BML MUNJAL
UNIVERSITY ™
A **Hero GROUP** INITIATIVE

AI: EMBRACING THE SHIFT IN HEALTHCARE

BEAST ™
Behavioural Economics and
Science Team

RESEARCH PARTNER

A YEAR SPENT IN ARTIFICIAL INTELLIGENCE IS ENOUGH TO MAKE ONE BELIEVE IN GOD.

-ALAN PERLIS, AMERICAN COMPUTER SCIENTIST

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FOREWORD

Mr. Sunil Kant Munjal
Chancellor,
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Chairman, Hero Enterprise

AI: The New Normal for Healthcare in India

As the world contemplated a new decade of possibilities with the dawn of 2020, disaster suddenly struck, presenting a colossal test for leadership and humanity. Even though a year has since passed, and we now know that we will be safer in 2021, the pandemic has severely dented our societies, posing fresh challenges to healthcare systems across the world.

The worst was expected from India's creaking public health system, yet stakeholders surprisingly proved their resilience over the year, battling the pandemic with doggedness, while adapting and innovating in terms of resources, best practices, and infrastructure.

Now that the worst of the crisis appears to be over, it is important to ensure optimal preparation for the next crisis, especially since COVID-19 has created endless opportunities for creative disruption in preventive healthcare.

There is a strong case for scaling up and sustaining investments in AI technologies beyond the pandemic as it becomes possible to systematically trace, track and target diseases quicker and more efficiently. With zero margins of human error in healthcare, Artificial Intelligence is also vital for reducing costs across the healthcare value chain while improving diagnostic processes.

The benefits to our large and diverse society would be immense, and so BMU decided to look at healthcare through the prism of AI. This report sheds light on the current state and future of AI in Indian healthcare and should be valuable for both researchers and professionals.

WELCOME MESSAGE

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>
> I take pleasure in presenting this research report to you on behalf of the team at BMU and BEAST and would like to acknowledge the sincere efforts put in by everyone involved. The research aims to contribute to the current discourse on AI in the healthcare sector and provides insights into its functioning within the Indian context. Apart from other things, an important issue that this research highlights is the need to review our approach to healthcare education, the interdisciplinary imperative, better technical knowledge integration and the need to reskill/upskill to better harness the benefits of AI and other emerging technologies.

Prof(Dr.) Vishal Talwar
Dean,
School of Management

KEY HIGHLIGHTS

A survey was run on 50 executives from medium to large healthcare organisations in India. The goal is to contribute towards the current discourse of AI in Indian healthcare and chart recommendations for the future.

100% OF THE PARTICIPANTS BELIEVE THAT AI HAS THE POTENTIAL TO SOLVE COMPLEX CHALLENGES FOR HEALTHCARE IN INDIA

90% OF THE PARTICIPANTS ALREADY HAVE A MODERATE TO LARGE AI STRATEGY IN PLACE FOR THEIR ORGANISATIONS

IT, MANUFACTURING OR OPERATIONS, CUSTOMER SERVICE ARE THE TOP 3 AREAS OF ADOPTION AND IMPLEMENTATION

54% OF PARTICIPANTS SAY THAT COVID-19 HAS PACED UP THEIR AI ADOPTION AND STRATEGY

EXECUTIVES FEEL THAT IN THE NEXT 4-5 YEARS, HEALTHCARE ORGANISATIONS WILL ADOPT AND IMPLEMENT THE USES OF AI WITH ITS PROPER UNDERSTANDING AMONGST THEIR STAFF WITHIN THE INDIAN CONTEXT

THE TOP 6 EMERGING TECHNOLOGIES BEING ADOPTED IN THE HEALTHCARE SECTOR ARE AI, CLOUD COMPUTING, IOMT, 3D PRINTING, BIG DATA ANALYTICS, ROBOTICS

62% OF PARTICIPANTS SAY THAT THEY ARE ALREADY SEEING SIGNIFICANT BENEFIT FROM AI ADOPTION

IMPROVED OPERATIONAL EFFICIENCIES, IMPROVED DISEASE DETECTION AND DIAGNOSTICS, BETTER PATIENT EXPERIENCE AND SATISFACTION ARE THE TOP 3 AREAS WHERE BENEFITS ARE SEEN/EXPECTED

LARGE INFRASTRUCTURE/CAPITAL REQUIREMENTS, POTENTIAL IMPACT ON JOBS, CULTURAL CONSIDERATIONS (ACCEPTANCE AND RELUCTANCE) ARE THE TOP 3 BARRIERS TO ADOPTION

76% OF THE PARTICIPANTS ARE INVESTING HEAVILY IN THE UPGRADATION OF SKILLS OF THE CURRENT WORKFORCE WITH RESPECT TO AI/EMERGING TECHNOLOGIES

66% OF THE PARTICIPANTS SAY THAT AI RELATED SKILLS AND KNOWLEDGE IS A PRIORITY FOR HIRING TALENT

A WHOPPING 96% OF THE EXECUTIVES SAY THAT CURRENT HEALTHCARE EDUCATION NEEDS SIGNIFICANT UPGRADATION IN INDIA TO KEEP PACE WITH THE CHANGING TECHNOLOGIES

88% OF EXECUTIVES FEEL THAT UNDERSTANDING THE FUNDAMENTALS OF AI AND MACHINE LEARNING IS THE TOP SKILL HEALTHCARE PROFESSIONALS NEED TO KEEP PACE WITH THE WAVE OF TECHNOLOGY AND MAKE THEMSELVES MORE HIREABLE

52% OF EXECUTIVES FEEL THAT AI WILL CREATE MORE JOBS THAN IT WILL DESTROY IN INDIAN HEALTHCARE

THERE ARE ALSO A RANGE OF FUTURISTIC JOB PROFILES OPENING IN THE HEALTHCARE SECTOR. THE TOP 6 BEING:

DEEP LEARNING/MACHINE LEARNING EXPERTS (74% FORESEE)

AI EXPERTS (70% FORESEE)

ROBOT DESIGNERS AND ENGINEERS (66% FORESEE)

CHATBOT DESIGNERS (52% FORESEE)

TELE SURGERY SPECIALISTS (50% FORESEE)

ANALYTICS EXPERTS (42% FORESEE)

INTRODUCTION[5,6,7,8,14,22,23,24,26,28]

After decades of ground-breaking research on Artificial Intelligence (AI) in the computer sciences, the subject matter is now being studied across various disciplines. Despite the elusive nature of the topic, its potential has been recognised, tested and successfully used in numerous applications. Artificial intelligence or AI, in layman terms, is the ability of machines (and things) to act in a manner that is consistent with human intelligence. Such machines can search, collect and analyse data to produce useful insights. The computational sophistication arising out of AI technology has yield ed better efficiency, productivity, products and services.

Artificial intelligence is the ability of machines (and things) to act in a manner that is consistent with human intelligence.

There are several ways artificial intelligence has directly made our everyday lives more convenient as well. AI assistants like Apple's Siri, Google Now, Amazon's Alexa, and Microsoft's Cortana have been around for years, and their evolution has enhanced the quality of life and work for millions. From reading our emails, voice-typing texts, giving driving directions to getting music or movie recommendations based on our past choices , AI has been doing it all.

BOX 1. KEY FEATURES OF AI

There are three features that distinguish AI from other emerging technologies:

Intentionality - AI algorithms help make decisions using real-time data that can be collected by sensors, cameras or even remote inputs.

Intelligence - The coexistence of machine learning and data analytics is very important for AI. In machine learning, underlying trends and patterns are detected from the dataset like digital information, satellite imagery, visual information or text, and the patterns are stored for future references.
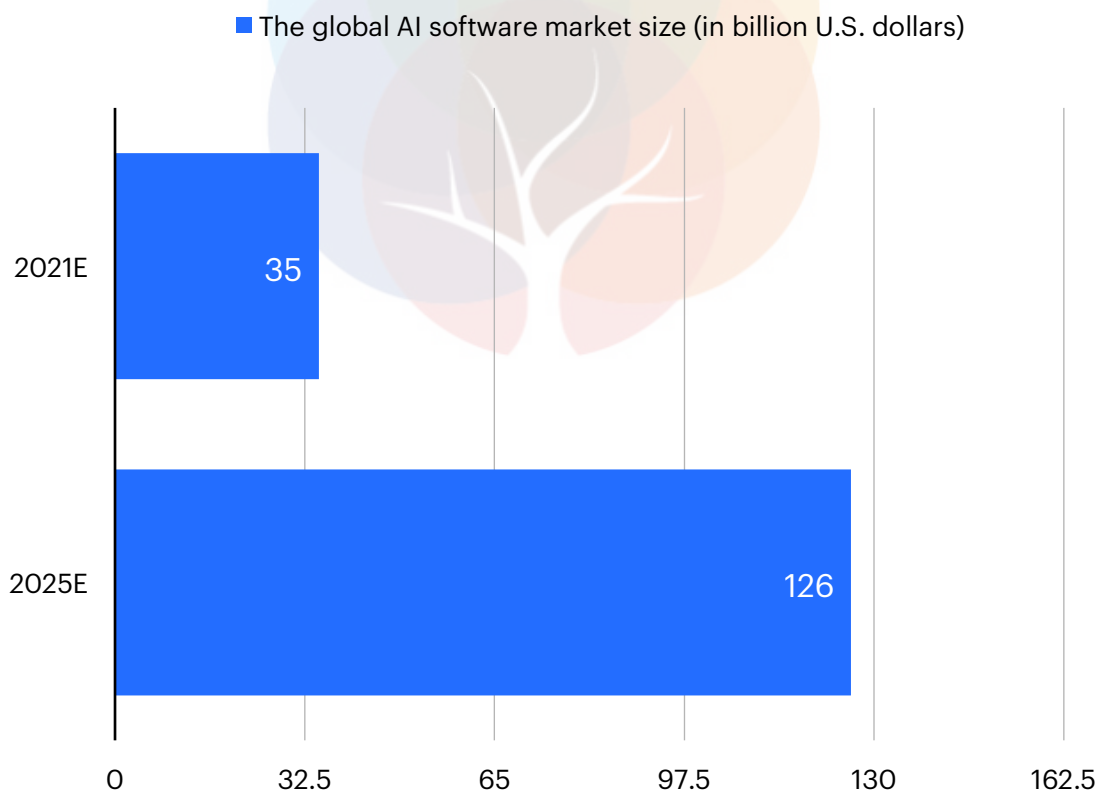
AI : EMBRACING THE SHIFT IN HEALTHCARE

AI is currently being used to integrate information, analyse data, draw logical conclusions, recognise patterns, infer and observe the unobservable in various sectors.

For example, AI is being used in banking to improve customer experience (chatbots for basic servicing requests, humanoid robots to service customers), and back office processes (natural language processing to process documents, real time risk monitoring). In automobiles, AI is being used to detect defects more accurately than humans (upto 90 percent more accurately), and making autonomous vehicles mainstream by 2037.

The adoption of AI also covers all major functions - product, manufacturing, operations, HR, marketing and sales, risk, supply chain, with organisations increasingly seeing value in terms of revenue and cost saving.

It is no surprise then that the the global AI software market is expected to grow rapidly in the next few years, reaching approximately 126 billion U.S. dollars by 2025.

■ The global AI software market size (in billion U.S. dollars)

Year	Value
2021E	35
2025E	126

Source: Statista. (2020, December 7). Artificial intelligence software market revenue worldwide 2018-2025.

In the Asia Pacific region, Artificial intelligence adoption at government-level alone is to reach US$29.3 billion by 2024, growing at a compounded annual growth rate (CAGR) of 26.8 percent during the forecast period. China, Japan and India are set to account for two-thirds of the overall revenue.

However, it is not just AI which is having significant impact on business and society. Other emerging technologies - Augmented reality, Blockchain, Drones, Internet of Things, Virtual Reality, 3D Printing, Cloud Computing are critical for businesses to adopt today to create value in the future.

The coexistence of these technologies is essential for complete integration of AI in any environment. In manufacturing for instance, AI can be used to check the quality of produced goods, only with the presence of smart cameras, cloud storage and machine learning algorithms.

The coexistence of other emerging technologies is essential for complete integration of AI in any environment

The discourse around AI is not all without controversy - academicians like Carl Benedikt Frey and Michael Osborne, estimate that 47% of American jobs are at high risk of automation by the mid-2030s. In India, up to 12 million women may lose their job to automation by 2030, and men could lose 44 million during the same period. AI can become a higher threat for individuals in labour intensive and low skill jobs like documentation and clerical work.

Undeniably, the onset of the COVID-19 pandemic has also impacted the market for artificial intelligence. For instance, out of 181 European organisations, 16% believe automation through AI and other innovations can assist them in limiting the effect of COVID-19. In fact, companies have increased their investments in AI after the onset of COVID-19.

Another area COVID-19 has focussed the world's attention to is one of the fastest growing, and largest industries in the world - Healthcare. Most countries have rapidly increased their healthcare expenditures in the last few decades, exceeding 9% on average for OECD countries. Along with the overall healthcare industry also poised to reach 11 trillion dollars globally by 2022, the importance and value of the healthcare industry cannot be emphasised enough.

In India, the healthcare industry is touted to reach 372 billion dollars by 2022, and over 40 million new jobs were expected to be generated by 2020. The medical tourism market is growing at 18% y-o-y and is expected to reach US$ 9 billion by 2020. There is a significant scope for enhancing healthcare services considering that healthcare spending as a percentage of Gross Domestic Product (GDP) is rising. The Government's expenditure on healthcare sector has grown to 1.6% of the GDP in FY20E from 1.3% in FY16. Health insurance is also gaining momentum, where, gross direct premium income underwritten by health insurance grew 17.16% y-o-y to Rs. 51,637.84 crore (US$ 7.39 billion) in FY20.

The healthcare industry in India is critically important for the future of the economy and employment.

But what is the role of AI in India's healthcare story?

Is AI already impacting India's healthcare organisations?

What kind of benefits are they seeing?

What are the challenges and barriers?

What's the impact on skills and job outlook?

This report focusses on answering these questions and more by running an AI-themed primary survey on healthcare executives in India. The next parts of this report, provides the context of AI in healthcare - global and Indian. The following sections provides key results from the survey and a final discussion. The aim is to contribute to

the current discourse on AI in healthcare in India and provide insights into its functioning within the Indian context.

AI IN HEALTHCARE: MAJOR APPLICATIONS [33,34,35,36,37,38]

The applications of AI in the healthcare sector can be classified into several categorised based on the stages of intervention, specific areas of intervention and fields of research. However, the most critical remain to be:

1) USING AI TO EFFICIENTLY DIAGNOSE AND REDUCE ERROR

Human errors have a much higher cost in healthcare when compared to any other sector. Incomplete medical history and large number of patients can cause deadly mishaps. The development and application of AI techniques in healthcare becomes the most vital when it comes to improving the diagnostic process. AI technology can assist pathologists in making more accurate diagnoses and develop methods for individualised medical treatment. Chatbots are also often used to record a patient's symptoms and health concerns and guide that patient to the correct care based on its diagnosis.

A study found that AI algorithms and deep learning was able to diagnose breast cancer at a higher rate than 11 pathologists

Similarly, deep learning medical tools can be used to streamline radiology diagnose and analyses unstructured medical data (radiology images, blood tests, EKGs, genomics, patient medical history) to give doctors better insight into a patient's real-time needs. AI-enabled assistants after being trained can receive imaging scans and automatically analyse them for clinical findings.

2) USING AI FOR DRUG DISCOVERY

In the drug development industry, AI can play a crucial role in reducing development costs and labour costs.

Drug re-innovation programs can employ AI technology to find new applications for existing drugs. 'Interrogative Biology' approaches with traditional R&D in AI, can develop more robust product candidates that fight rare diseases. Combining AI, the cloud and quantum physics, platforms has improved predictive ability, to statistically raise the chances of successfully passing clinical trials while also decreasing time and cost to market.

Trials for a new drug cost about 2.6 billion dollars on average and only 10% of them are launched to market. Pharmaceutical companies are adopting AI to improve efficiency and accuracy of drug creation.

3) USING AI TO ENHANCE THE PATIENT EXPERIENCE

Mining data from an entire population with AI technology helps doctors provide more accurate diagnoses and design more effective, personalised treatment plans. Limitless data means better treatment outcomes for patients. Telemedicine driven by AI devices can allow patients to search trusted data sources to determine whether their symptoms might require professional consulting. Patient engagement is vital to patient experiences, and apps like Ada are enhancing this experience by providing a constant sense of connect and assurance. Natural language and computer-assisted physician documentation (CAPD) solutions combine high-end spell checking with the intelligent analysis of clinical notes to suggest ways to the doctor to be more specific

to the patient. The use of chatbots can also proactively create a seamless experience for the user, and resolve problems for customers in real time.

## 4) USING AI TO INCREASE ACCESS OF QUALITY HEALTHCARE

Applications of AI in healthcare not only improves the efficiency and quality of medical services, but can also compensates for a lack of physicians. Thus, it improves the availability of quality healthcare and medical services in the remotest of areas. For example, while doctors can be stationed in urban locations, AI trained machinery can conduct tests and share reports from the remote locations. Several experts have also advocated that the use of AI might be the only means to alleviate the existing inequality between rural and urban healthcare systems. In developing countries, the number of healthcare centres and number of doctors per 1000 people are often lower than required. A multilevel medical AI service network system can help to implement and deliver better healthcare facilities throughout the country for those with low quality physician contact.

5) IMPROVING OPERATIONAL EFFICIENCY

The strongest financial burden of the healthcare sector includes salaries and machinery. Optimising scheduling and clerical tasks using automation, can substantially reduce the costs of running day to day business. For example, algorithms can be used to optimise patient schedules, wait time, cancellations, and match with available doctors. AI enable kiosks can also be leveraged for self service and booking. AI-driven softwares can be leveraged to effectively manage inventories and medical supplies, invoice processing, while also providing intelligent solutions to save cost.!

AI IN HEALTHCARE: SIZE AND GROWTH[11,20,21]

The global AI healthcare market was valued at $4,836.87 million in 2019 and is projected to reach $99,491.58 million by 2027.
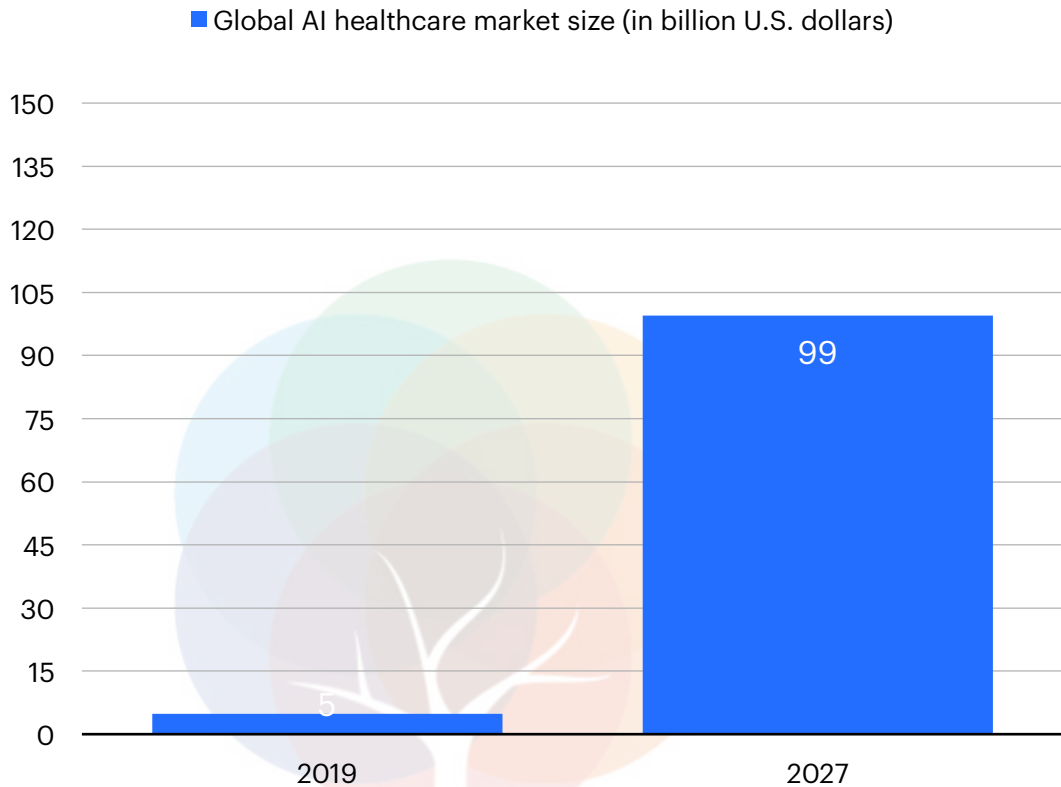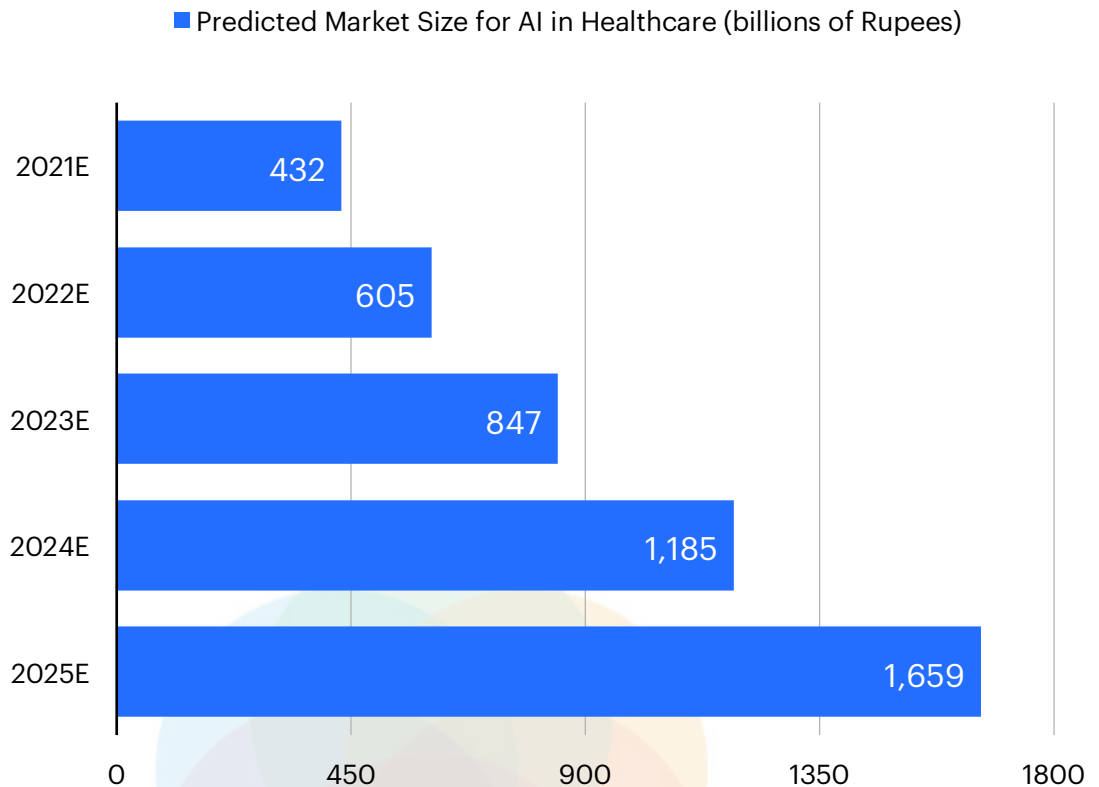

Source: Joshi, K., & Sunant, O. (2020, June). *AI in Healthcare Market by Offering, Algorithm, Application and End User: Opportunity Analysis and Industry Forecast, 2019–2027.*

The Indian market for AI in healthcare is also expanding at a fast pace, it was estimated that the space will be worth INR 431.97 billion by 2021, expanding at a rate of 40%. A positive hike in the market of AI applications in healthcare is expected to push the doctor-patient ratio in India to 6.9:1,000 by 2023, from 4.8:1000 in 2017. AI is also touted to help increase India's doctor efficiency, provide rural populations high-quality healthcare, and assist doctors and nurses to handle complex medical procedures.

AI : EMBRACING THE SHIFT IN HEALTHCARE

■ Predicted Market Size for AI in Healthcare (billions of Rupees)

Year	Predicted Market Size
2021E	432
2022E	605
2023E	847
2024E	1,185
2025E	1,659

Source: ResearchAndMarkets.com. (2019a, July). Artificial Intelligence (AI) in Healthcare Market in India (2018-2023). Netscribes (India) Pvt Ltd.

From a market-oriented perspective, the integration of AI in the healthcare sector, can be done based on the kind of service, product or consumer in the market:
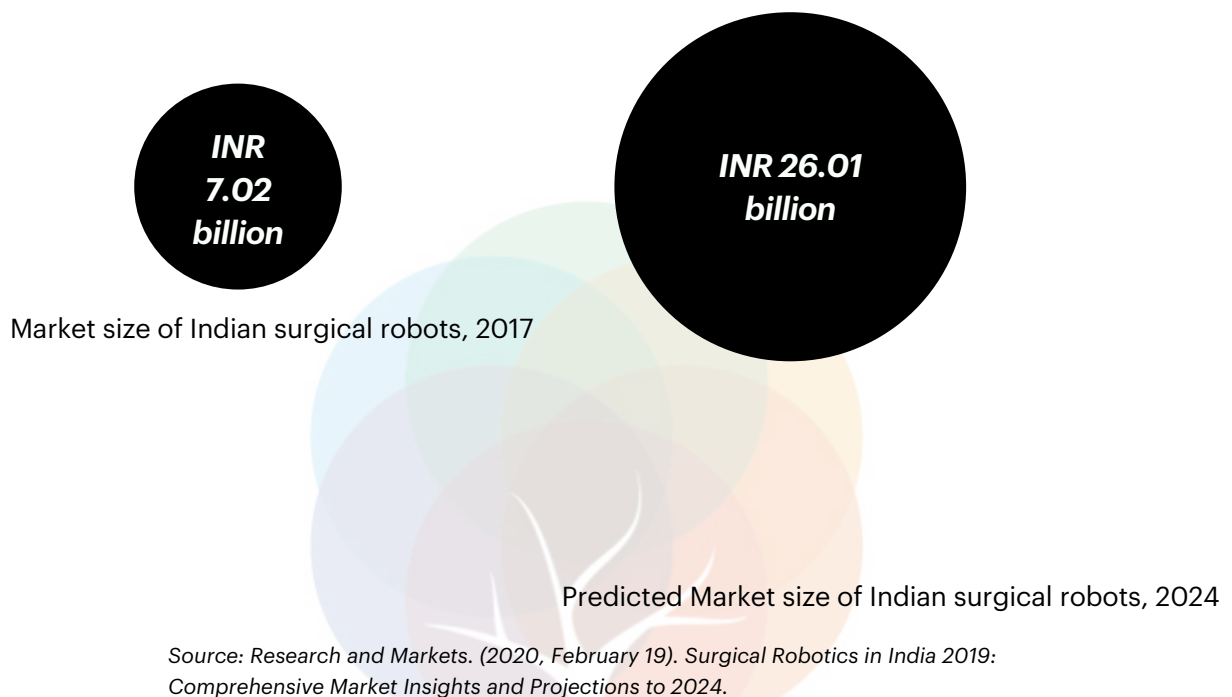
The first segment deals with AI compatible hardware and software that are sold to organisations to create an AI- enabled environment.

The second segment comprises of algorithms that are designed to create highly specialised programmes required to train and run the machinery for performing complex tasks.

The third segment includes well designed and trained machines/equipment that perform specific tasks.

The fourth segment looks at the end user of the AI-enabled technology.

Other AI subsegments, like the Indian surgical robotics market, which was valued at INR 7.02 billion in 2017, is also predicted to grow rapidly to reach INR 26.01 billion in 2024, expanding at a CAGR of 19.8% during the 2019-2024 period.

INR 7.02 billion

Market size of Indian surgical robots, 2017

INR 26.01 billion

Predicted Market size of Indian surgical robots, 2024

Source: Research and Markets. (2020, February 19). Surgical Robotics in India 2019: Comprehensive Market Insights and Projections to 2024.

AI IN INDIAN HEALTHCARE: DRIVING FORCES [1, 2, 4, 7, 9, 10, 12, 13, 15, 17, 18, 19, 21, 25, 29, 30]

There are a few key driving forces in the backdrop of this large growth of the AI market for healthcare in India. These can be categories into four:

1) GOVERNMENT INVESTMENT IN AI

Government initiatives play an integral role in motivating companies to adopt AI in India and the National Strategy for Artificial Intelligence (NSAI) is one such initiative. Under , NITI Aayog, healthcare has been mentioned as the core beneficiary from the

NSAI. The government looks to deploy a Centre of Research Excellence (CORE) team to carry out a deeper research of AI technology and the International Centers of Transformational AI (ICTAI) to foster new and existing ideas in the development of AI. A Task Force on AI has been deployed to browse and explore new avenues where AI can be used and subsequently leveraged. The prospect of introducing cognitive systems to help disable people (divyang) and the ageing population had been highlighted .

The Information Technology Act, 2000, and the Information Technology (Reasonable Security Practices and Procedures and Sensitive Personal Data or Information) Rules, 2011, require that service providers and patients exchange information constantly by using the latest digital technologies.

The government of India has also set a target to achieve Universal Health Coverage for all Indians in its National Health Policy 2017, for which, it has created the National e-Health Authority (NeHA) - a regulatory body for the deployment of digital interventions in the healthcare sector.

Partnerships are also now increasingly common, for example, NITI Aayog is collaborating with Microsoft and Forus Health to roll out an AI-driven technology for early detection of diabetic retinopathy in remote areas.

Overall spending for the healthcare sector is increasing as well - The Government of India aims to increase healthcare spending to 3% of the Gross Domestic Product (GDP) by 2022.

2) HEALTH-TECH STARTUP BOOM

As of 2020, there were 3,225 startups in India in the health tech space. Most famous examples include Pharmeasy, Curefit, Maine etc. There are now a vast number of health tech startups with truly innovative AI-driven product offerings and portfolios. Box 2 provides a glance.

Healthcare has been one of the strongest areas of startup investments in AI, reaching 2.5 billion US dollars in VC investments over the last 5 years preceding 2018, most of which has been in medical imaging and diagnostic services. Other segments include drug discovery, insights and risk analytics.

India's healthtech market is also estimated to reach $21 Bn in 2025.

Preventive healthcare in India also is expected to reach a market size of $170 Bn by 2025, driven strongly by fitness and wellness apps and diagnostics solutions.

The most recent start-ups in the Indian market are focusing on providing consumers with AI based software and applications to promote better lifestyles and healthier living. Most common product solutions have been in fitness, mental health and tele-medicine applications.

While the first half of 2020 saw a 46% increase in health and fitness apps around the world, India had the biggest rise with a 156% increase in the downloads. Similarly, India also had the highest daily active users (DAU) with 84% (12 million) new users. Apart from Curefit, which is India's most used health and fitness app, apps like HealthifyMe, Growfit and Obino also gained popularity among the Indian masses.

While the first half of 2020 saw a 46% increase in health and fitness apps around the world, India had the biggest rise with a 156% increase in downloads.

Mental health issues are also on the rise, and apps like Wysa have helped many deal with emotional health and well-being through its AI-driven chatbot. Other initiatives like YourDost is one of the new online platforms which enables people to chat anonymously with a concerned expert and express their insecurities and problems. The experts help the people in solving and removing mental blockades virtually. They have also created a special section to deal with problems like loneliness, work stress, lockdown fatigue and laid off stress which people have been facing during COVID-19.

BOX 2. INDIAN AI DRIVEN HEALTH TECH STARTUPS AT A GLANCE

Tricog - Aims to provide advanced cardiology services to clinics and hospitals virtually through its AI-powered technology. Its InstaECG and InstaEco have been designed in a way which focuses on a detailed review of cardiac ultrasound to help diagnose heart diseases.

Perfint Healthcare - Its image guided interventional procedure helps in fighting cancer. Their main products include the Robio EX, Robio EZ and Maxio. All of these equipment with their robotic positioning system and image guidance during CT scans help doctors in planning out treatments and reducing pain during the delivery of medicines and other scans.

Niramai- Its AI monitored system stores data of all thermal testing done to deliver more accurate techniques of analyzing thermal images through its data algorithms. The AI by analyzing more than 4 lakh temperature points, which cannot be done manually, helps in identifying breast abnormality in the earliest stages.

SigTuple - Operates in the field of pathology and ophthalmology offering automated digital microscope and AI platform solutions. Both these features combine to convert physical samples into digital images and then analyze them to generate a detailed report of the blood smear, urine sample, data concerning retinal damage, diabetes and glaucoma.

HeathPlix - Integrates an AI-supported software which provides Clinical Decision Support (CDS) for doctors and helps them give out e-prescriptions to their patients.

Cureskin- Offers skin treatment solutions and recommendations with just one scan of the face through a device. The app first allows the person to choose their skin goals and problems like acne, scars, dark spots, etc.

Wysa - Aims at helping people going through mental health problems like depression, anxiety, stress, relationship stress, work stress, etc. with their AI-based chatbot. It tries finding solutions to different problems by striking conversations between the user and itself. In the process, Wysa measures the emotions and cognitive behavior expressed by the user.

3) COMPETITION AMONG HEALTHCARE ORGANISATIONS

Premium hospitals such as Max, Apollo, Fortis, have been the pioneers in the market, both as consumers and providers of applications of AI in the healthcare sector. While these hospitals have adopted AI centric technology designed and sold by companies like IBM, they have also acted as providers to this technology to consumers. Adoption of latest technological innovations have given such hospitals enhanced efficiency and popularity, subsequently, they have acted as motivators to promote healthy competition in the market.

Apollo Hospital's telehealth services provided them a competitive advantage over the others through the tele-consults, tele-radiology, tele-condition management. A similar telemedicine service was soon matched by Fortis Escorts Heart Institute which adopted Philips Innovation Campus's online TB chest x-ray and detection services and mobile obstetrics monitoring services to help people and women with high-risk pregnancies respectively. Fortis has also introduced an AI-powered chat bot which helps decide whether to visit the doctor, postpone the appointment or consult the doctor through telecommunication by analyzing the pedigree of the patient's problem. Max healthcare also started adopting the use of AI in radiology (especially for x-rays and CT scans), pathology, patient care delivery systems and the integration of clinical and non-clinical data to combine the AI model and the pre-existent software of the hospitals. A virtual tumor board, 3D printing systems, and Bluetooth Low Energy (BLE) have also become a part of their AI-powered technology.

Aravind Eye Care Systems has also been working with Google Brain to use its AI algorithm to detect eye diseases. In August 2019, Microsoft in association with Apollo Hospitals set up a National Clinical Coordination Committee for AI-powered cardiovascular disease risk score API. The committee works towards tackling cardiology and cardiovascular-related problems using AI. The technology is based on analytical insights, treatment guidelines based on clinical data-based algorithms and multi-centre prospective studies.

Watson for oncology is an IBM developed computing platform, which is helping doctors at Manipal Group of Hospitals since July 2016 to analyze and interpret a large

amount of data to diagnose and treat cancer, advance treatment options and offer individualised care for cancer patients.

Narayana Hospital, in 2019 adopted the Power BI dashboards to use real-time data of more than 3,000 doctors across 30 comparable parameters to ensure a more efficient, reasonable, and better patient care to undertake predictive analysis, analyze attrition rates among nurses, optimise cost and give treatment recommendations.

RISKS AND CHALLENGES[30,31,32]

Despite the boom in the sector, there are several challenges that need to be calculated and accounted for while analysing the application of AI in healthcare. For an overall cost-benefit analysis this section explores the challenges and risks involved in using AI systems for healthcare solutions in India across three stages:

1) DEVELOPMENTAL CHALLENGES

a) **Privacy Concerns:** Collecting patient data and maintaining their privacy is certainly a big challenge. In the development stage, researchers can work to ensure that patient data remains private. Wide presence of hackers exploit mistakes and errors. In the era of big data, the core strategies long used to ensure privacy – individual notice and consent, opting out, and anonymization – have lost much of their effectiveness' (Mayer-Schönberger and Cukier, 2017). The lack of laws that define 'personal data' in our country can invariably cause ambiguity to prevail, a unified code that legalises the use of 'well-defined medical data' is extremely crucial for India to increase the application of AI.

b) **Bias and Inequality:** If the data used to train an AI system contains any hint of bias, it will be present in the actual model output as well. On top of that, practitioners and healthcare workers are also prone to cognitive and behavioural biases. If the data available for AI are principally gathered in academic medical centres, the resulting AI systems will know less about the data set from populations that do not frequently visit academic medical centres. The biases can also be a result of biased data collection processes. If a machine has to be trained using data that is biased, despite its well-intended use, the chances of algorithms making errors is high. The growth of the sector is highly dependent on the development of strategies and practices that minimise the scope of biases entering the algorithms.

2) CHALLENGES IN ADOPTION

a) **Professional Realignment:** One long-term risk of AI in healthcare is the shifts it can potentially do in the medical profession. Certain roles and specialties are likely to be automated, one such specialty can be radiology. For a developing country like India, the sudden change of labour market forces, can result in a shock. It is imperative to pre-asses the consequences of AI on the jobs in the healthcare sector. The changing nature of skill set and required knowledge can be addressed by making necessary alterations to the course material of healthcare workers. Experts are of the opinion that widespread use of AI might also eventually reduce human knowledge on the subject. Subsequently, humans will also lose the ability to detect biases and errors made by the technology.

b) **Injuries and Error:** Compared to human beings, machines are less likely to commit errors, however, we cannot completely overlook the possibility. The presence of biases in algorithms can be, for example, a cause behind such errors, similarly, inadequate or unrepresentative data can also lead to erroneous algorithms and possible misdiagnosis. The result of such errors can be prescribing wrong medicines, overlooking small sizes of tumors etc. Changing the perception of people towards use of technology in healthcare is also necessary in order to successfully utilise it, the absence of this can create uncertain reactions from the public. Individuals when wrongly diagnosed or treated are also bound to react more strongly to a computer error than a human one.

c) **Data availability:** The lack of mechanism to collect medical data and the operational challenges during implementation becomes one of the major reasons behind paucity of data. The lack of data also eventually leads to skewed data that is collected from a sample that is the most convenient, data from clinical trials to inform AI typically under-represent women, minorities and the elderly, as fewer of them are selected for such trials (Hart, 2017). In certain cases, the data can be well-representative but shows the latest medical conditions of the patients overlooking the medical history. Such underrepresentation makes implementation of AI in the healthcare sector very challenging. The wide rural-urban divide in India can also be felt in the conditions of healthcare services in the two geographical locations. The lack of technologically advanced hospitals in rural sets and absence of them in remote locations will lead to a condition where AI adoption has to be preceded by technological advancement like use of computers.

3) BEHAVIOURAL AND ETHICAL CHALLENGES

a) **The Nirvana Fallacy:** Humans often tend to believe that a new situation or option is definitely better than the existing one, this nirvana fallacy, can be one of the reasons behind the boom in the sector. While several studies have reported application of AI in the healthcare sector can yield substantially high benefits and lower costs for the healthcare sector for the overall society is still debated.

b) **Ethical and Legal Challenges:** While several questions about ethical behaviour of machines remain unasked, the need of a code of conduct has to be identified and mitigated since lack of ethics can threaten patient preference, safety, and privacy. Legal issues such as medical malpractice and product liability that arise with the use of "black-box" algorithms because users cannot provide a logical explanation of how the algorithm arrived at its given output, along with defining 'medical data', the state has to create laws around the breech of privacy, exploitation of power and other loopholes that have not been identified or discussed.

TAKING STOCK OF AI IN INDIAN HEALTHCARE

With the context of the previous sections of the report in mind, let's now move onto the key results of a survey run on 50 executives and partners in the mid to large healthcare organisations in India. The goal is to contribute towards the current discourse of AI in Indian healthcare and chart recommendations for the future.

ABOUT THE DATA SET & RESEARCH METHODOLOGY

The primary research was conducted by running an online survey on 50 executives from the healthcare industry in India. Participants were recruited from an online panel of respondents from SurveyMonkey - a global leader in market research solutions. In order to remove any bias from the responses, the study was blinded (the participants were anonymous and did not have any direct contact with researchers).

Medium to large scale healthcare organisations were selected for the survey having a higher likelihood of awareness and implementation of AI driven technologies.

Participants were from various cities - Delhi/NCR, Mumbai, Kolkata, Chennai, Bangalore, Hyderabad. Ahmedabad, Chandigarh, Jaipur.

44% were male, 56% were female

72% of the participants were from organisations having more than 500 employees, and 28% having 100-500 employees.

70% of the participants were senior management, C-level executives, functional heads or founders/partners in their organisations. 30% were middle management.

24% of the participants were from the hospitals industry, 28% from pharmaceuticals, 8% from diagnostics and research, 22% from medical equipment and insurance, 18% from telecommunication and digital health.

100% OF THE PARTICIPANTS BELIEVE THAT AI HAS THE POTENTIAL TO SOLVE COMPLEX CHALLENGES FOR HEALTHCARE IN INDIA
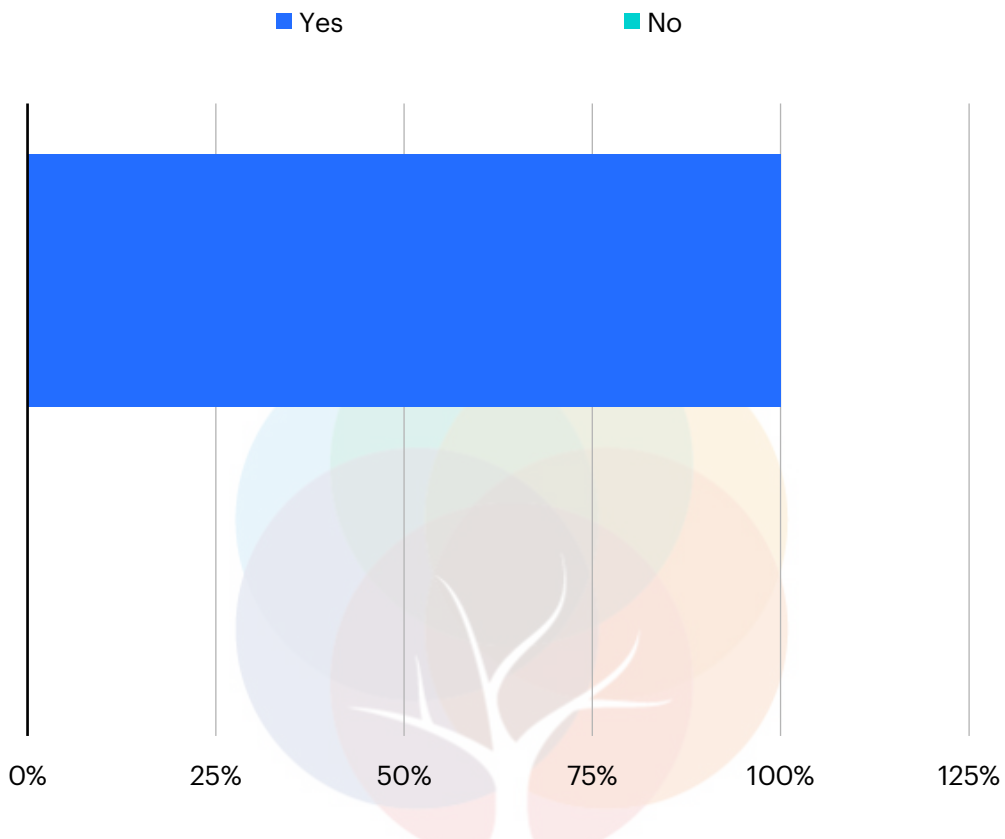

Graph 1. Answer to - "Do you believe AI (Artificial Intelligence) has the potential to solve complex challenges and meaningfully enhance the delivery of healthcare in India?"

All the participants are extremely optimistic about AI's potential to meaningfully solve complex challenges for healthcare in India. Many currently abound as was covered in the previous sections.

90% OF THE PARTICIPANTS ALREADY HAVE A MODERATE TO LARGE AI STRATEGY IN PLACE FOR THEIR ORGANISATIONS

Unsurprisingly, 90% of the participants already have an AI strategy in place from a

Legend: ■ Not at all ■ Low extent ■ Moderate extent ■ High extent ■ Very high extent (main priority)
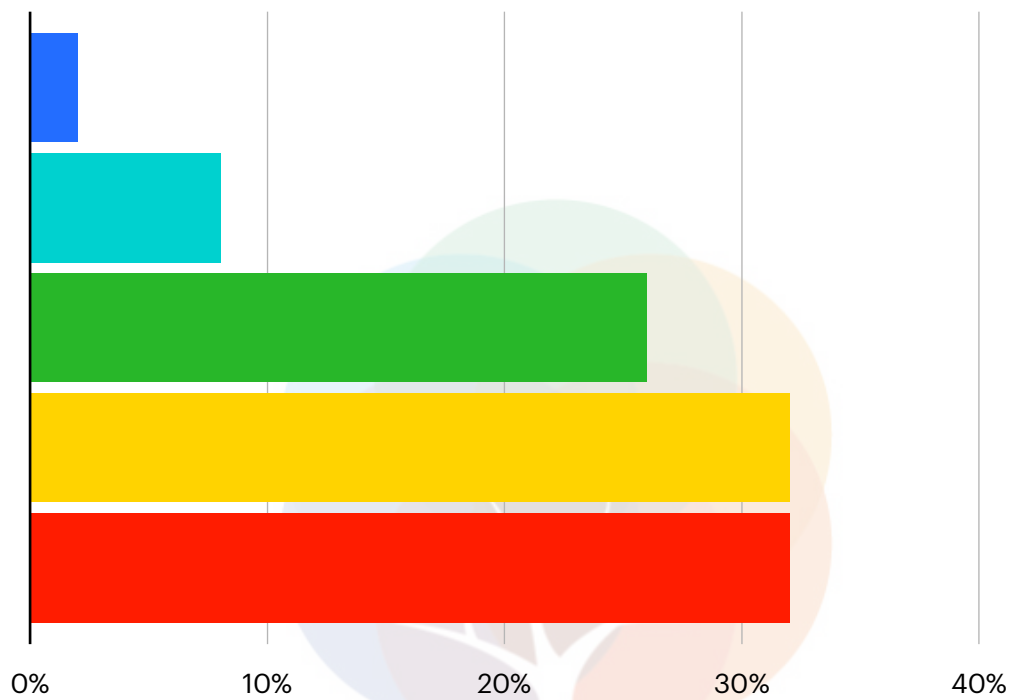
Graph 2. Answer to - "To what extent does your organization currently, have an AI (Artificial Intelligence) strategy?"

moderate to very large extent. In fact, for 64%, AI is of high priority in terms of organisational strategy.

HOWEVER, MAJORITY OF THE ORGANISATIONS ARE AT AN EARLY STAGE IN TERMS OF AI ADOPTION
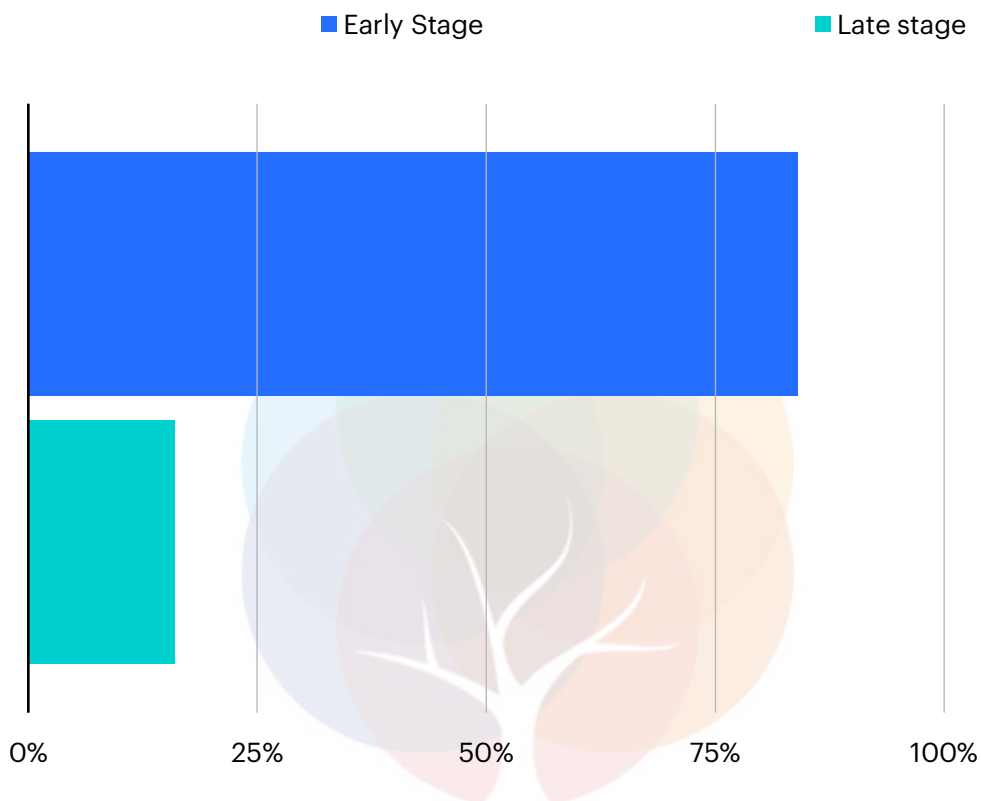
Graph 3. Answer to - "At what stage would you say your organization is currently with respect to adopting AI (Artificial Intelligence) - driven technologies?"

Also, it is not just AI which is being adopted. As was stated earlier in the report, the coexistence of emerging technologies is critical for the application of AI in any environment, and healthcare organisations are following a diverse strategy towards the adoption of other technologies as well. Nonetheless, AI is the highest adopted, followed by cloud computing and the internet of medical things (IoMT).

Graph 4. Answer to - "Which of the following technological advances has your organization adopted? (select all that apply)"
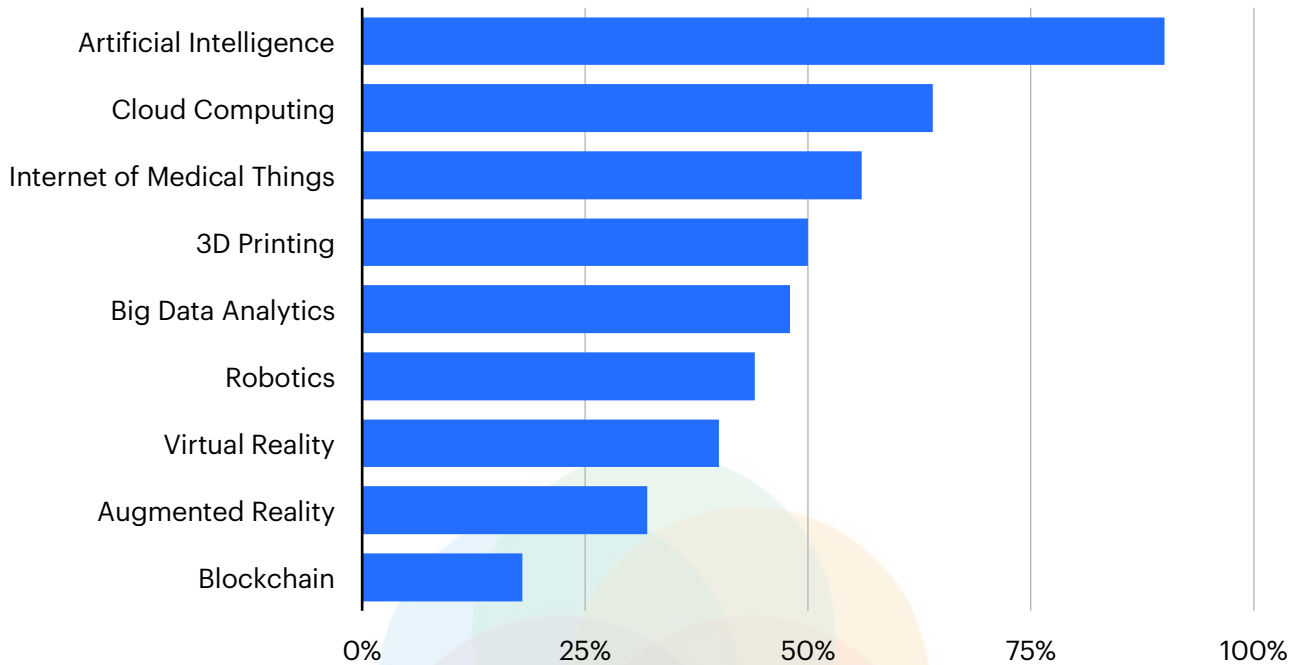
The top 6 emerging technologies being adopted in the healthcare sector are AI, Cloud Computing, IoMT, 3D Printing, Big Data Analytics, Robotics

The adoption and implementing of AI is also spread across various functional areas. The top 5 are:

IT

Manufacturing or operations

Customer service

R&D

Marketing

This is interesting to see as the applications of AI to enhance marketing strategies is also being used to improve reach in a highly competitive and growing market.

The top areas of focus are IT process improvements, manufacturing efficiency enhancement, operational improvements, and providing a superior customer service.
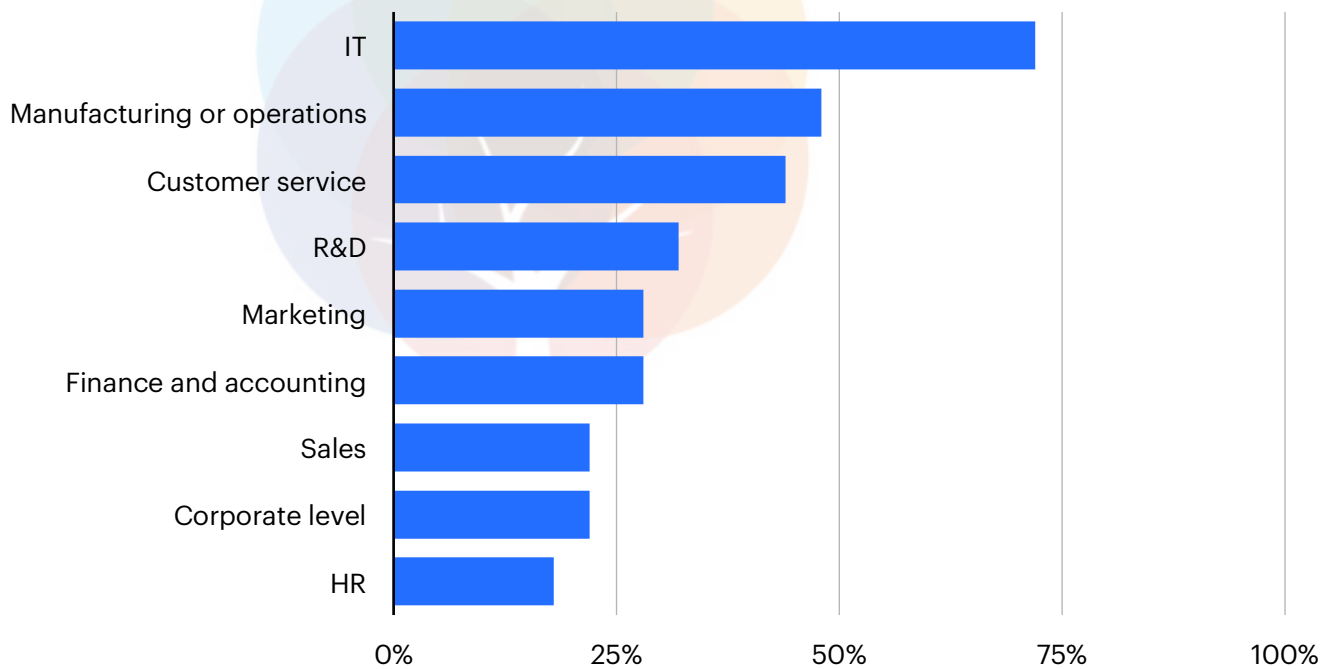
Graph 5. Answer to - "In which of the following functions are you currently implementing AI (Artificial Intelligence) - driven technologies? (select all that apply)"

While adoption is fairly high, and at an early stage, organisations plan to accelerate their AI strategy in the near future (74% state this of high priority). The impact of COVID-19 has been mixed on the adoption levels, however, the majority (54%) have said that it has paced up plans to adopt AI even further.

# 54% OF PARTICIPANTS SAY THAT COVID-19 HAS PACED UP THEIR AI ADOPTION AND STRATEGY

■ Slowed down plans   ■ Paced up plans
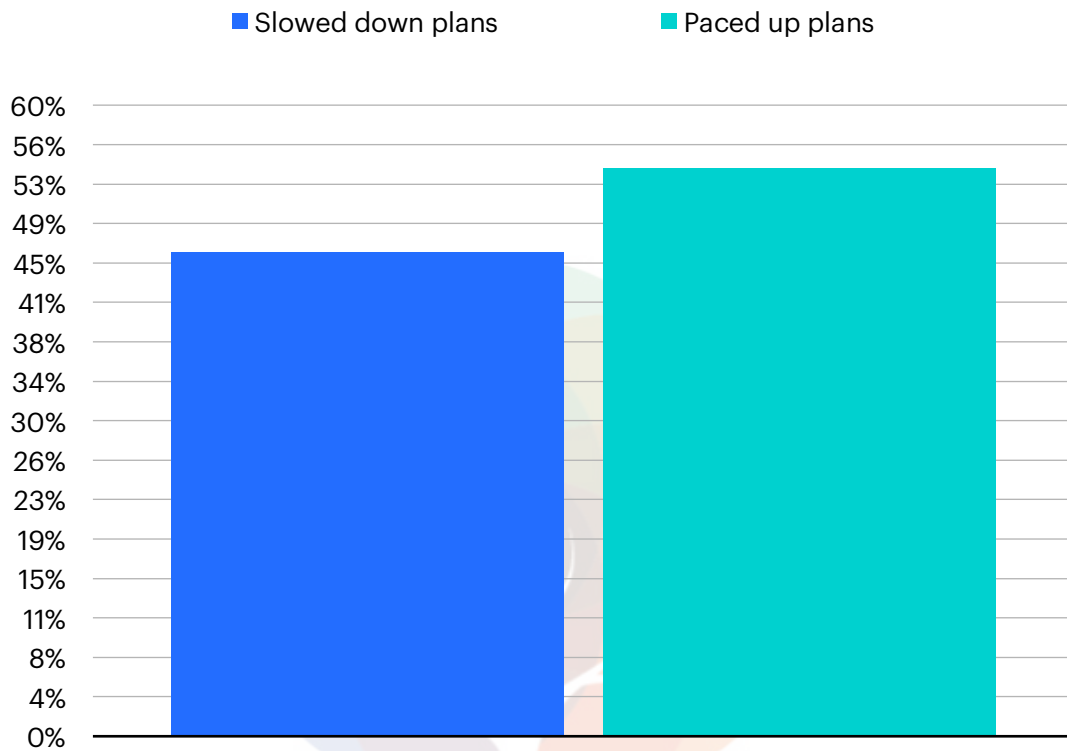
Graph 6. Answer to - "To what extent has Covid-19 impacted your AI (Artificial Intelligence) strategy?"

COVID-19 has given a push to a variety of industries to digitalise their offerings, so it is no surprise that healthcare as been impacted as well to adopt emerging technologies to improve overall offerings.

62% OF PARTICIPANTS SAY THAT THEY ARE ALREADY SEEING SIGNIFICANT BENEFIT FROM AI ADOPTION
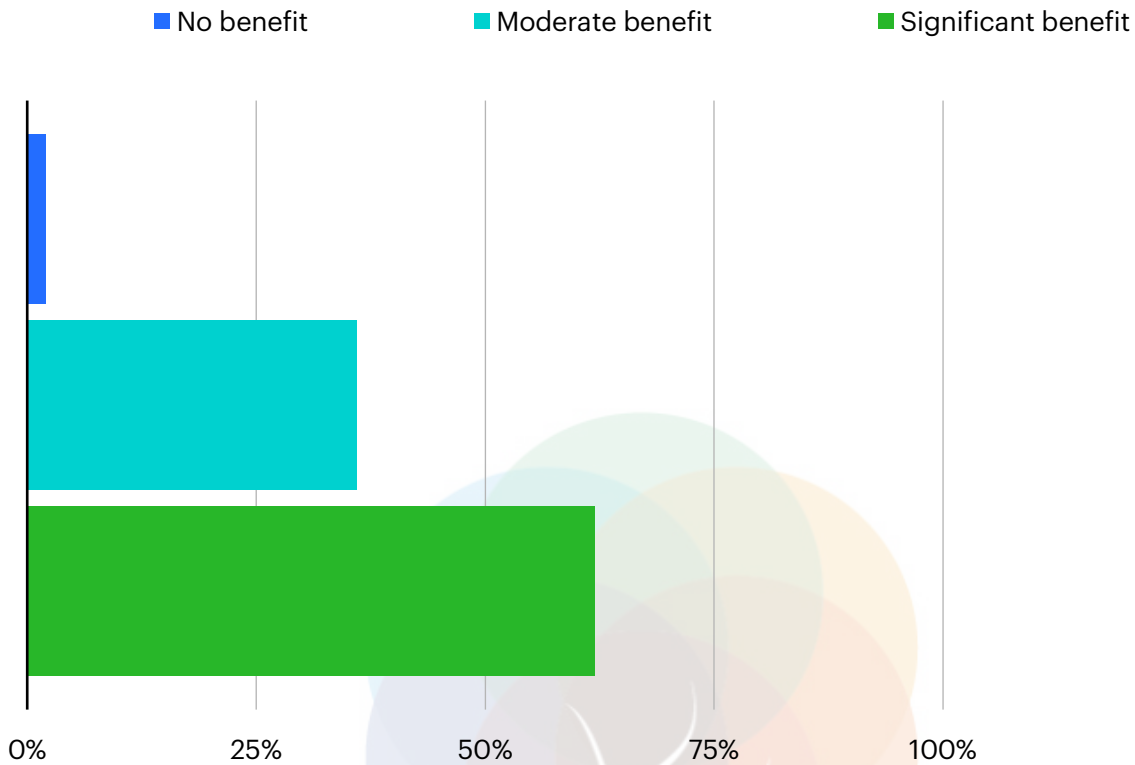
Graph 7. Answer to - "What kind of benefit are you already seeing within your organization with respect to AI (Artificial Intelligence) -driven applications?"

98% of the participants are already seeing moderate to significant benefit from their AI strategy and adoption. This is a tremendous insight as even though adoption is at an early stage, impact can be seen very visibly. But what are the key areas of impact?

46% of the participants also expect to see further significant benefit in the next 4-5 years from AI adoption

THE TOP AREAS WHERE ORGANISATIONS EXPECT TO SEE SIGNIFICANT BENEFITS FROM THEIR AI STRATEGY ARE:

| Area	% expecting benefit	Integration examples
Improved operational efficiencies	80%	Booking appointment, bed management, digital health records
Improved disease detection and diagnostics	72%	Remote diagnostics, predictive analytics
Better patient experience and satisfaction	56%	Chatbots, personalized solutions
Cost savings	54%	Patient churn, automated first-level screening, virtual assistant, labour reallocation
Improving reach	54%	AI(Artificial Intelligence) /machine learning-based marketing tools
Improved data and cybersecurity	44%	
Improving access to quality healthcare in underserved areas	42%	
Improved staff experience	30%	

Table 1. Answer to the question - In which of the following do you expect to see the greatest benefits from your investment in AI (Artificial Intelligence)? (select all that apply)

Operational efficiency and improvements is the key area for benefit of AI in Indian healthcare. Another significant area is the use of chatbots and personalised solutions to provide better patience experience in a highly competitive space. As consumers of healthcare products, we have already come across a variety of these as first level points of contact for large healthcare organisation websites.

Interestingly, many do not feel that staff experience will improve significantly with the use of AI, again pointing towards the inherent duality between AI and human intervention.

Executive feel that in the next 4.5 years, healthcare organisations will adopt and implement the uses of AI (Artificial Intelligence) with its proper understanding amongst their staff within the Indian context.

They also feel that their staff are significantly open to integrating AI technologies in their way of work.
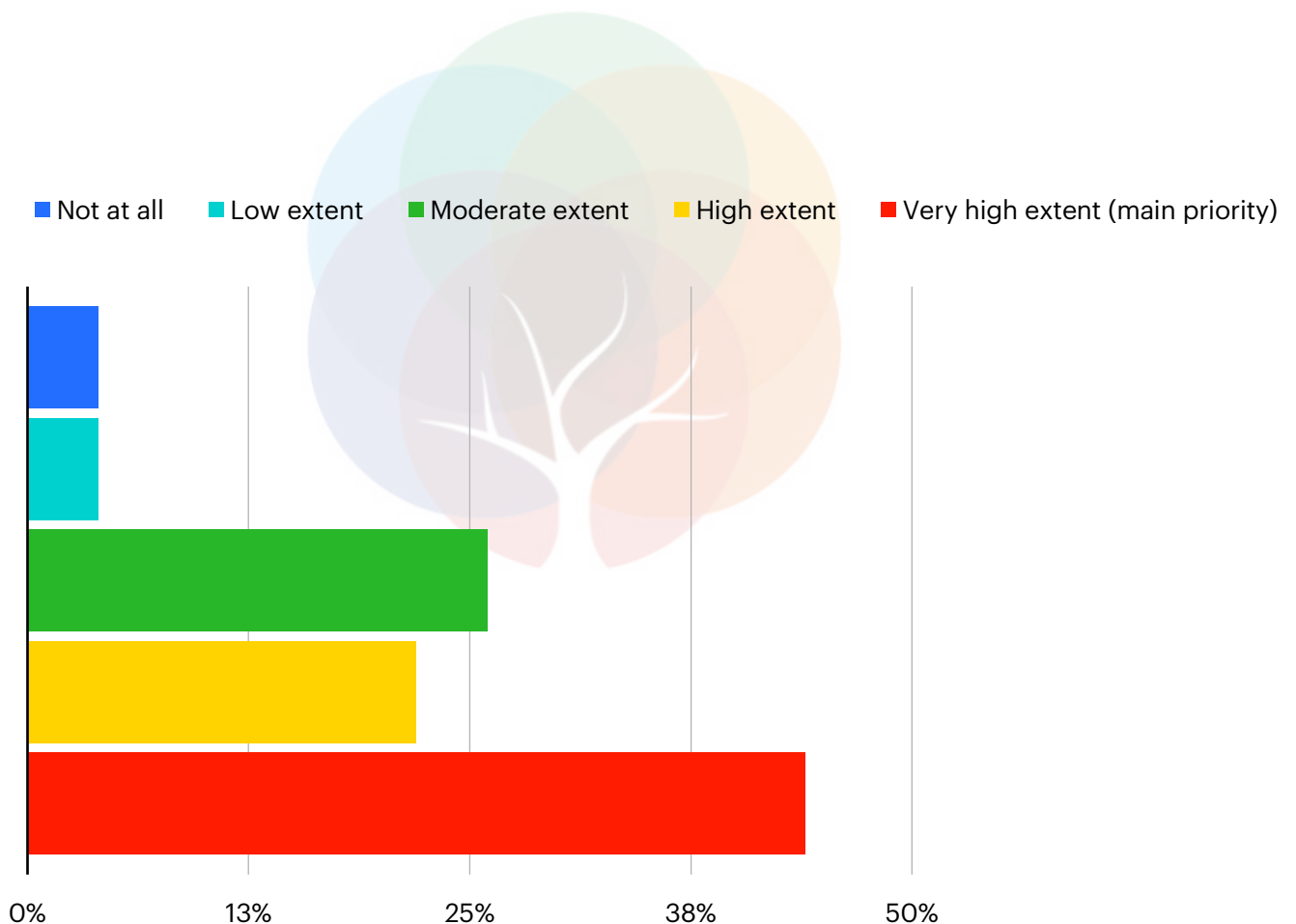
Graph 8. Answer to - "How open is your organizational staff to AI (Artificial Intelligence) -driven technologies?"

# THE TOP CHALLENGES TO SUCCESSFUL IMPLEMENTATION OF AI STRATEGIES CURRENTLY ARE:
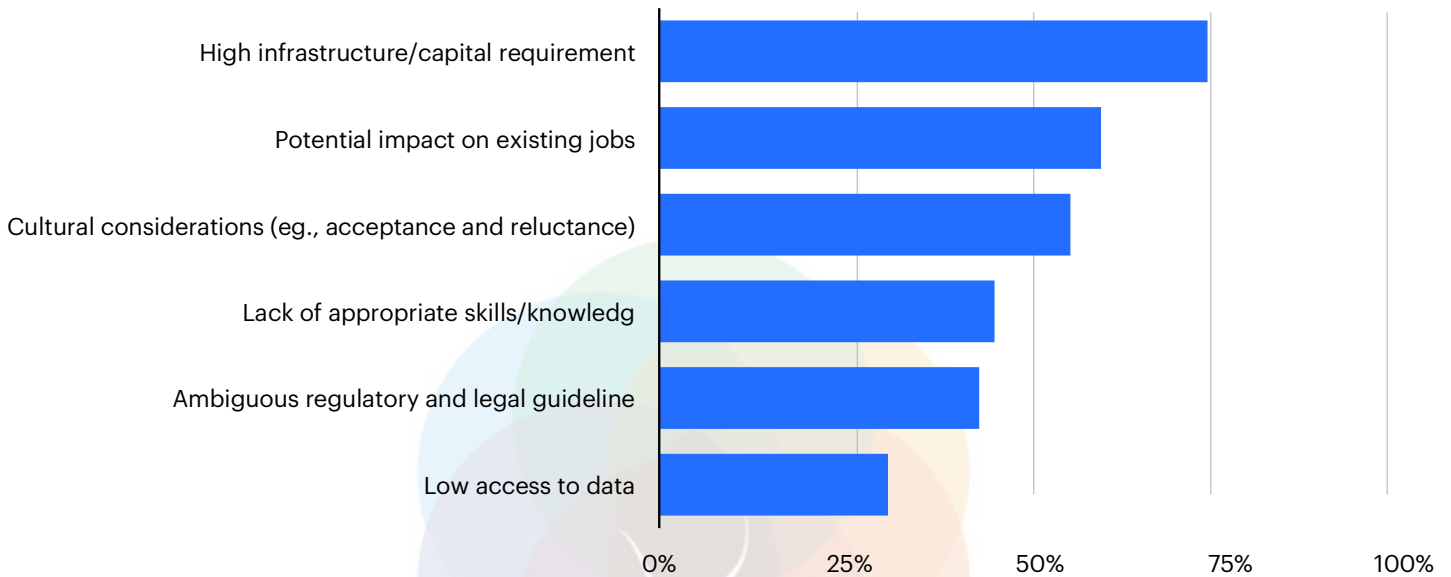
Graph 8. Answer to - "Which of the following do you see as key challenges to the successful implementation of your AI (Artificial Intelligence) strategy? (select all that apply)"

High capital requirement remain to be the key challenge to implementing AI strategies within healthcare organisations. Executives also strongly feel that the potential impact on jobs (reduction due to automation) is a big challenge towards implementation. Given that AI is expected to leave numerous low-skilled jobs redundant in the next decade (as was shared in the first half of the report), executives need to manage this skilfully.

Cultural considerations, such as trust on AI technologies is also seen as a large barrier. This is hypothesised to have to do with the openness of the consumer/patient to AI technologies. The executive are split with respect this - with 34% feeling only to a moderate/conservative extent, while 56% feel that to a high extent that the consumer is open.

The lack of skills and knowledge is also unsurprisingly seen as a barrier (similar to various other industries) as the nature of work changes and the workforce needs to be reskilled to work effectively with emerging technologies like AI. This will be explored further in the next section.

76% OF THE PARTICIPANTS ARE INVESTING HEAVILY IN THE UPGRADATION OF SKILLS OF THE CURRENT WORKFORCE WITH RESPECT TO AI/EMERGING TECHNOLOGIES
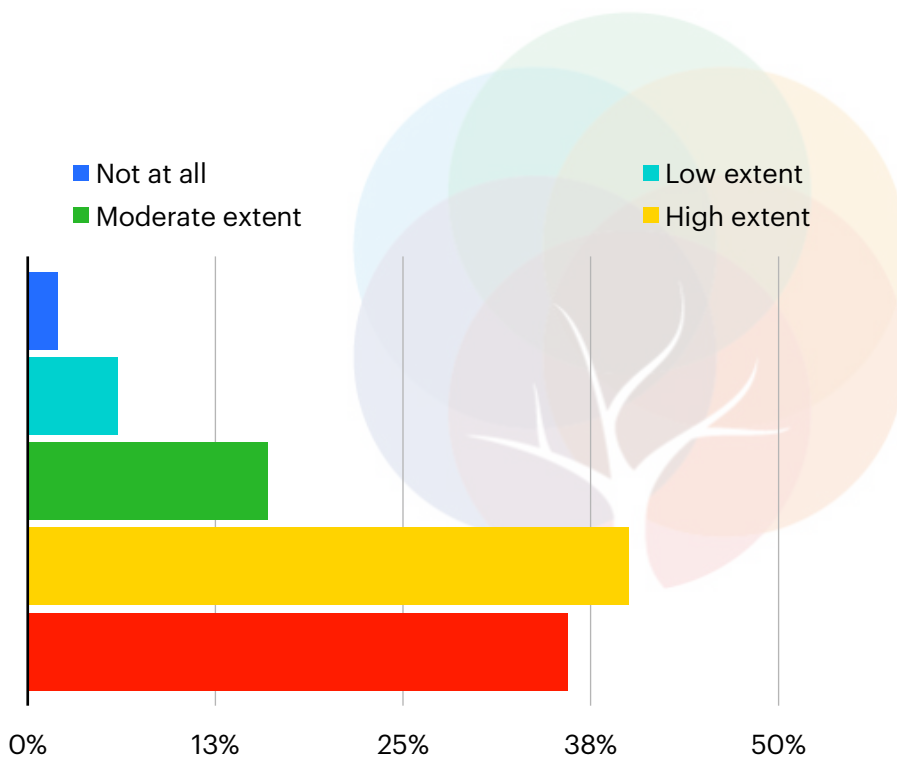
Graph 9. Answer to - "To what extent are you investing in the upgradation of skills for your workforce with respect to AI(Artificial Intelligence) /emerging technologies?"

66% OF THE PARTICIPANTS SAY THAT AI RELATED SKILLS AND KNOWLEDGE IS A PRIORITY FOR HIRING TALENT

- ■ Not at all
- ■ Low extent
- ■ Moderate extent
- ■ High extent
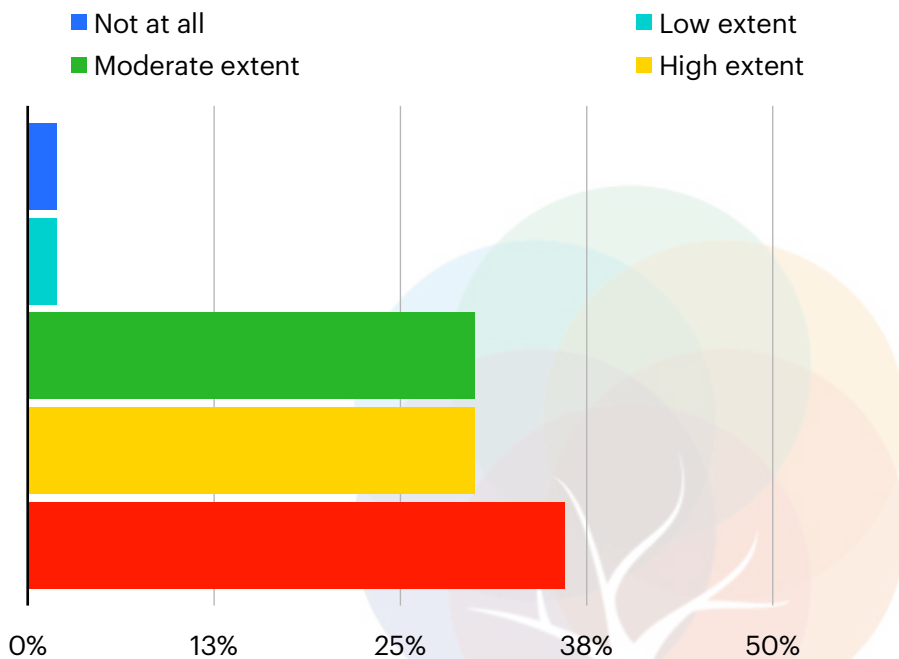
Graph 10. Answer to - "To what extent is AI (Artificial Intelligence) -related skills/knowledge a priority for hiring talent?"

88% of executives feel that Understanding the fundamentals of AI (Artificial Intelligence) and machine learning is the top skill healthcare professionals need to keep pace with the wave of technology and make themselves more hireable

This is followed by the development of a continuous learning mindset, and having proficient digital skills.
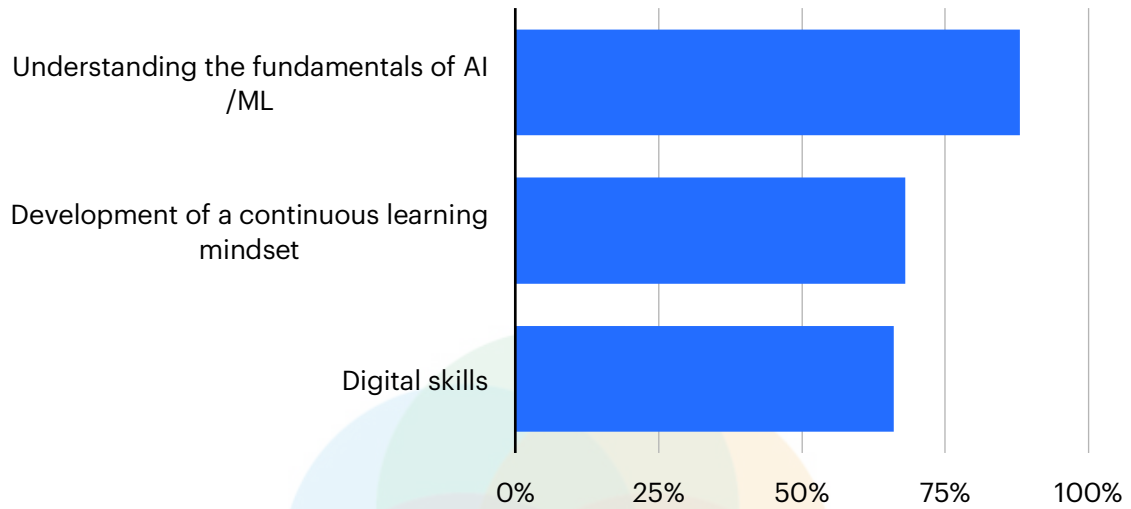
Graph 11. Answer to - "Which of the following do you see as the most important for professionals in healthcare to keep pace with AI(Artificial Intelligence) /emerging technology applications? (select all that apply)"

A WHOPPING 96% OF THE EXECUTIVES SAY THAT CURRENT HEALTHCARE EDUCATION NEEDS SIGNIFICANT UPGRADATION IN INDIA TO KEEP PACE WITH THE CHANGING TECHNOLOGIES

THERE ARE ALSO A RANGE OF FUTURISTIC JOB PROFILES OPENING IN THE HEALTHCARE SECTOR. THE TOP 6 BEING:

DEEP LEARNING/MACHINE LEARNING EXPERTS (74% FORESEE)

AI EXPERTS (70% FORESEE)

ROBOT DESIGNERS AND ENGINEERS (66% FORESEE)

CHATBOT DESIGNERS (52% FORESEE)

TELE SURGERY SPECIALISTS (50% FORESEE)

ANALYTICS EXPERTS (42% FORESEE)

Driven by the background of these new jobs profiles, and significant growth in the sector, the majority of executives feel AI will create more jobs than it will destroy in Indian healthcare

■ Destroy more jobs than it will create ■ Create more jobs than it will destroy ■ Can't say
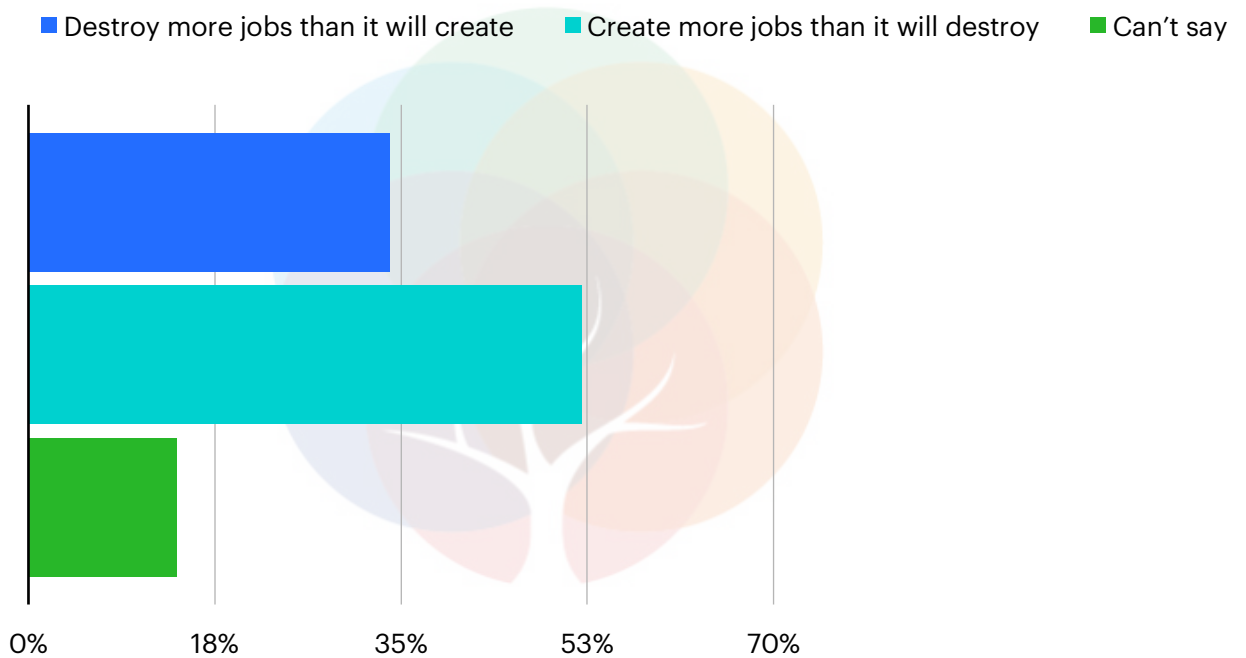
Graph 12. Answer to - "Do you believe AI (Artificial Intelligence) -driven technologies will create more jobs or destroy them within the Indian healthcare context?"

DISCUSSION

The AI in healthcare market is certainly one of high lucrative and societal value. Significant growth can be seen in the market, and as our data shows, there is bullish optimism on the scope for AI to solve India's healthcare challenges.

While most companies have an AI strategy in place, the adoption is still at very early stage. Technologies focus primarily in IT, Customer service and manufacturing or operations. There is significant scope for adoption in key functions such as R&D to drive innovation and inventiveness within the Indian healthcare sector.

Even though at early stages, many are seeing/expecting significant benefits from their adoption from AI, and operational improvements come out on top. The transition to digital health records, and using AI based software to assist bed management, patient records, may be adding significant cost and efficiency improvements.

There is also strong integration of remote diagnostics and analytics based technologies to diagnosis accuracy, which can be hypothesised to very soon have direct impact on heath outcomes for consumers and patients alike.

Interestingly, a lot of the applications of AI also focussed in marketing - to use chatbots and machine learning tools to enhance outreach strategies, to improve revenues and enter areas where formalised healthcare in currently missing. This has significant scope to improve quality of healthcare nation-wide, and fits with the overall vision of AI's impact on healthcare.

The entire look of healthcare in India will also change significantly in the next 4-5 years as executives feel there will be strong amounts of integration with the right staff skill-set set by that time period.

Capital constraints and infrastructure costs is still the key barriersto adoption. Perhaps, the role of the government and other support industries must focus on improving the cost to market and implementation for AI in organisations for healthcare. With cultural barriers still showing strongly as a key challenge, various educational and awareness campaigns become a must to assuage misinformation and increase trust in AI based systems.

AI : EMBRACING THE SHIFT IN HEALTHCARE

Other challenges - data use and regulation also cannot be ignored as a quarter of the participants do see these being highly influential.

This growing future of AI needs to be controlled and governed by regulations defining the National AI vision and the financial and socio-economic impacts that the government wants to make. Large amount of data is still scattered in India and another chunk is kept private for the time being. Productive solutions are needed to collect the available data to form a larger database and harvest better analytical scope for results for the AI systems. The categorization of important datasets and the facilitation of such datasets through a central agency might help in giving a better structure and stability to the available data. The unavailability of data has prompted some AI-powered systems to use data from a different geographical location. This may not help in the accuracy of data analysis as the diseases and variations of disease will vary according to the demographics and geographic location .

Regulations will play a key part in the future of AI as there might be a possibility of many patents and trademarks being introduced in the field. There is currently no AI regulatory body in the country. Similarly, the privacy and security of customer data is important and therefore a proper regulatory body should be formed to help with the surveillance of any irregularity in this space. Many people are not yet convinced with the credibility of AI and the secrecy of personalised information that big data analytics companies would keep and the regulatory body would ensure just this.

Perhaps, one of the most startling results of this study is that executives very strongly feel that healthcare education is lacking significantly in terms of emerging technology related skills. Digital skills, understanding of AI/ML, having a learning mindset are key aspects lacking currently. They feel that education in healthcare needs significant improvement and upgradation to make professionals of the future more in line with how the market is transforming. Only if this occurs will they be able to fulfil the growing needs new jobs profiles.

And not just in healthcare, engineering has also been touted to be a field with major skills gaps which must be addressed to support the changing healthcare workforce requirements to fulfil jobs such as analytics experts, AI developers, Robot designers.

The most hopeful result emerging is certainly also that the impact of AI on jobs is seen to be positive by industry experts, saying that it will add more than it will take away on aggregate - which should excite professionals, analysts and job-seekers alike.

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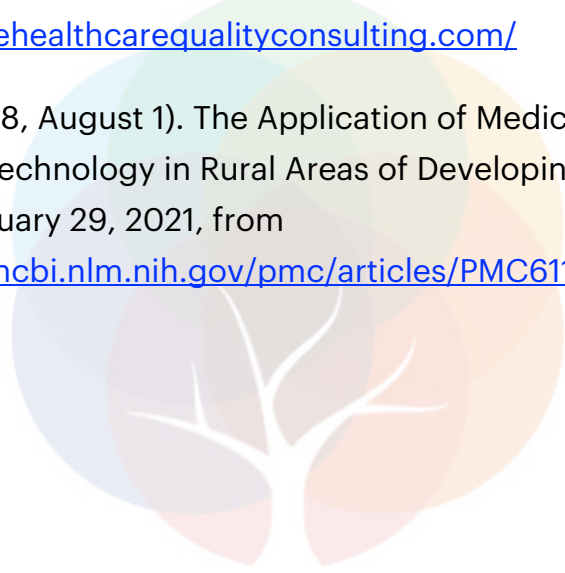
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