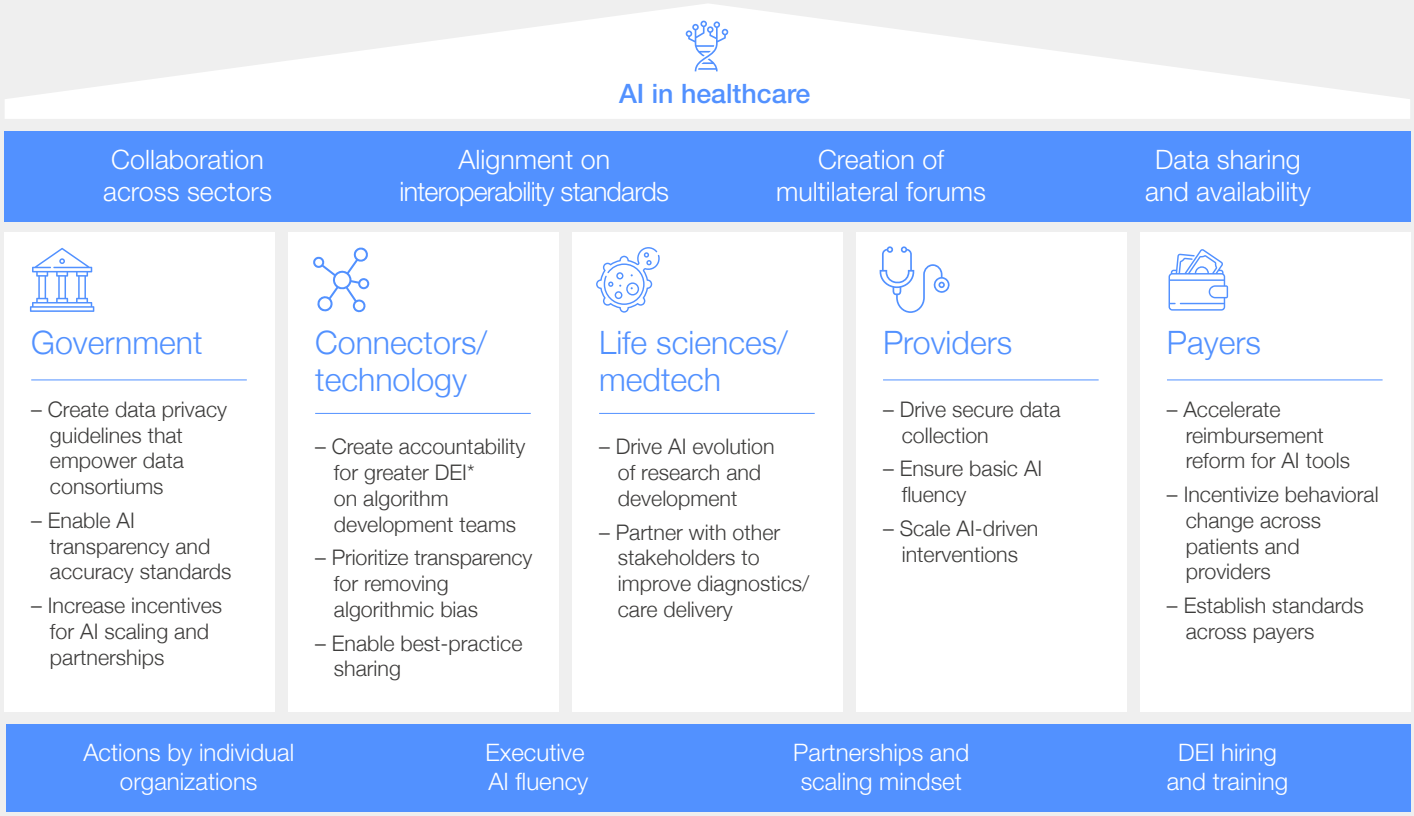
> **Creating incentives for the private sector to deploy solutions in emerging markets is a really hard problem to solve, but the impact would be immediate.**
>
> Aboubacar Kampo, Representative, UNICEF

5 A call to action for all sectors

Accelerating the realization of AI's full potential in global health requires increased urgency, collaboration and targeted action.

Considering the potentially transformative impact AI can have on global health, and despite recent advancements in the underlying technology and accompanying buzz, the pace of change in health can still feel distressingly incremental. It can be argued that the sense of urgency doesn't match the scale of the challenge. Increased public-private partnerships are badly needed to ensure a strong foundation of data, limit algorithmic bias and focus on scalable solutions. What follows is a series of recommendations intended for players across the healthcare arena to take action now to lower the barriers that impede the realization of AI's full potential in healthcare.

FIGURE 7 **Recommended actions to further responsibly scale AI in healthcare**



*Diversity, equity and inclusion

Note: Connectors are defined as NGOs, advocacy, distributors, group purchasing organizations, investors and other organizations in healthcare.

5.1 Creating a data foundation

Protect patient privacy: ZS's recent survey of 9,500 healthcare consumers from the US, UK, Sweden, Germany, China and Japan found that, while between 50% and 60% of healthcare consumers are willing to share personal health information if it improves their health, they express dramatically varying levels of comfort in sharing their data with different stakeholders. While most healthcare consumers say they trust their doctors with their private health information, introducing innovative AI into healthcare requires many players to work together. Collaboration is required to increase trust across the ecosystem, as guaranteeing patient privacy is paramount to success.

Governments must continue to develop legislation that strengthens consent requirements and transparency of patient data used to train AI. However, they must ensure data use restrictions aren't so broad that they discourage the legitimate use of deidentified patient data for innovative use that improves public health and healthcare.

Providers, payers, technology and life sciences companies must end the current approach of protected data siloes and improve on existing federated learning solutions that train algorithms collaboratively without exchanging data. NVIDIA Clara,[34] for example, offers a wealth of applications and frameworks to improve healthcare delivery and accelerate drug discovery by training AI models on data sets that can be accessed remotely without moving data from its secure location of origin.

> If data is to be collected responsibly to make it fit for AI, it must be harmonized across disparate geographies and organizations.

Availability: Data consortiums for sensitive health data should continue to maximize the volume of usable data that have already been collected but are sitting in servers across the globe. For example, the World Economic Forum's Breaking Barriers to Health Data initiative advocated for a data consortium approach to help solve the shortage of genomic data available to researchers for diagnosing rare diseases.[35]

Providers and governments should accelerate data sharing through the Forum's framework[36] of outlining the problem, aligning on incentives, deploying a governance model and planning for long-term viability. Providers and payers, meanwhile, should make increased use of untapped data hiding in undigitized medical records. Mayo Clinic, a leading US-based research institution, has collaborated with the digital pathology company Pramana to digitize 5 million glass pathology slides.[37]

Interoperability: In its January 2023 report, *Global Health and Healthcare Strategic Outlook: Shaping the Future of Health and Healthcare*, the World Economic Forum identifies data interoperability as one of the major barriers to improving global health and healthcare outcomes.[38] If data is to be collected responsibly to make it fit for AI, it must be harmonized across disparate geographies and organizations.

Government must define data ownership policies and reinforce data security to encourage the sharing of valuable insights in an ecosystem where data security is a shared responsibility and data ownership varies by country and situation. This report recommends taking inspiration from the aviation industry's global participation standards and practices or the payment industry's data security standards, which codify data security standards and serve as a repository for sharing best practices. These standards have been implemented globally, sometimes in deep partnership with the private sector.

5.2 Designing AI with adoption in mind

Responsibility: AI has the power to solve an incredible variety of challenges. Technology companies, however, must be cautious and conscious about choosing the "right" algorithms – those with the potential to do the greatest good while limiting harm. From pulse oximeters misreading skin tones featuring different melanin concentrations to algorithms misdiagnosing non-white patients, there are countless examples of algorithmic misuse.

Moreover, when data science teams aren't representative of the populations their products aspire to serve, they can fail to spot potential sources of bias and their real-world implications. In 2021, the World Health Organization provided guidance on the *Ethics and Governance of Artificial Intelligence for Health*. The report highlights responsibility and accountability as critical ethical principles for using AI in healthcare.[39] The World Economic Forum has also strongly advocated for an ethical and responsible approach to AI in prior reports across sectors such as *Earning Digital Trust: Decision-Making for Trustworthy Technologies* (2022) and *The AI Governance Journey: Development and Opportunities* (2021).

Governments, payers, life sciences and technology companies must encourage design team diversity internally and with key partners and hold stakeholders accountable when algorithms create or perpetuate bias. Providers should acquire a basic level of AI fluency, starting with updating medical and nursing school curricula.

Competency: To gain acceptance, AI doesn't need to be perfect, but it must meaningfully increase efficiency for the user, fit into the current workflow and do so at scale. Examples abound of algorithms that fail to gain traction because they have been forced into a process without sufficient human-centred design. In addition, to ensure AI is working as advertised, companies developing and deploying algorithms must use real-world evidence to validate (and re-validate) their effectiveness in the clinical setting. Several years ago, an algorithm employed by a healthcare payer to flag patients for high-risk care management was found to be systematically biased against Black patients.

Governments must ensure AI meets standardized accuracy thresholds for all groups before allowing technology to be deployed at scale. They should consider using appropriate policy levers for high-risk AI use cases and taking steps to ensure developers prioritize equity when designing AI solutions. Developers also should be made to demonstrate high standards of documentation and transparency for algorithms and be encouraged to be future regulation ready in case auditing and certification requirements are introduced.

Payers must continue to encourage the use of AI through greater reimbursement incentives, which will ultimately help ensure algorithms are adopted.

Transparency: Doctors and patients must be fully apprised of the risks and benefits of any AI-based application to guide their care. Mayo Clinic, for example, has recommended that governments institute AI "nutrition labels" similar to those the FDA employs on packaged foods to provide transparency on ingredients and nutrition for greater transparency.[40]

Government policy can drive transparency standards around algorithmic fitness across demographic groups. Still, these standards may only be extended to highly regulated software as a medical device (SaMD) applications – potentially leaving the much broader, less-regulated category of healthtech tools to police themselves.

Nevertheless, governments, payers, healthcare providers, technology and life sciences companies must equip leaders with a baseline level of AI fluency to ensure appropriate safeguards and hold their organizations accountable in the event of shortfalls.

5.3 Building scale

> Great ideas should not be bottled up inside high-income countries, as they often are. Successful AI solutions must be scaled across organizations and borders.

Partnerships: Many of the world's most transformative innovations – the personal computer, to name one – came about only with government support and assistance.

Governments must use the power of the purse to spur private investments into healthcare AI. In the US, the National Institutes of Health plans to invest $130 million over four years to accelerate the use of AI in healthcare,[41] and the UK plans to put in a similar amount over the same timeframe through its AI in Health and Care Award.[42] This is a great step, but much more investment is needed. Countries like Saudi Arabia, Singapore, the United Arab Emirates and the UK have created centralized AI authorities to help their countries maximize the value of healthcare AI. Other countries should follow suit by creating mechanisms to fund or incentivize partnerships to encourage AI innovation.

Transferability: Great ideas should not be bottled up inside high-income countries, as they often are. Successful AI solutions must be scaled across organizations and borders. This will ensure a faster, more efficient scale-up of impact and more equitable transformation as low- and middle-income countries benefit from AI in health.

Governments shouldn't stop at funding pilots; they must provide funding to scale AI that's already working in other countries. Of course, data must be trained on local nuances, but advances in generative AI will help overcome some of these barriers. More favourable reimbursement schemes may also help accelerate scaling. At least eight AI tools already receive payer reimbursement in the US, but many public health authorities outside the US are playing "catch up" rather than proactively creating incentives that spur innovation.

Conclusion

This report was created to focus the attention of the public and private sectors on those use cases for AI with the largest potential to transform public health and healthcare and improve patient health outcomes. The world already has the technology to do so. While data gaps certainly exist, leaders can't wait for the perfect data foundation to be in place but rather should work now to start building the coalitions needed to make the transformation possible.

Some will continue experimenting, leading to incremental improvements, which are always needed. However, for the vast majority of those in healthcare, government and NGOs, the focus should be on building scale in the real world. Without scale, far fewer patients will benefit from AI's transformative potential. The agenda should be clear to all stakeholders in the complicated healthcare ecosystem: choose a few use cases, select the partners whose capabilities and access complement your own, and bring single-minded focus to removing the barriers impeding the widespread adoption of AI tools in healthcare. The future depends on it.

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Endnotes

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