

Understanding the impact of GenAI on the Indian healthcare ecosystem

March 2024



Messages from PwC

Generative artificial intelligence (GenAI) could revolutionise healthcare in unprecedented ways as stakeholders develop more efficient and scalable digital health systems – a survival strategy for business.

AI is driving the transformation of the healthcare industry into a phygital human-centred ecosystem at a rapid pace, with a focus on patients, clinicians and administrative personnel. In recent years, it has found application in areas such as imaging, radiology and precision medicine as well as the mapping of much-needed evidence-based clinical pathways.

For healthcare to be future ready while rethinking value-based offerings and reinventing business models, there needs to be a paradigm shift in clinical recommendation and digitisation of contact centres and patient interaction. GenAI has proved to be an enabler for the same. From generating a discharge summary in the patient's native language to providing clinical notes in real time, GenAI's potential will drive better patient experience, enhanced productivity and optimised administration effort.

As industries gear up for change with the rapid adoption of GenAI in their day-to-day operations, the Indian healthcare sector is at the forefront of this trend with the development of new service models for inclusive growth and a focus on essential governance needed to handle nuances such as safety, security and regulations. In this paper, we have charted the opportunities GenAI presents and the challenges that need to be overcome to make the implementation of this technology more holistic and comprehensive.



Arnab Basu

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Like many other industries, AI has significantly impacted healthcare. GenAI is one subset of AI that has shown promise for revolutionising healthcare. It entails some clear uncertainties and risks, but also holds the potential to dramatically increase efficiency, improve the quality of care, and create value for healthcare organisations. Some of these potential applications include:

- enhancing patient journey and experience
- personalising medicine and treatment
- facilitating medical research, drug discovery and development
- enhancing medical imaging and diagnostics.

GenAI has the potential to transform the healthcare industry in India, enabling doctors to provide better care and treatment to patients. Healthcare is implementing GenAI models to protect patient privacy by implementing anonymisation techniques and to secure data-sharing frameworks.

Healthcare professionals can make more accurate diagnoses, discover new treatments and provide personalised care with the help of this technology. However, ethical considerations and challenges must be addressed. With continued research, GenAI can improve patient outcomes in the future.



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In this era of fast and far-reaching technological advancement and adoption, it is crucial for healthcare industries to understand, test and benefit from the improvements that modern technologies such as GenAI can offer. These innovations can vastly improve efficiency, operational excellence and user experience. GenAI in particular has the potential to revolutionise the healthcare ecosystem along these major application areas:

- care delivery
- medical and patient education
- operational excellence
- drug discovery and related activities.

It can do so by collecting information from patients in a comprehensible language, removing interactions with automated responses, and introducing human-like conversation for conflict resolution, better engagement and summarisation of data for care providers.

The size of the GenAI market is projected to reach USD 1.18 billion in 2024, and grow at a six-year CAGR (2024–2030) of 23.56%, resulting in a market of USD 4.20 billion by 2030.¹

However, it is important to address several areas of improvement in India, such as data privacy concerns, lack of technical infrastructure, and the cost of implementation of GenAI in the healthcare sector, before these benefits can be realised.

In this paper, PwC has attempted to highlight the opportunities that GenAI has to offer in the healthcare sector and some of the difficulties in adopting this technology.



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1. Generative India – AI market insights (<https://www.statista.com/outlook/tmo/artificial-intelligence/generative-ai/india>)

Message from Bengal Chamber of Commerce and Industry (BCC&I)

The healthcare industry has gone through a major transformation due to digital advancements. The pandemic further accelerated the pace of transformation. The industry has the scope to leverage emerging technologies in areas ranging from research to wellness.

Gen AI is the new buzzword in the technology landscape which is revolutionising different sectors. Gen AI relies on deep-tech algorithms to create new content with and from varied formats, including text, audio and code. It has the advantage of deriving information value from unstructured and unlabelled data of various forms. Gen AI use cases have significant potential to help research and innovations in biomedicine, biotechnology and drug developments.

The essence of healthcare is personalisation and speed. Decision making in healthcare may be best made by minute analysis of a huge amount of data from various sources such as medical records, lab tests, imaging scans, genetic tests, wearable devices, and patients or their families. Gen AI has the advantage of natural language processing (NLP), which helps in creating relevant information for efficient decisions at faster speed.

The efficiency that GenAI solutions bring in can also help in catering to a large number of people in less time, which is important in a socioeconomic set-up like ours.

With the availability of better data from mapping of disease profiles, food habits and other conditions and factors, it is possible to adopt a more focused preventive healthcare approach.



Angana Guha Roy Chowdhury

Assistant Director General
BCC&I



Table of contents

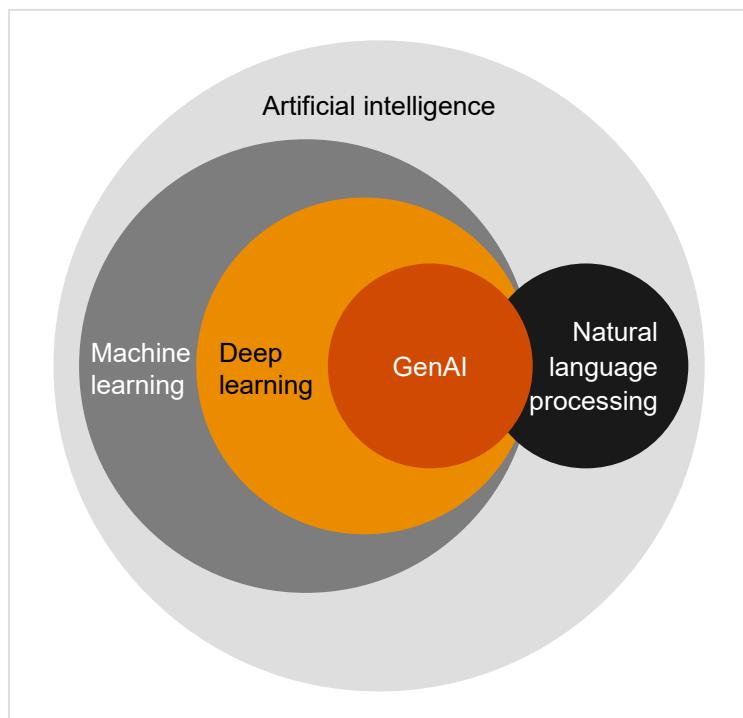
01	Overview of GenAI	08
<hr/>		
02	Maturity of global and Indian AI market	11
<hr/>		
03	Emerging themes for GenAI in healthcare	15
<hr/>		
04	Perceived risks with GenAI and governance	21
<hr/>		
05	Use cases for GenAI in healthcare	29
<hr/>		
06	Challenges to GenAI adoption in healthcare	36
<hr/>		
07	PwC's GenAI framework for healthcare	42
<hr/>		
08	The road ahead	45



01 Overview of GenAI

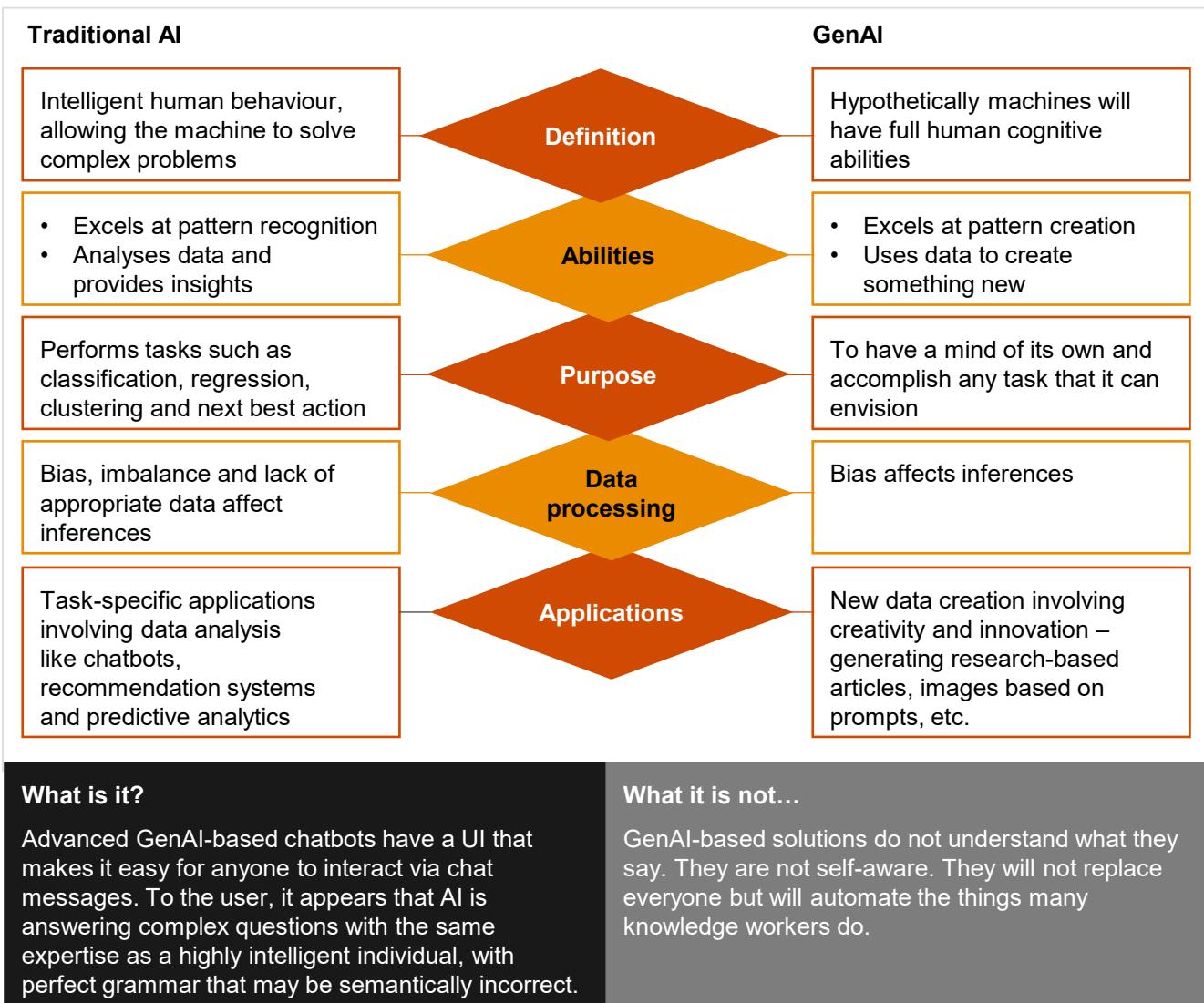
As artificial intelligence (AI) enabled technologies continue to mature, they bring forward a myriad of possibilities. Generative AI (GenAI) is a set of AI-based algorithms which can create original content based on large language models (LLMs) and deep learning models. These models forge new content based on inputs (also called prompts) by leveraging the vast amount of data they have been trained on. The human-like interaction with GenAI is enabled through implementation of natural language processing (NLP) algorithms along with the source LLMs. This has led to a paradigm shift in the interaction medium between users and AI. Users can share their inputs/prompts with the GenAI platform in conversational language and get the desired results without performing any coding. This has proved to be a turning point in the application of AI, as models are able to provide human-like responses (in mediums such as image, sound and video) without any domain-specific training.

Artificial intelligence landscape



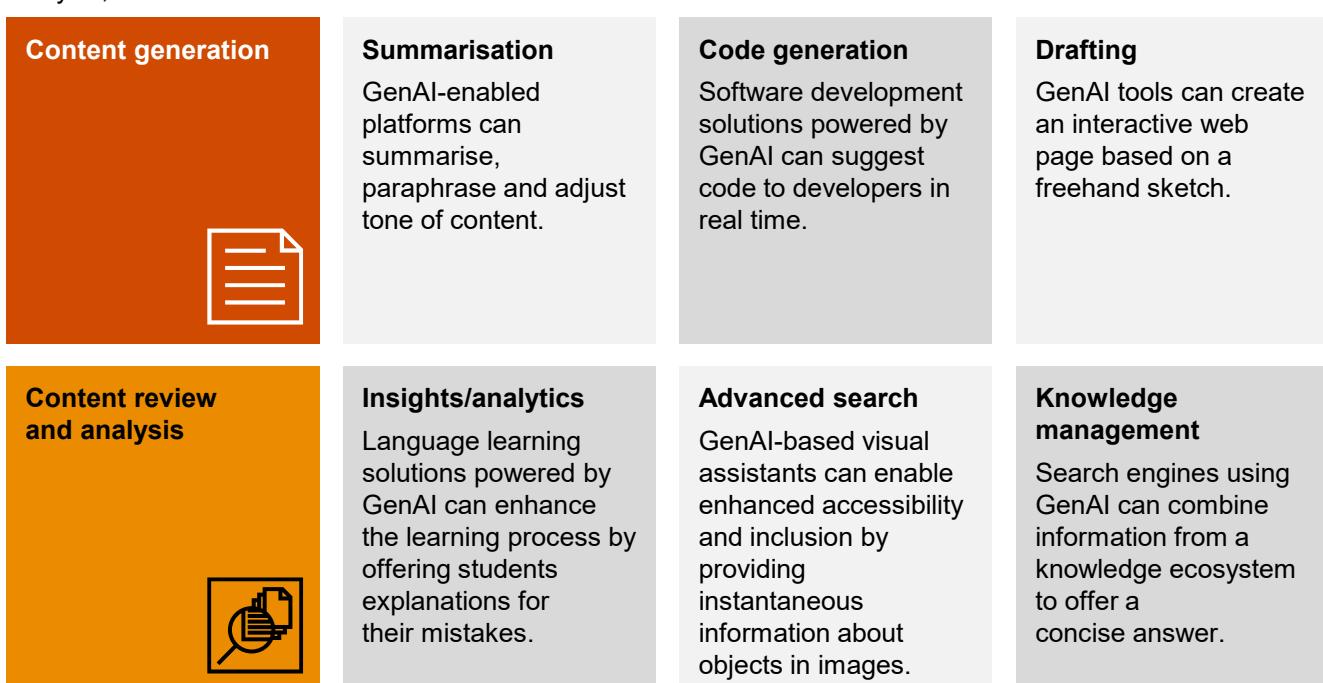
Source: PwC analysis

Traditional AI vs GenAI



Source: PwC analysis

GenAI can help in simplifying multiple activities in the healthcare domain across content generation, review and analysis, such as:

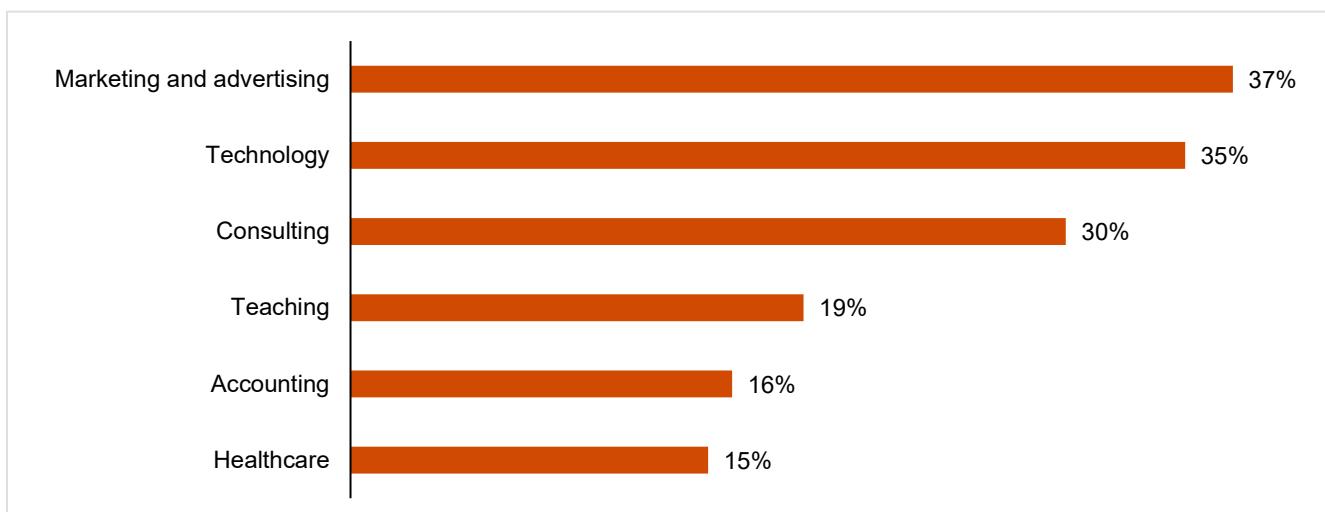


With GenAI solutions gaining increasing popularity, there have been considerable concerns regarding the potential threats it poses to society. The National Association of Software and Service Companies (NASSCOM), an Indian non-governmental organisation primarily operating in the Indian technology sector, has developed a set of guidelines² which can help in mitigating possible abuse of GenAI:

- 01** Proliferation of misinformation, disinformation and hateful content
- 02** Infringement of intellectual property and academic malpractice
- 03** Privacy harms through violations of data protection norms and standards
- 04** Propagation of harmful social, economic and political biases
- 05** Large-scale job displacements, loss of livelihood and economic strain for considerable portion of the existing workforce
- 06** Huge carbon and water footprints and associated environmental degradation
- 07** Surge in malicious cyberattacks

A recent study³ conducted across the US showed that professionals across various sectors have adopted GenAI-powered solutions to aid them at the workplace. The use of GenAI among professionals has become more widespread in industries which traditionally require higher levels of creativity and imagination.

Rate of GenAI adoption in the workplace in the US – 2023



Source: Statista

2. Responsible AI guidelines for generative AI (<https://www.nasscom.in/ai/img/GenAI-Guidelines-June2023.pdf>)
3. Rate of generative AI adoption in the workplace in the United States 2023, by industry (<https://www.statista.com/statistics/1361251/generative-ai-adoption-rate-at-work-by-industry-us/>)



02

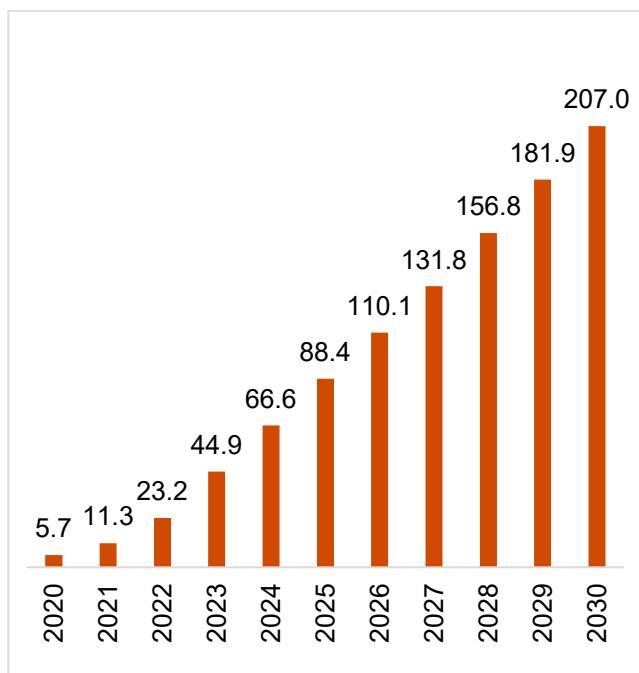
Maturity of global and Indian AI market

Across geographies, healthcare industries have been looking at opportunities created by and for the larger application of AI as a key capability in their digital strategies, convinced that AI will transform the landscape of technological advancements through amplified experience as well intelligent workflows and processes in terms of providing better patient and provider experience.

The GenAI market size is projected to reach USD 66.62 billion in 2024 and is anticipated to have a yearly growth rate (CAGR 2024–2030) of 20.80%. This might result in a market volume of USD 207 billion by 2030.⁴

AI has been able to drive growth and productivity for businesses by enhancing the customer experience. Conversational AI has become a part of our everyday lives, blurring the lines between machines and humans. Although there are many different types of AI technology, GenAI, which can produce human-like content is currently generating a lot of buzz with chatbots that can easily provide quicker suggestions to a patient in need.

Size of global GenAI market (in billion USD)



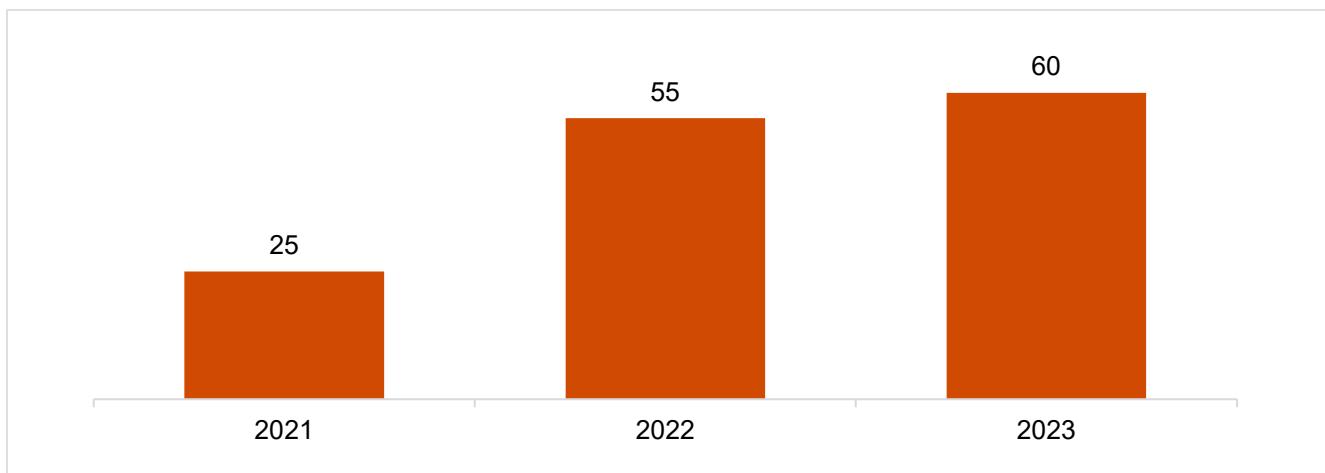
Source: Statista

4. Generative AI - worldwide | Statista Market Forecast (<https://www.statista.com/outlook/tmo/artificial-intelligence/generative-ai/worldwide>)

As we narrow down our focus to India, we see that the Indian healthcare system has witnessed multiple healthcare innovations, ranging from low-cost medical devices to new-age healthcare delivery models. The country's healthcare system has evolved to ensure patient safety, promote quality care and control costs. AI, machine learning, IoT and 3D printing have been some of the core technologies driving this change. Yet, we often observe that Indian healthcare facilities still face challenges in terms of enhancing operational efficiency, predicting patient demands, optimising staff allocation, managing medical supplies, etc. This is where GenAI can come in and provide solutions.

Most Indian industries, such as finance, e-commerce and manufacturing, have been gradually adopting AI technologies, including GenAI, to enhance operational efficiency and automate processes. On the other hand, in healthcare particularly, GenAI can augment advanced analytics and provide intelligent human-like insights to facilitate clinical recommendations and targeted interventions to improve patient outcomes and affordability. Between 2021 and 2023, the number of GenAI startups in India has more than doubled, while the overall market size is expected to show an annual growth rate (CAGR 2023–2030) of 27.66%, resulting in a market volume of USD 4.20 billion by 2030.⁵

Number of GenAI startups in India from 2021 to May 2023



Source: Statista

As per our observations, more than 50% of healthcare organisations have bundled their GenAI solutions with productivity tools to enhance efficiency and enable faster decision making by leveraging AI algorithms for tasks like data analysis, prediction and automation.

Organisations which have adopted GenAI solutions bundled with productivity tools



Source: PwC survey 2024

5. Generative AI startup landscape in India, NASSCOM (<https://nasscom.in/knowledge-center/publications/generative-ai-startup-landscape-india-2023-perspective>)

India has one of the most modern ‘open’ digital infrastructures in the world, and this paves the way for GenAI to break out from labs and proofs of concept (POCs) and launch the latest GenAI tools for the large ecosystem of technologists in the country.

PwC’s 27th Annual Global CEO Survey: India perspective⁶ suggests that around 71% of India CEOs expected GenAI to increase employee efficiency over the next 12 months, while 70% believed it would improve their own performance. They also believed it was likely to increase revenue (48%) and profitability (46%).

It is worth noting that the adoption of AI in India (57%) surpasses both the US (34%) and the global average (25%).⁷ It is essential to recognise that India has launched several conversational AI tools which is a true representation of how GenAI is making its mark as a progress parameter for India, paving the way for innovation and inclusive development.

The Government of India (GoI) has laid out several initiatives to promote and develop AI in India, including:

- National Strategy for AI (2018)
- Principles of Responsible AI (2021)
- National AI Mission under PM-STIAC (2022).

The GoI has been actively promoting the development of AI training modules such as the ‘Responsible AI for Youth’ programme and AI platforms such as ‘INDIAai’ portal to facilitate the creation of AI applications as it firmly believes that AI can propel India towards a USD1 trillion digital economy by 2025–26.⁸

While healthcare organisations want GenAI to quickly steer them towards better member, patient and provider experiences, with greater productivity and lower administrative costs, they need to be conscious of the fact that GenAI is still a human-led process. Further, life-affecting decisions such as diagnoses and treatments need to be carefully evaluated and monitored by medical professionals by re-engineering workflows along with AI professionals, managing change and recognising what GenAI can and can’t do. AI’s ability to ‘hallucinate’ occasionally or present inaccurate information as fact can often produce embarrassing results and erode credibility – which clearly suggests that GenAI works best when there is an actual human in the loop.

“

Looking forward, the combination of all technologies (be it traditional or disruptive) and keeping the human in loop is what is going to help. This augmentation will reduce healthcare providers’ burden without diluting the seriousness of healthcare delivery. To ensure leveraging GenAI to the fullest of its potential would require coupling young talents who are trained in these technologies with the experienced healthcare personnel and put a layer of governance on top of it, so that we get the best of both the worlds.

– Arvind Shivaramakrishna, CIO, Karkinos Hospitals

Across industries, GenAI is demonstrating its applicability in building a ‘marketing assistant’ than can help create hyperpersonalised marketing campaigns, or an AI-dashboard generator which automates the creation of data visualisations. For the healthcare sector, GenAI-powered ‘virtual chatbots’ are providing 24x7 real-time interaction, offering instant personalised responses, tailored health advice and administrative automation. Thus, is rapidly reshaping the healthcare landscape, empowering healthcare professionals with comprehensive insights to optimise patient care.

GenAI has the potential to save time for healthcare professionals and improve the patient experience by automating administrative tasks. It can streamline back-office functions like HR, IT and financial services, offering a safer starting point for implementation. This efficiency can free up resources for frontline care.

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6. 27th Annual Global CEO Survey: India perspective, PwC (<https://www.pwc.in/assets/pdfs/27th-annual-global-ceo-survey-india-perspective-v1.pdf>)
 7. Decoding India’s \$17 Bn+ generative AI market, Inc42 (<https://inc42.com/features/turning-data-into-gold-decoding-indias-17bn-generative-ai-market/>)
 8. Retrieved from Decoding India’s \$17 Bn+ Generative AI Market - Inc42 (<https://inc42.com/features/turning-data-into-gold-decoding-indias-17bn-generative-ai-market/>)

Below are the seven areas where GenAI can enhance back-office operations:⁹

01 Appointment scheduling

- GenAI's advanced algorithms can efficiently manage appointment scheduling by analysing patient data, availability of healthcare providers and other relevant factors.
- GenAI thereby offers the capability of intelligently assigning appointments, reducing waiting times and optimising resource utilisation.

02 Medical records management

- GenAI can help organise and digitise medical records, making them easily accessible and reducing the risk of errors with manual handling.
- NLP techniques can extract relevant information from medical documents, improving data accuracy and enabling faster retrieval.

03 Billing and claims processing

- The billing and claims process is often complex and time-consuming. GenAI can ease this burden by automating tasks such as generating invoices, verifying insurance information and processing claims.
- By reducing manual intervention, hospitals can minimise errors and expedite reimbursement processes, ensuring timely payments better financial management.

04 Customer service

- GenAI-powered chatbots can offer instant and accurate responses to patient queries, improving communication and accessibility.
- This, coupled with virtual assistance for routine tasks, allows hospital staff to focus more on direct patient care, creating a more personalised and efficient healthcare experience.

05 Inventory management and supply chain optimisation

- Efficient inventory management is crucial for hospitals to ensure the availability of essential medical supplies and equipment.
- GenAI can analyse historical data, predict demand patterns and optimise inventory levels.
- This helps hospitals avoid shortages or overstocking, reducing costs and ensuring smooth operations.
- It can also automate reordering processes, saving time and minimising human error.

06 Enhanced data analytics and decision support

- Gen AI's ability to analyse vast amounts of data can provide valuable insights for hospital administrators and decision makers.
- By leveraging ML algorithms, it can identify trends, patterns and potential areas for improvement in back-office functions.
- This data-driven approach enables informed decision making, leading to more efficient resource allocation and process optimisation.

07 Improved compliance and security

- Maintaining compliance with data protection regulations and ensuring the security of sensitive patient information is a top priority for hospitals.
- GenAI can help identify potential security vulnerabilities and ensure adherence to privacy guidelines.
- By continuously monitoring and analysing data access patterns, suspicious activities can be detected and the overall cybersecurity of the hospital's back-office operations can be enhanced.

6. Empowering clinical support functions with GenAI (<https://www.pwc.ie/industries/healthcare/publications/genai-clinical-support-functions.html>)



03 Emerging themes for GenAI in healthcare

GenAI has altered India's healthcare business¹⁰ by improving patient care and treatment through efficient data and image analysis. It might completely transform the pharmaceutical sector and make it possible for medical professionals to anticipate patient outcomes and take preventative action. Legislators and business executives must, however, address concerns about employment loss while making sure GenAI is applied morally. All things considered, this technology has enormous potential to transform Indian healthcare.

Potential impact of GenAI in healthcare

GenAI algorithms can generate **synthetic medical images** that resemble real patient data, aiding in the training and validation of machine-learning models.

01

GenAI has the potential to revolutionise **personalised treatment plan** by leveraging patient data to create tailored treatment plans.

02

GenAI can help to customise **patient education** content in multi format basis individual needs & preferences.

03

Early identification of potential epidemic/pandemics and tracking incidence of the disease to enable efficient population health management.

04

GenAI simplifies **clinical documentation** by summarising consultations and creating electronic health records, enhancing message drafting and boosting system efficiency.

05

GenAI can analyse **scientific literature to identify patterns**, helping researchers **discover new research areas** and generate hypotheses.

06

Source: PwC analysis

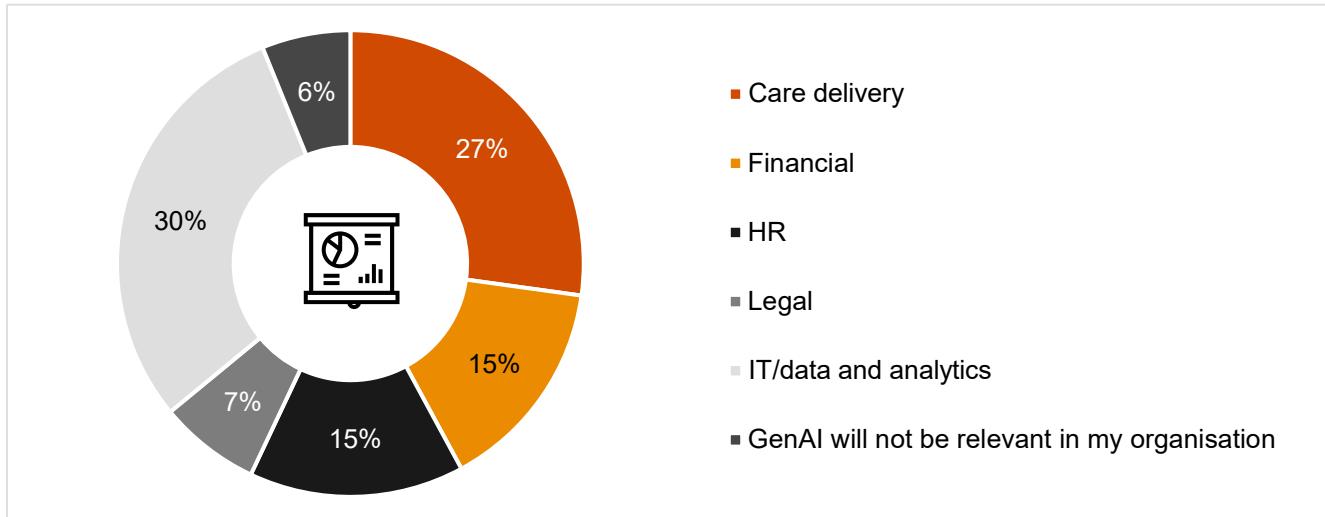
10. The impact of generative AI on healthcare industry in India (<https://indiaai.gov.in/article/the-impact-of-generative-ai-on-healthcare-industry-in-india>)



GenAI has transformed the healthcare sector. One of the forerunners in India to use GenAI was healthcare, and this innovation has had a big impact on the industry. GenAI has the potential to completely transform India's healthcare system by improving the efficiency with which doctors treat and care for patients.

As per our observations, there are ample opportunities in transforming care delivery and generating insights from data sets to unlock untapped potential in terms of efficiency and efficacy.

Potential impact of GenAI on business functions



Source: PwC survey 2024

A NASSCOM study¹¹ from 2023 states that the use of AI and data in healthcare might increase India's GDP by USD 25–30 billion by 2025. In order to enhance Indian healthcare services and promote better quality, lower prices, increased accessibility, and a strong emphasis on patient care, experience, operational efficiency, and research and development, it will be important to implement strategic mechanisms for AI-driven change.

How can GenAI help in the adoption of the Ayushman Bharat Digital Mission (ABDM)?

ABDM focuses on creation of a national digital health ecosystem that supports universal health coverage in an efficient, accessible, inclusive, affordable, timely and safe manner.¹² For the successful adoption of ABDM, the GoI has defined three milestones to implement specific functional capabilities and pass functional validation.

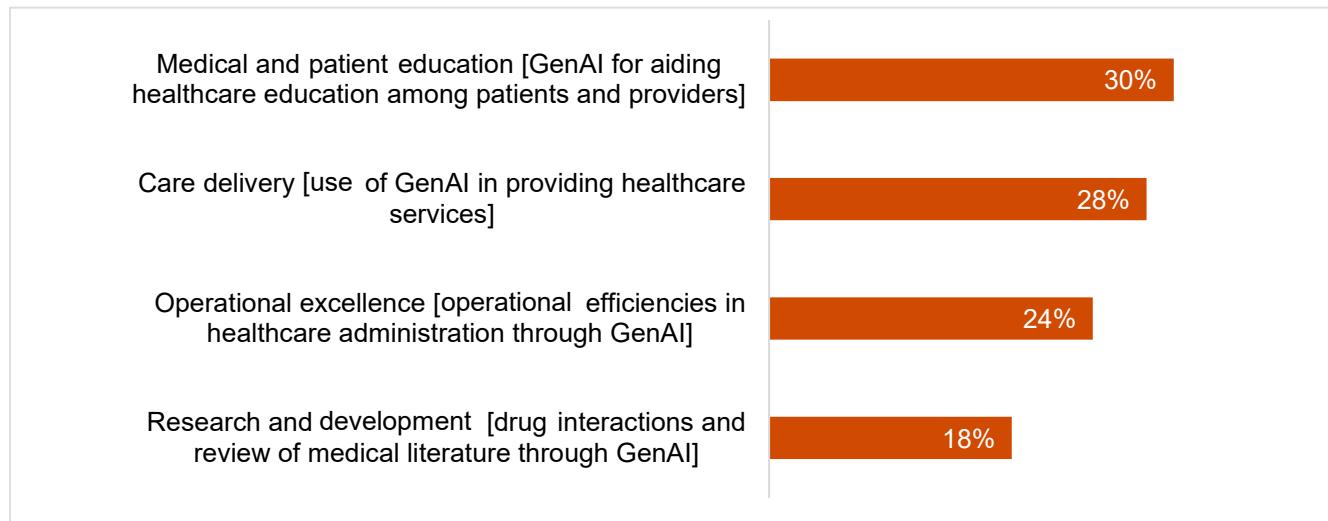
Milestone	Milestone description	Healthcare use case
Milestone 1 (M1)	This milestone involves creating a verified Ayushman Bharat Health Account (ABHA) during patient registration.	-
Milestone 2 (M2)	This milestone involves linking a patient's health records with the ABHA ID, allowing the patient to access their own health records	GenAI can help in summarising longitudinal health records for easy consumption and real-time insights for patients.
Milestone 3 (M3)	This milestone involves developing health information user (HIU) services that can enable viewing of a patient's health history by healthcare personnel.	GenAI can help in selectively obfuscating patient data when it is shared across health institutions.

11. How AI Is transforming the future of healthcare In India, NASSCOM (<https://nasscom.in/knowledge-center/publications/how-ai-transforming-future-healthcare-india>)

12. Ayushman Bharat Digital Mission (<https://abdm.gov.in/abdm>)

We have observed that when it comes to the impact of GenAI in healthcare, medical and patient education is anticipated to have the highest impact, followed closely by care delivery (as perceived by the healthcare fraternity). It will ensure continuous and progressive learning for patients, thus enabling them to make well-informed decisions.

Healthcare value chain domains where GenAI will have impact



Source: PwC survey 2024

Let us take a close look at the different avenues where GenAI is anticipated to have a significant impact.

Care delivery



Health care delivery forms the most visible function of the health system, both to patients and the general public. It concentrates on patient flows as well as the organization and delivery of all services dealing with the diagnosis and treatment of disease, or the promotion, maintenance and restoration of health. It covers the main areas of service provision such as public health, primary care, specialized care (often divided into secondary and tertiary care), urgent and emergency care, pharmaceutical care, rehabilitation/intermediate care, long-term care, services for informal carers, palliative care, mental health care and dental care.

– European Observatory on Health Systems and Policies¹³

With the evolving complexities in healthcare delivery, incorporation of GenAI within the healthcare ecosystem can help in significantly bridging the gap between healthcare professionals, patients and their families. Advanced capabilities in GenAI such as NLP and predictive analytics can help in rationalising clinical workflows to achieve enhanced efficiency in healthcare delivery while also optimising costs incurred by healthcare institutions.¹⁴

A recent study¹⁵ has shown that GenAI has the potential to identify the steps required to screen breast cancer and evaluate breast pain. This presents significant value to healthcare professionals and patients as it can be used for supporting real-time clinical decisions through historical data in GenAI training models.

Furthermore, GenAI can help healthcare institutions in unlocking revenue potential through medical tourism and brand strategies. NLP capabilities of GenAI can be leveraged to create targeted communication for possible medical tourists by capturing their attention and sharing information relevant to their individual needs.

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13. European Observatory on Health Systems and Policies (<https://eurohealthobservatory.who.int/themes/health-system-functions/health-care-delivery>)
 14. ChatGPT utility in healthcare, education, research, and practice: Systematic review on the promising perspectives and valid concerns (<https://doi.org/10.3390/healthcare11060887>)
 15. Evaluating ChatGPT as an adjunct for radiologic decision-making (<https://doi.org/10.1101/2023.02.02.23285399>)

Medical and patient education

GenAI-enabled chatbots are technology solutions which can imitate conversations with humans. In the simplest form, these solutions are rule driven, and responses are limited to a pre-defined set of queries. These are leveraged in multiple industries to aid consumers in a quick and cost-efficient manner with round-the-clock availability. In the healthcare industry, these solutions have a plethora of applications, and a survey conducted by IDC¹⁶ in January 2022 shows its most frequently used capabilities by consumers in the United States:

Which of the following health services have you used chatbots or digital assistants for?



Source: US Consumer Healthcare Survey (N = 177), IDC, January 2022

Advanced conversational AI chatbots are built on LLMs. This augments a chatbot's capability to educate patients by providing possible personalised treatment plans based on medical symptoms and can enable better health outcomes. Further, these solutions can be leveraged by healthcare providers to create educational content and tutorials for common, avoidable and easily treatable medical conditions to make healthcare more accessible.

16. U.S. consumer and provider adoption trends: Chatbots and digital assistants – US Consumer Healthcare Survey, January 2022 (<https://www.idc.com/getdoc.jsp?containerId=US50495023>)

Operational excellence

Healthcare administration plays a pivotal role in the ever-evolving landscape of care delivery. This involves efficient patient care management through coordinated medical and administrative responsibilities.

Overview of healthcare administration



GenAI can assist in improving operational efficiency by reviewing large quantities of data about patients for hospitals, care providers, administrative staff, etc. This includes activities such as completing patient forms, updating post-visit notes and other administrative tasks. GenAI can generate discharge summaries, diagnostic reports, summarise care coordination notes and other clinical data in a patient's native language with clinician oversight. This ensures better understanding for the patient and reduces the time spent by healthcare administrators on administrative tasks, thereby leading to greater efficiencies. Further, GenAI can streamline electronic health record management, which enhances operational efficiency and efficacy through real-time retrieval of information.

Hospital systems often operate in silos, relying on manual inputs through fragmented systems. GenAI has the potential to extract critical information from invoices of different formats such as supplier names, total amount and invoice numbers, regardless of the invoice format. Also, GenAI enabled chatbots can address frequent IT and HR queries raised by hospital employees. All of this can improve employee experience and reduce time and money spent on hospital administration.

Drug discovery and related activities

Drug discovery is a multi-step process involving various stakeholders. At a high-level, it can be illustrated through the following steps:



GenAI can speed up literature review and knowledge extraction by analysing academic research and vast quantities of genomic and population health data to identify new drugs and disease patterns in patient groups. It also helps researchers to remain updated with the latest discoveries.

GenAI helps in identifying niche targets by analysing large datasets containing biological information that were previously overlooked by the traditional trial-and-error methods with little or no data-driven decision making. It has image recognition capabilities that can analyse, classify, and describe molecular structures and chemical formulae which can help in identifying functionally relevant combinations of compounds.

A critical component of drug discovery involves understanding how individual drugs interact with each other. Manually reviewing scientific literature is a time-intensive activity and is prone to errors. GenAI can be used within the design of clinical trials by generating synthetic patient data to simulate different scenarios and test hypotheses to prioritise compounds for further validation.





04

Perceived risks with GenAI and governance

The healthcare industry is seeing constant innovation, with new technologies being implemented across multiple domains. As per the World Health Organization (WHO), 'AI can augment the ability of healthcare providers to improve patient care, provide accurate diagnoses, optimize treatment plans, support pandemic preparedness and response, inform the decisions of health policymakers or allocate resources within health systems.'¹⁷

The implementation and adoption of AI in India's healthcare ecosystem have been slow due to the lack of a policy and regulatory framework. While India does not have mature AI policies and regulations for healthcare, there have been efforts to address this gap. In 2018, NITI Aayog, the policy think tank of the GoI, was given the responsibility of formulating the national strategy on AI and other emerging technologies. Later, in 2018, NITI Aayog released the 'National Strategy for Artificial Intelligence' (NSAI) discussion paper.¹⁸ The strategy adopted by NITI Aayog is 'AI for all' (#AIforAll) and focuses on five sectors, including healthcare. To ensure reliability of AI in healthcare, the National Digital Health Mission (NDHM), in its strategy overview document, mentioned the need for laying down guidelines and standards on AI applications.

In 2021, the NSAI released a second approach paper under its 'Towards responsible AI for all' plan. This study focuses on establishing a foundation of broad ethical standards for the design, development and implementation of AI in India. The paper also highlights the need for specific laws and regulations for AI development and usage given that health is a high-risk sector.

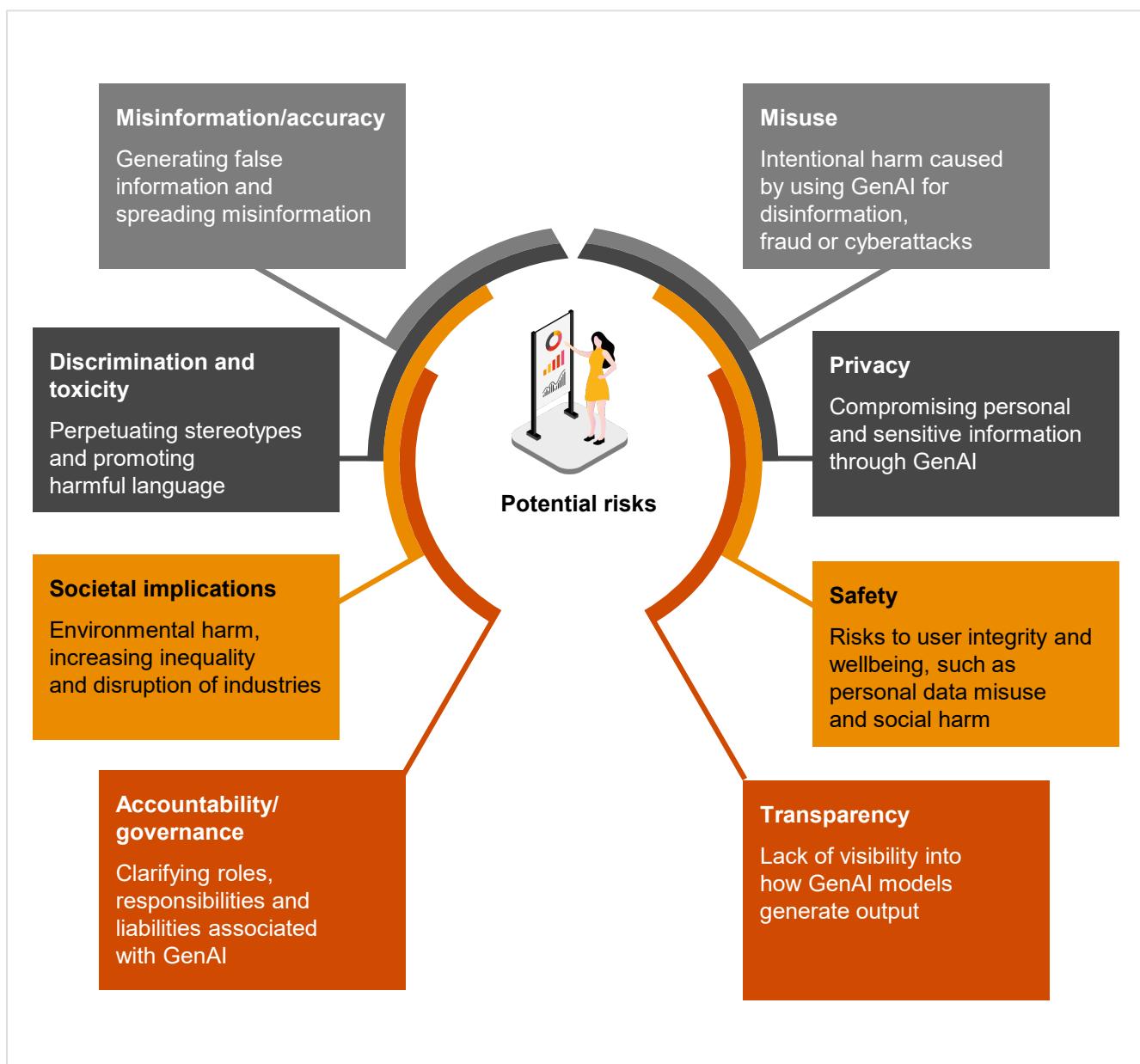
17. Ethics and governance of artificial intelligence for health: WHO guidance Executive summary (<https://www.who.int/publications/i/item/9789240037403>)

18. Press release by National Strategy for Artificial Intelligence on Jun 2018 (<https://niti.gov.in/sites/default/files/2019-01/NationalStrategy-for-AI-Discussion-Paper.pdf>)

Potential risks

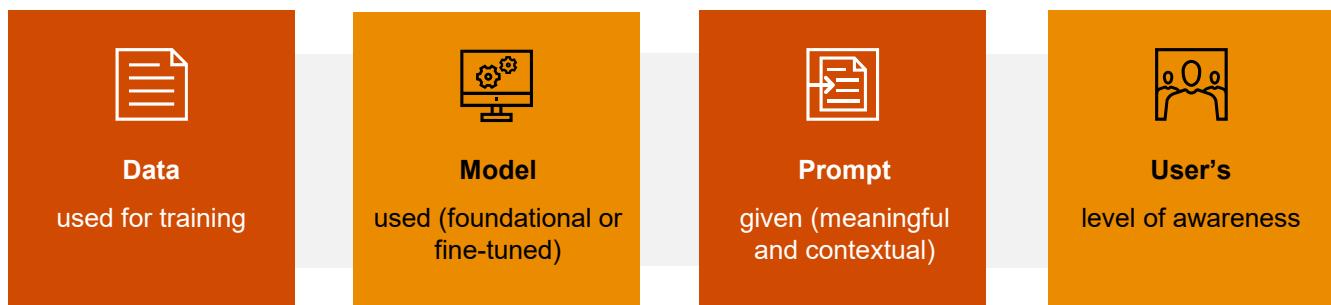
GenAI systems would be capable of predicting medical issues, providing clinical advice, supporting and streamlining physician consultations, and disseminating knowledge about treatments and healthier lifestyle options. On the other hand, GenAI is also known to hallucinate and produce responses that have turned out to be false and deceptive. Since GenAI systems are taught using data from the internet, which may include information about individuals, organisations and protected intellectual property, this raises issues around data privacy, consent and other related aspects.

Therefore, while GenAI systems are beneficial to society, they also pose risks and challenges which need to be carefully assessed. However, with the formulation of the right policies and regulations, their detrimental effects can be controlled.



Source: PwC analysis

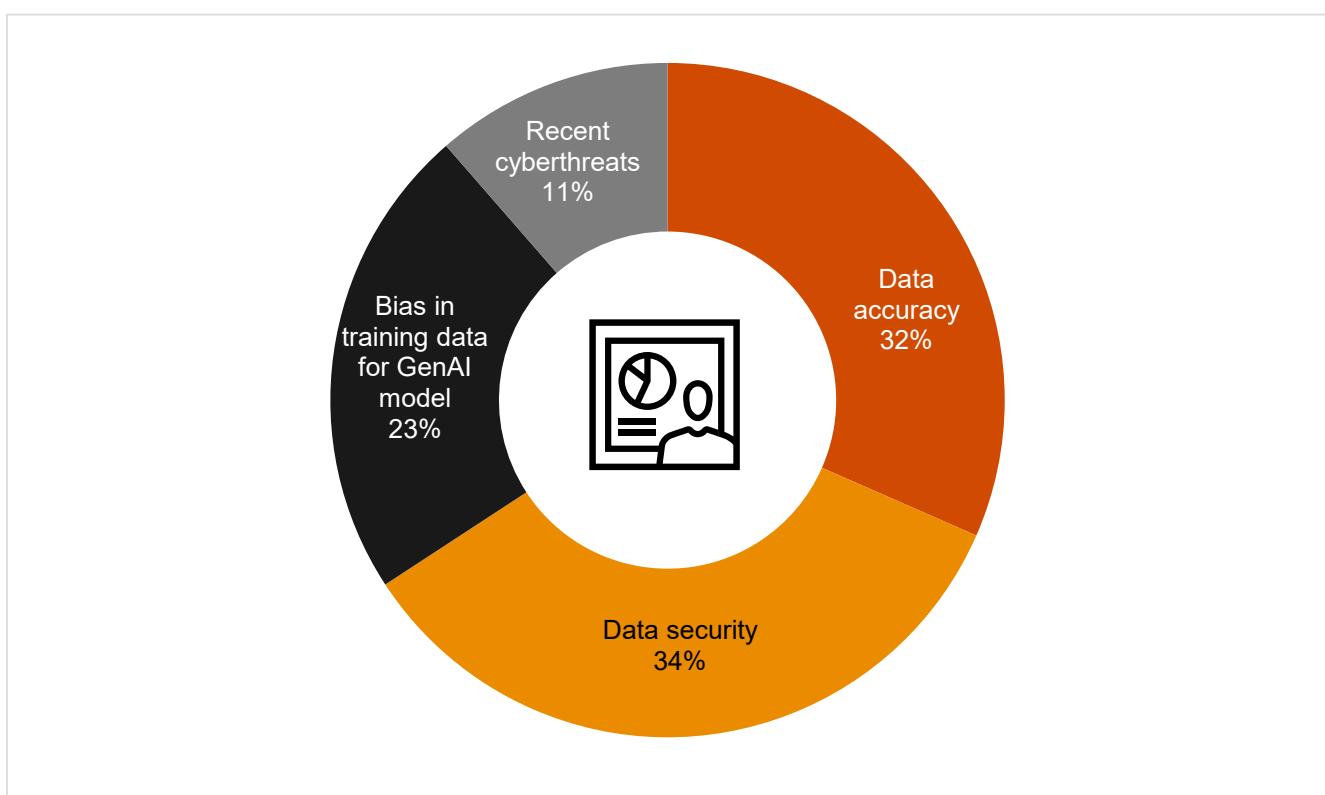
The characteristics, efficiencies and risks of Gen AI systems predominantly derive from four major factors:



Healthcare being a high-stake industry requires, the adoption of GenAI principles and use of the technology in a safe and responsible manner is important to prevent undesirable outcomes. For example, a study published in Science found that a racially biased healthcare tool used extensively by hospitals in the US resulted in unfavourable outcomes for patients of colour.¹⁹ The ineffectiveness in this instance may be ascribed to a deficit of representative training data, or it may be understood as a case of 'model bias';, in which the model is unable to identify the ideal characteristics for precise prediction. Thus, it's important to consider from the outset how these interconnected aspects of a Gen AI system may contain underlying biases that result in unfair outcomes.

Data security and data accuracy along with regulation and compliance emerge as the most significant challenges to GenAI adoption in healthcare organisations. Surprisingly, only a small percentage of respondents anticipate cyberthreats as a major impediment to GenAI adoption.

Perceived challenges to GenAI in healthcare



Source: PwC survey 2024

19. Dissecting racial bias in an algorithm used to manage the health of populations (<https://www.science.org/doi/10.1126/science.aax2342>)

Responsible GenAI

Risks are not mutually exclusive. As one risk tends to affect other aspects as well, it is important to examine these interrelationships in order to utilise GenAI safely and responsibly. Let us look at some of these areas:

Accurate and reliable



Develop AI systems to achieve industry-leading levels of accuracy and reliability, ensuring outputs are trustworthy and dependable.

Accountable and transparent



Establish clear oversight by individuals over the full AI lifecycle, providing transparency into development and use of AI systems and how decisions are made.

Fair and human-centric



Design AI systems with human oversight and diverse perspectives, aligned with our firm values to mitigate risks of unfair discrimination and harmful bias.

Safe and ethical



Prioritise the safety of human life, health, property and the environment when designing, developing, and deploying AI systems, aligning with ESG principles.

Secure and resilient



Mitigate potential cyberthreats and vulnerabilities to ensure the robustness and resilience of AI systems.

Interpretable and documented



Design AI systems to be interpretable, allowing humans to understand their operations and the meaning and limitations of their outputs. Document design decisions, development protocols and alignment with responsible AI principles.

Privacy-enhanced and data governed



Develop AI systems with careful attention to privacy, security, confidentiality and intellectual property ownership considerations around the data used.

Vendor and partner selection



Exercise diligence and ongoing oversight when selecting third-party vendors involved in AI system development (e.g. data brokers, cloud service providers).

Continuous learning and development



Commit to continuous learning and development of AI systems through adaptive training, feedback loops, user education, and regular compliance auditing to remain aligned with ethical, legal, and societal standards.

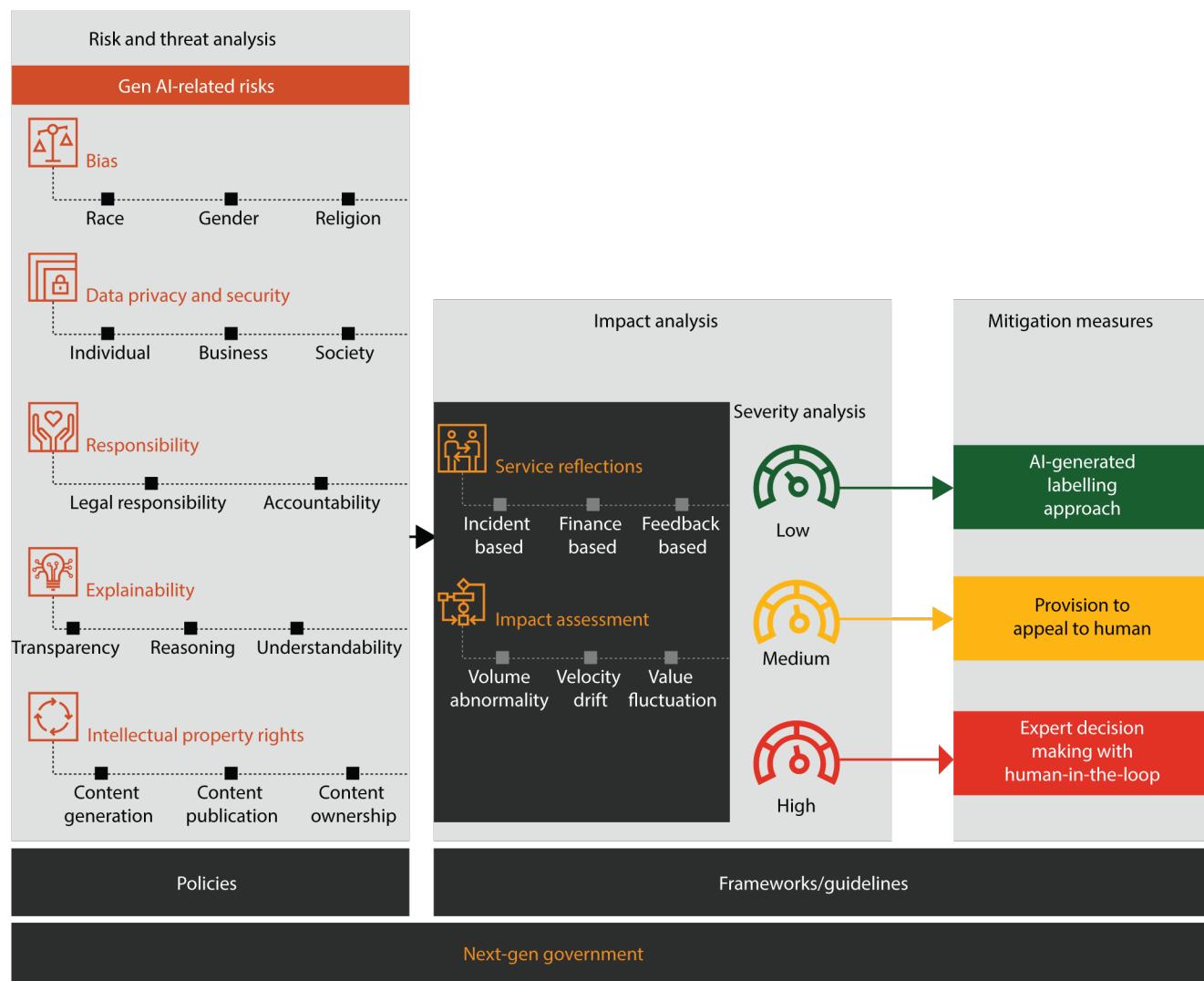
Ongoing monitoring



Establish standards for continuous monitoring and evaluation of AI systems to uphold ethical, legal, and social standards and performance benchmarks.

Governments may employ the three-stage risk assessment and mitigation framework demonstrated below to ensure a comprehensive assessment of the risks related to a GenAI system. To ensure the safe and reliable adoption of GenAI systems, governments would need to develop frameworks and rules that identify and address risks, evaluate the implications, and put risk mitigation strategies into practice.

How can next-gen governments analyse and mitigate risks in GenAI systems?



Source: PwC analysis

Ethics and governance

The risks and uncertainties surrounding AI have increased dramatically as adoption of AI becomes more widespread and its algorithms become more advanced. These technologies are now capable of driving cars, detecting cancer, providing voice assistance, recommending music, and even shortlisting candidates for jobs. Many AI technologies are effectively ‘black boxes’, meaning that not even their designers are able to fully understand how they operate and produce a given result.

Complicated and incomprehensible AI tools have allowed discrimination and societal biases to creep into their outputs. Chatbots based on LLMs have the ability to generate versatile, human-competitive and authentic-looking content, which may be inaccurate and contain copyrighted material. Governance refers to steering regulatory practices, governing security and promoting the ethical use of AI by governments along with other important decision-making organisations, such as international health bodies. Attracting attention from lawmakers and regulators worldwide, governance plays a crucial role in the responsible procurement and use of AI. This is especially critical in healthcare settings, where biased algorithms can result in biased outcomes, eventually translating into unfair care delivery to a certain section of society. It is therefore imperative to ensure that national and global health policies are evolving continuously along with innovation in AI technologies. Organisations must be mindful of establishing robust systems and controls to comply with existing ethical and legal frameworks while deploying AI in their systems. Governance of large multi-modal models (LMMs) requires pacing up with their rapid growth and emerging usage while also ensuring no undue

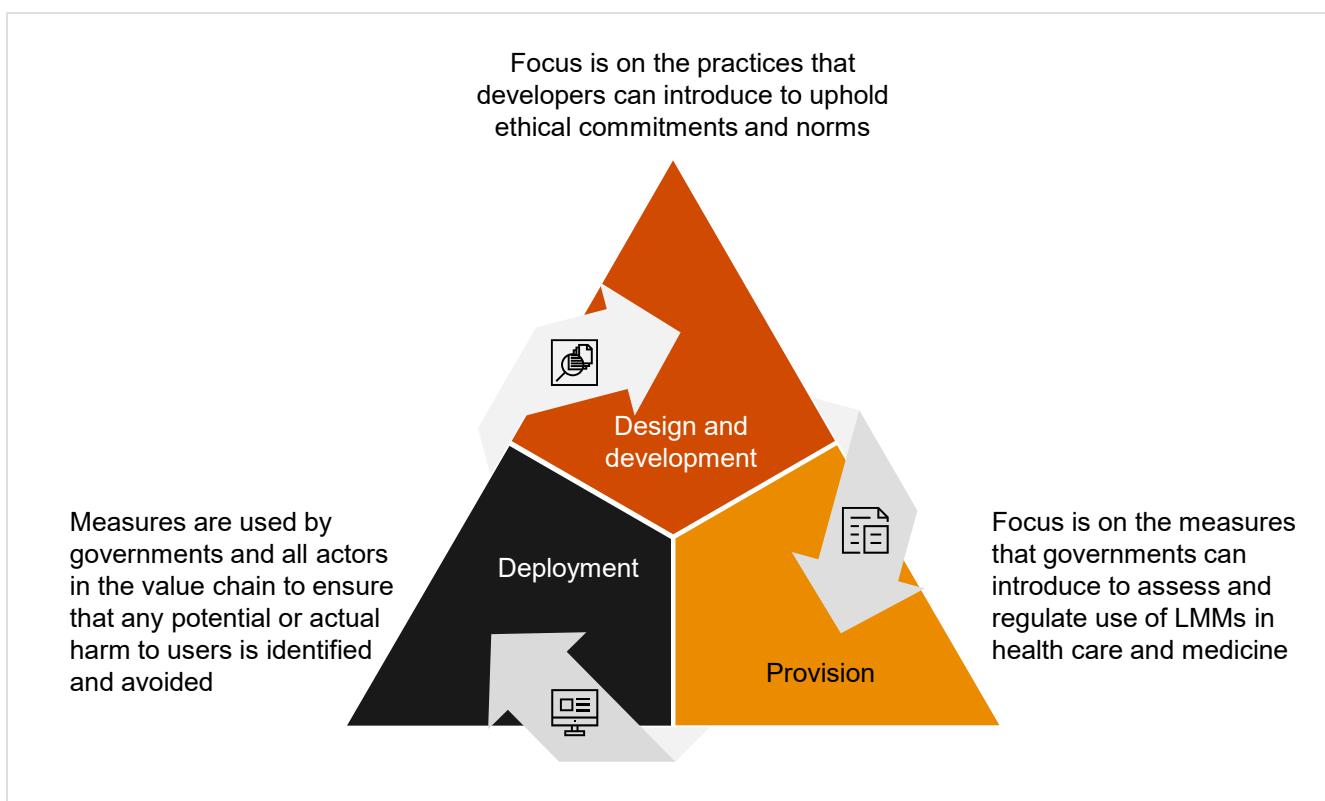
technological or commercial advantage is sought by organisations. Current policies may be insufficient for effective oversight of the use of LMMs.²⁰ The administration of LMMs requires the development and application of new legislation and regulations based on ‘soft law’ of ethical principles, human rights requirements, codes of practice, and internal processes of corporations, industry groupings, and standard-setting bodies. Leading AI companies have also called for the systematic and purposeful development of LMMs and other forms of AI.

LMMs used in healthcare and medicine should be governed at each stage of the value chain, from collection of data to deployment of applications. LMMs should be committed to prioritise ethical principles and human rights in suitable governance. They must include both procedures and practices that can be used and laws and policies implemented by governments.

The GenAI value chain:

Design and development phase	Which actor (the developer, the provider and/or the deployer) is best placed to address relevant risks? What risks should be addressed in the AI value chain?
Provision phase	How can the relevant actor(s) address such risks? What ethical principles must they uphold?
Deployment phase	What is the role of a government in addressing risks? What laws, policies or investment might a government introduce or apply to require actors in the AI value chain to uphold specific ethical principles?

Focus areas in the GenAI value chain:



20. Ethics and governance of artificial intelligence for health: Guidance on large multi-modal models (<https://www.who.int/publications/item/9789240084759>)

Let's discuss the risks related to the development of general purpose foundation models (LMMs):

WHO's guidance on ethics and governance²¹ recommends that developers of medical AI invest in measures to improve the design, supervision, reliability and self-regulation of their products.

- AI expertise (scientific and engineering personnel):** WHO's expert committee recommends licensing or certification requirements for developers of 'high-risk' AI, including AI for health according to which developers should ensure that their scientific and programming personnel can detect and prevent potential hazards.
- Data:** The quality of data which is used to train LMMs impact whether the models follow the required ethical principles and regulatory criteria. Data quality, if overlooked, can have serious consequences, especially in 'high-stakes' industries such as healthcare and medicine. As per the General Data Protection Regulation, the EU's data protection law, developers should conduct 'data protection impact assessments'. These assessments investigate the potential hazards of data-processing activities on people's rights and freedom and personal data. These would prevent jeopardising model's performance in healthcare and medicine, where new evidence and information is critical in decision making. To make LMMs acceptable and useful, datasets must be updated at regular intervals.

To augment risk mitigation, developers should ensure transparency of the data they use to train AI models. This allows downstream users, such as users who work on fine-tuning a healthcare application or users who directly use the LMM to be aware of the inefficiencies or gaps in the training dataset.

- Design for value:** WHO's 'Design for values' is an inclusive and collaborative approach for designing and developing AI systems which involves all end users and stakeholders. The approach calls for integrating ethics and human rights norms into AI technology and focuses on human dignity, equality, freedom and solidarity. Through this approach participants are encouraged to voice their viewpoints, express ethical concerns and provide input which can create a transparent design and deployment process. Stakeholders ranging from medical professionals, researchers, patients and vulnerable populations should be involved in processes related to LMM creation, data tagging, and testing to prevent provider automation bias and promote human autonomy.

As a preventative measure, the developer can perform a 'pre-mortem test' before the development of the LMM. This enables developers to identify potential failures and allows them to reverse-engineer unexpected issues in the initial stages. Identification of known and unknown hazards can help in suggesting alternative solutions. Another approach to this is the 'red teaming' evaluation of a model or system to discover vulnerabilities in real-world simulations that might result in unwanted behaviour.

Risk management strategies

Good governance requires efficient risk management. By implementing best practices for AI, organisations can proactively manage and mitigate risks associated with GenAI, fostering the responsible and ethical use of the technology.

Risks taxonomy and categorisation	Risk tiering
Risk impact assessment	Risk management processes
Clear accountability and ownership structure	Continuous evaluation and improvement
Compliance with ethical standards	Training and awareness
Regular assessments	Data governance

21. Ethics and governance of artificial intelligence for health: Guidance on large multi-modal models (<https://iris.who.int/bitstream/handle/10665/375579/9789240084759-eng.pdf?sequence=1>)

Responsible GenAI framework as a guideline for compliant integration into organisations

Strategy	Control
<p>Data and AI ethics</p> <ul style="list-style-type: none">• Ensure ethical alignment, prevent misrepresentation, and avoid harmful or inappropriate outputs. <p>Policy and regulation</p> <ul style="list-style-type: none">• Align with evolving policy trends and regulatory compliance. <p>Economic considerations ★</p> <ul style="list-style-type: none">• Address potential job displacement, inequality, and broader economic impacts.	<p>Governance</p> <ul style="list-style-type: none">• Enable oversight of systems across the three lines of defence. <p>Compliance</p> <ul style="list-style-type: none">• Ensure outputs meet company guidelines, industry standards and legal mandates. Regularly adjust for evolving legal landscapes. <p>Reputation management ★</p> <ul style="list-style-type: none">• Address potential reputation threats from generative outputs; be proactive in public relations strategies. <p>Enterprise management ★</p> <ul style="list-style-type: none">• Ensure GenAI aligns with broader enterprise goals, considering reputation, financial performance and IP concerns.

Responsible practices	Core practices
<p>Interpretability and explainability</p> <ul style="list-style-type: none">• Provide insights into how GenAI processes work and decisions are made. <p>Sustainability</p> <ul style="list-style-type: none">• Monitor and optimise the environmental impact of GenAI training. <p>Robustness</p> <ul style="list-style-type: none">• Ensure consistent, reliable outputs, especially in varied scenarios. <p>Bias and fairness</p> <ul style="list-style-type: none">• Actively prevent the amplification of societal biases in generated content. <p>Security</p> <ul style="list-style-type: none">• Protect against malicious interventions and ensure content integrity. <p>Privacy</p> <ul style="list-style-type: none">• Safeguard user data and prevent private information leaks in outputs. <p>Safety</p> <ul style="list-style-type: none">• Prioritise user safety, ensuring content avoids harm or misleading information.	<p>Problem formulation</p> <ul style="list-style-type: none">• Clearly define the scope and purpose by understanding the nuances, challenges and objectives of desired outcomes. <p>Standards</p> <ul style="list-style-type: none">• Uphold best practices for quality and credibility of generated output. <p>Vendor lock-in ★</p> <ul style="list-style-type: none">• Mitigate risks from changes in external model dependencies, considering availability and costs. <p>Validation</p> <ul style="list-style-type: none">• Validate the accuracy and relevance of outputs, avoiding misleading or inaccurate results. <p>Monitoring</p> <ul style="list-style-type: none">• Track performance continuously, detecting and addressing any anomalies or drifts.

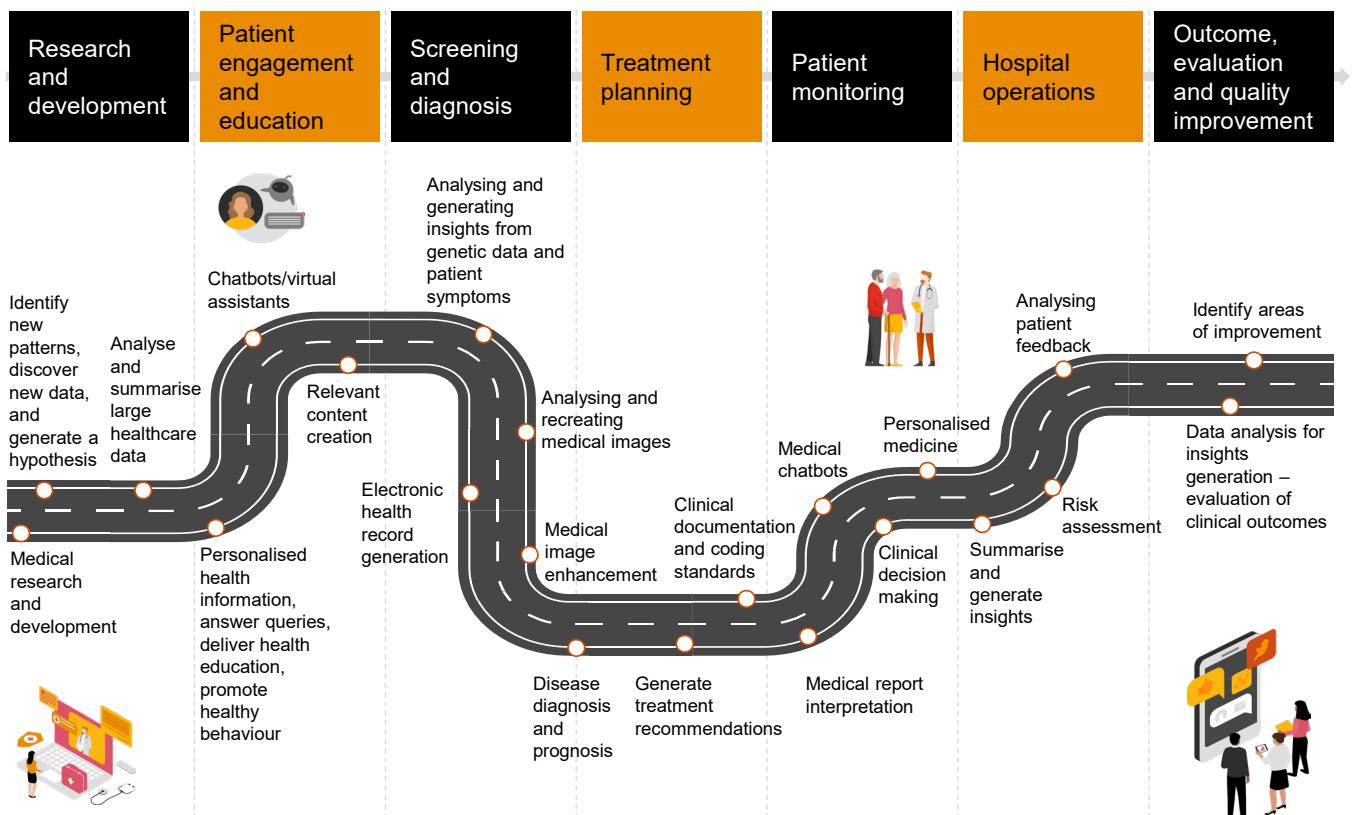
★ New and GenAI specific

Source: PwC analysis



05 Use cases for GenAI in healthcare

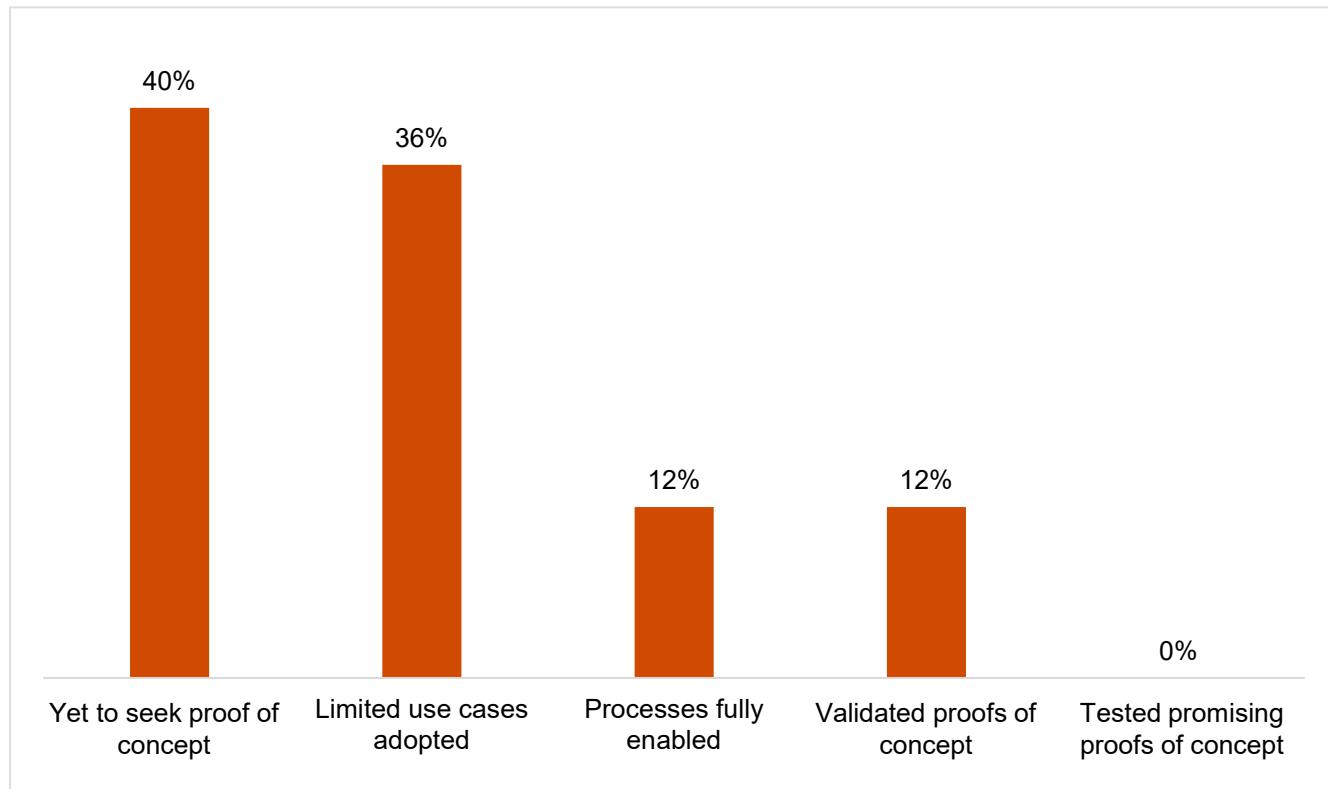
GenAI touchpoints across the healthcare pathway



Source: PwC analysis

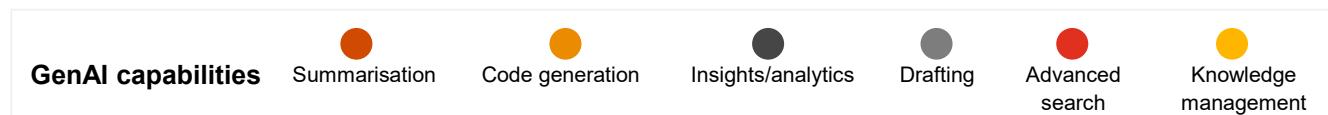
We have observed that 40% of organisations are yet to seek a proof of concept for GenAI solutions in their current operations. On the other hand, 36% of organisations have adopted limited GenAI use cases such as, but not limited to, improved efficiency, reduced wait times and higher care capacity.

Extent of adoption of GenAI technologies by organisations into their operations



Source: PwC survey 2024

Use case	Business problem	Outcomes
Research and development (R&D)		
Medical research and development	The sheer volume of literature available makes manual analysis for pattern identification a time consuming and overwhelming task for doctors involved in medical research.	GenAI can automate the analysis of scientific literature for healthcare providers by identifying patterns and new areas of research thereby, driving innovation in patient care
Drug discovery and development	Longer time frame to identify and target promising candidates for clinical trials ends up consuming more time of healthcare providers and clinicians.	Use of GenAI allows efficient analysis of datasets to swiftly identify promising candidates for clinical trials and for predicting potential side effects and interactions.





Use case	Business problem	Outcomes				
Patient engagement and education						
Patient matching 	There is a need to accurately associate and evaluate the patient's data and health records/status and match it to appropriate healthcare service providers for improved patient care.	Using AI algorithms to analyse existing data to match patients to most appropriate provider based on insurance, location and services as required including hyperpersonalised patient experience.				
Patient education 	There exists limited means to create and share easily digestible health information with patients which would assist them in responsible decision-making.	GenAI can help in creating and sharing interactive patient education modules based on latest research and industry trends in healthcare, as well as details on diseases and medical conditions including multi-lingual support.				
Patient virtual assistant 	There is lack of engagement with the patients and no support system to respond to patient enquiries in healthcare institutions which limits patient-healthcare provider interaction.	GenAI technologies like self-service chatbots, which can respond to patient queries, schedule requests, provider matching, information, billing inquiries, payment plan options, explanation of benefits (EOB) related queries, etc. It can also be used to enhance patient support with auto complete/ customised suggestions for post-visit inquiries.				
Enhanced care coordination 	In the current healthcare landscape, care coordination remains suboptimal, leading to fragmented and inefficient delivery of services. Enhancing care coordination with recommended actions and human-like interactions is required to make healthcare more patient-centric.	Based on specific triggers, healthcare providers should proactively reach out to customers for remediation/updates (e.g. nutrition advice for at-risk diabetic patients). Additional capabilities to support patients can be the translation of prescription/medical advice into native languages and a more humanised tone tailored to suit the customer base, recommended treatment suggestions based on a patient's condition as well as overall needs and barriers for informed patient decision-making.				
GenAI capabilities	Summarisation 	Code generation 	Insights/analytics 	Drafting 	Advanced search 	Knowledge management 





Use case	Business problem	Outcomes
Screening and diagnosis		
Disease diagnosis 	One of the critical challenges in healthcare is the timely and accurate diagnosis of diseases. The complexity and diversity of medical conditions, coupled with the increasing volume of patient data makes it challenging for healthcare professionals to provide swift and precise diagnoses.	Chatbots enable humans to understand medical terminology and symptoms easily. They can analyse medical history and symptoms to suggest plausible diagnose which can expedite the process of generating accurate results, thereby improving patient health outcomes.
Medical image enhancement 	As observed, there is limited availability of medical images and imaging data for rare diseases which affects patient outcomes and care delivery.	GenAI models learn from large datasets to automatically enhance medical images such as X-rays, MRI, and CT scans. These enhanced images can help in improving visualisation, aiding diagnosis and potentially reduce the need for additional invasive procedures.
Treatment planning		
Personalised medicine 	In the current healthcare landscape, one-size-fits-all approaches to medical treatment prevail. This standardised approach fails to account for individual variations in genetic make-up, lifestyle factors, and unique clinical profiles, contributing to disparities in treatment efficacy and potential adverse effects.	By analysing patient healthcare data, conversational AI chatbots can provide insights into the best treatment options tailored for the patients based on their unique needs, thereby improving the effectiveness of the treatment.
Predictive analytics and risk assessment 	There is seldom any mechanism for forecasting complications and post operation treatment plans for a patient.	By leveraging historical data, algorithms can identify patterns and predict future risks which would help healthcare professionals in better management of conditions and healthcare outcomes in future.
GenAI capabilities 		
Summarisation	Code generation	Insights/analytics
Drafting	Advanced search	Knowledge management





Use case	Business problem	Outcomes
Patient monitoring		
Real time health monitoring (post operation)	There is no mechanism to track the real-time progress of a patient as a part of post treatment care for medical tourism. Inefficient management of unstructured content and document also lead to poor information retrieval.	AI-driven wearables and remote monitoring systems can be helpful in collecting real-time data on medical adherence, patient vitals and prompt interventions, if needed.
Medication management and adherence	Non-adherence to prescribed medications, often fuelled by complex dosing regimens, forgetfulness and lack of understanding results in suboptimal treatment outcomes and increased healthcare costs.	AI-driven chatbots can assist patients with medication management, including dosage instructions and potential side effects. They can also provide patients with information on drug interactions, contraindications and other important considerations.
Hospital operations		
Patient and care management, Q&A assistance	Due to abundant electronic health records (EHR) unstructured data and medical records, a healthcare manager spends extensive time in sourcing and navigating through the medical history of patients to devise an appropriate care plan.	Gen-AI enabled care management can reduce the time spent by managers to collate the information for conducting assessments or answering ad hoc questions related to patient demographics and vitals which can help healthcare managers in creating robust patient care plan. It can also help in forecasting patient's healthcare journey based on historical data and care plans.
EHR management	EHR interfaces may be clunky and difficult to work which can take a lot of time for the staff to enter basic information or retrieve proper records.	Potential error detection by analysing patient data using GenAI can lead to faster and improved data quality, while reducing work hours for the administrative staff. This would additionally lead to increased productivity and better utilisation of human resources.
Clinical documentation and coding with post-visit summary and care instructions	Healthcare providers generally face challenges in generating discharge summary, instructions and follow up recommendations to patients due to resource constraints. Manual generation of summaries often results in inconsistencies, delays and a lack of standardised information impacting the patient's understanding of and adherence to care plans.	GenAI can automate clinical documentation and coding by analysing patient-clinician conversations, identifying gaps and providing information. This can reduce the administrative load of the staff and speed up the discharge process. It can also help in streamlining post-visit steps including automatic generation of Rx orders, lab/imaging orders for nurse/PA review, and sharing of care summary and instructions with the patient.
GenAI capabilities	Summarisation	Code generation
	Insights/analytics	Drafting
	Advanced search	Knowledge management





Use case

Business problem

Outcomes

Outcome, evaluation and quality improvement

Medical education

Manual transcription is time-consuming and prone to errors which can delay access to vital patient information. Inaccurate summarisation of medical discussions further hinders healthcare providers' communication, misdiagnoses, and inadequate treatment plans.

GenAI can be utilised to extract medically relevant information from discussion recordings, transcribing the interactions in real-time and summarising the key points in a concise, easy-to-understand format.

Scribe/ summarisation during visit

During a doctor-patient conversation, it can be tricky for the medical personnel to jot down pointers and effectively and proceed with a clinical note post consultation (for both virtual and in-person consultations).

GenAI-powered automated transcription modules can help by taking notes during consultations, create a summary of patient's information while also discovering any patterns and trends in the transcriptions. These can be beneficial for future consultations as well as re-assessing medical histories for reference.

GenAI capabilities

Summarisation



Code generation



Insights/analytics



Drafting



Advanced
search

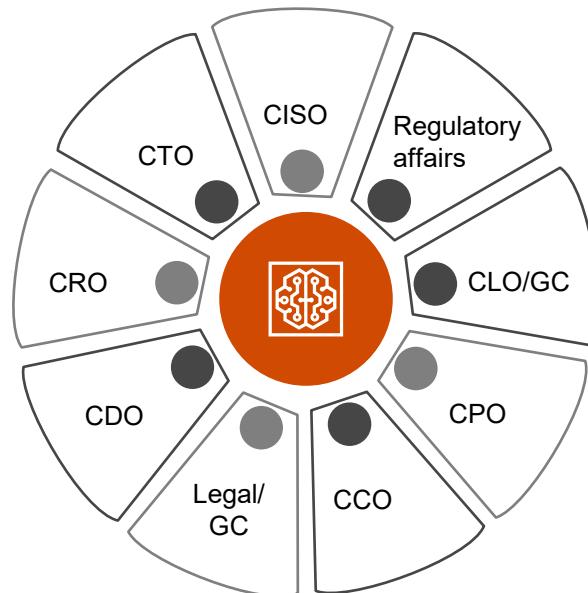


Knowledge
management



Opportunities and risks of building a GenAI-powered medical consultation chatbot

A healthcare provider contemplates using GenAI to offer medical advice in place of telehealth sessions with clinical staff. The provider gathers years of patient data, symptoms, diagnoses and treatments to train the model.



- **Chief data officer(CDO):** Makes sure the data is accurate in terms of populations, age groups, etc.
- **Chief compliance officer (CCO):** Determine whether the use of the data meets compliance obligations under state boards of health such as Health Insurance Portability and Accountability Act (HIPAA).
- **Chief privacy officer (CPO):** Collaborates to take a privacy-by-design approach and makes it clear to users how their inputs will be used and which data will be retained.
- **Chief technology officer (CTO):** Designs a dedicated instance for this use case so as to not inadvertently commingle the data with other operational GenAI tools.
- **Legal/general counsel (GC):** Negotiate contractual assurances with the GenAI platform so that patient data will remain segregated from the AI model's public instance.
- **Chief information security officer (CISO):** Designate this application and data store as a 'crown jewel' and provide adequate protection for it based on sensitive data classification.
- **Internal audit:** Develop an audit risk assessment and plan the proposed system and model – including legal and compliance risks based on HIPAA, HITECH and/or CMS policy and procedures – and assess the reliability and performance of system and models.
- **Chief regulations officer (CRO):** Coordinate with the CCO to establish policies, training, testing and controls to confirm that AI-generated medical advice is accurate and compliant with state medical board standards.

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Use case development and finalisation will be a focus area for healthcare industry leaders while ensuring that data maturity and infrastructure readiness are achieved to deploy impactful solutions. Additionally, standardised policies and guidelines need to be established with a shield of ethics and privacy.

– Sudeep Dey, CIO, Healthcare Global Enterprises Ltd



06

Challenges to GenAI adoption in healthcare

Regulation and compliance

With the growing popularity of GenAI, concerns around data security and privacy have also resurfaced. Examples of security protocols which are vulnerable to prompt-injection, i.e. malicious text inputs that can be used to hijack a language model's output, raised concerns around data privacy. As a result, more laws are being developed in the UK, the EU, and other countries to address data privacy in AI. Italy was the first nation in Europe to outlaw one of the conversational AI chatbots due to privacy issues related to gathering of personal information (which was lifted later on).

Global regulations and GenAI

The regulatory landscape surrounding GenAI is intricate and multifaceted. It encompasses a wide range of existing laws, such as those related to privacy, cyber and operational resilience, intellectual property, antitrust laws, employment, product safety, content moderation, sustainability, human rights, and consumer protection. As GenAI's capabilities advance, sector-specific regulations and AI-specific legislation will complement the existing laws. Let us look at some of the regulations in countries across the globe.

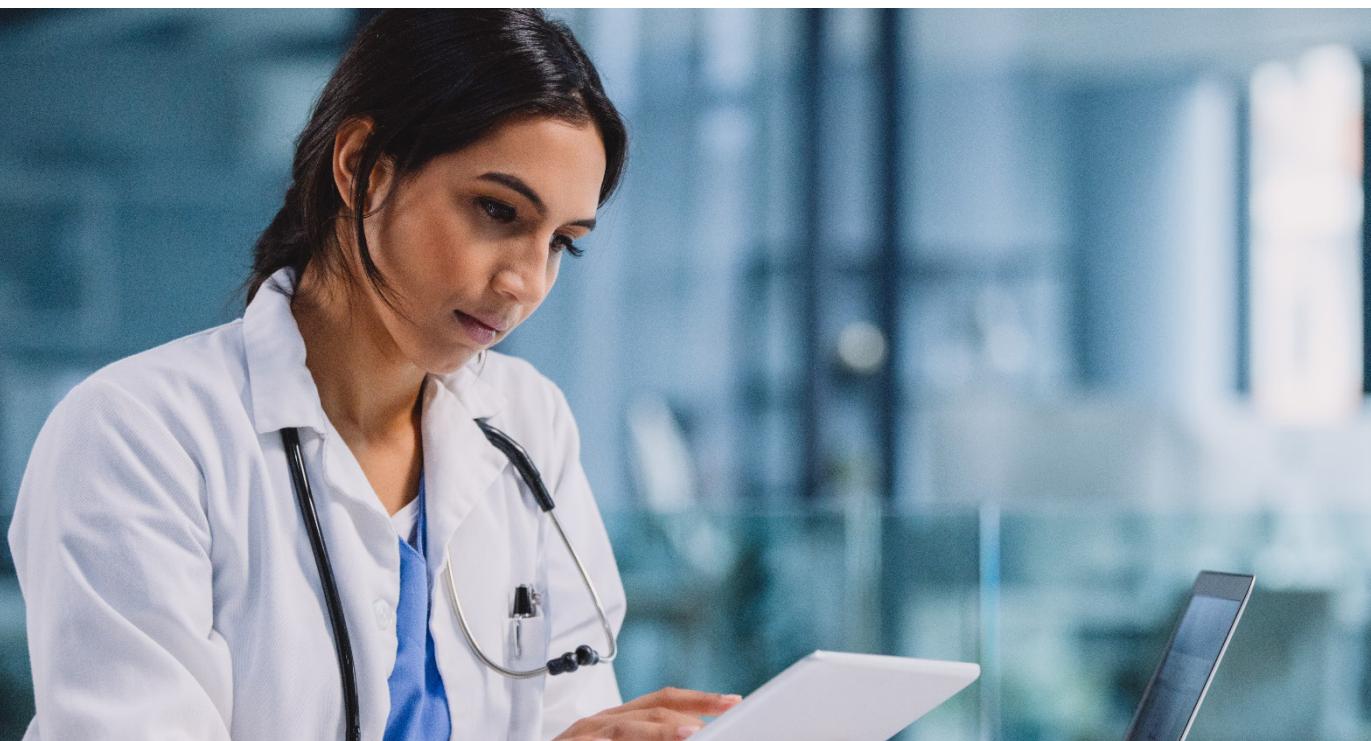
While there is currently no specific federal mandate to regulate GenAI tools, lawmakers in the US have introduced several legislations which address various aspects of automated systems. Massachusetts is the only state which has introduced a bill on regulating GenAI.²² This bill provides operating standards on privacy and algorithmic transparency. Though there is a general consensus over the need of AI regulations in the US, currently, no specific federal initiative is in place to govern GenAI tools. The US has employed a disintegrated approach to AI regulation across different agencies to oversee specific sectors (e.g. the Federal Trade Commission to prevent misleading marketing and deceptive AI use). An AI Risk Management Framework has been issued by the National Institute of Standards and Technology to offer voluntary guidance on the development and use of AI.²³ These regulatory bodies are responsible for providing recommendations on AI governance, including risk management and disclosures.

EU

Though the adoption of AI can have numerous benefits, its use should be inclusive, transparent and safe. The EU has been actively working on making amendments to the EU AI Act, which was the first comprehensive regulatory framework proposed in 2021.²⁴ To cater to the specific challenges GenAI may pose, it needed to include a specific governance regime. Thus, it has incorporated foundation models and GenAI into its legislation, following a tier-based approach. The European Parliament adopted the latest compromise text for the AI Act which includes a new section (Article 28b) specifically for governing foundation models. It mandates that providers of foundation models integrate various safeguards in their products, such as design, testing, data governance, cybersecurity, performance, and risk mitigation measures. In 2023, the European Commission announced the establishment of a new EU AI office for monitoring the effective implementation and compliance related to the EU AI act.

In addition to the EU AI Act, other regulatory efforts seek to address data protection and privacy risks through the GDPR. Instances like the restriction of one of the conversational AI chatbots in Italy due to privacy concerns have prompted investigations by data protection authorities in Germany, France and Ireland.

Both Canada and Brazil are developing AI regulatory frameworks modelled after the EU AI Act, but neither of them have any specific GenAI provisions. The Cyberspace Administration of China has issued draft rules to regulate GenAI providers, focusing on data governance, content moderation and security assessments.



22. Governor Healey signs executive order establishing artificial intelligence strategic task force (<https://www.mass.gov/news/governor-healey-signs-executive-order-establishing-artificial-intelligence-ai-strategic-task-force>)

23. AI risk management framework (<https://www.nist.gov/itl/ai-risk-management-framework>)

24. EU AI Act: first regulation on artificial intelligence (<https://www.europarl.europa.eu/topics/en/article/20230601STO93804/eu-ai-act-first-regulation-on-artificial-intelligence>)

India's regulations for GenAI

India has not developed a comprehensive AI-specific legislation and has opted for a light-touch regulatory approach. The Indian Government kickstarted various initiatives and programmes to harness AI and GenAI for the betterment of the technological landscape of the country. Following the **National Strategy for Artificial Intelligence** in 2018, the Ministry of Electronics and IT (MeitY) launched the **National programme in AI** as part of the India AI programme which is considered an umbrella programme to leverage transformative technologies that can help in fostering inclusion, innovation and adoption of AI in creating social impact.

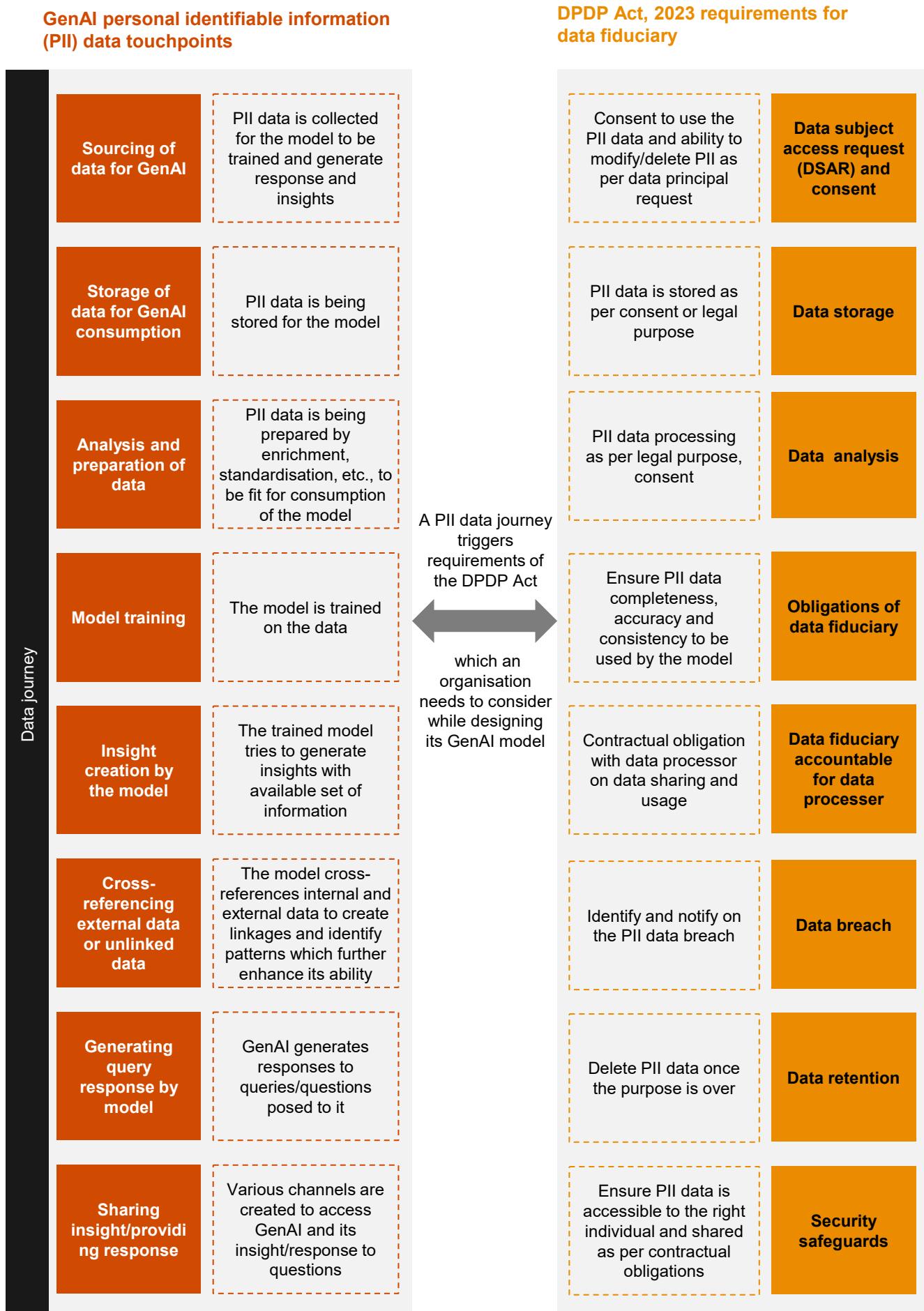
Until the **Digital Personal Data Protection (DPDP) Act 2023**, India lacked a thorough, all-inclusive data protection legislation unlike its western counterparts like the US and the EU. Up until this Act, the development and deployment of AI was governed through laws and policies related to data protection, privacy, cybersecurity and intellectual property. However, these initiatives come with a fair share of shortcomings, particularly in the case of emerging and novel problem-solving technologies such as GenAI. Therefore, stricter legislative safeguards are an imperative to protect data, which is core element for AI development in India.

Key tenets of DPDP Act, 2023, to be considered for GenAI

Data lifestyle	Data protection	Data processing	Data storage/transfer	Transparency and accountability	
Data principal	Consent and consent withdrawals	Right to access information about personal data	Right to correction of personal data	Right to erasure	Right of grievance redressal and nominate
Data fiduciary	Notice	Grounds of processing personal data	Certain legitimate uses	Security safeguards	Data fiduciary accountable for data processor
	Verifiable parent/guardian consent	Additional obligations of significant data fiduciary	Data processor engagement	Data retention	Data protection officer
		Personal data breach notification	Processing of personal data outside India	Consent managers	Independent data audits
				Complying to government notifications	
Data Protection Board of India					
Penalty	Grievance redressal	Review and appeal	Dispute resolution		

Source: PwC analysis

GenAI alignment with DPDP Act, 2023



Source: PwC analysis

Data accuracy

Generating accurate data is a challenge for AI systems due to the following reasons:

- Missing or incomplete data can lead to inaccurate results.
- Variability in data formats terminology and quality across different sources leads to data inaccuracy.
- Human error during data entry affects the reliability of AI models.
- If robust data validation processes and quality assurance is not in place, it can lead to inaccuracy of healthcare data used for training AI models.

The challenges listed above can be addressed using the following approaches:

- Implement standardised data format terminologies to ensure consistency across different datasets.
- Involve healthcare SMEs to validate a model and ensure its alignment with the clinical needs.
- Implement EHRs with built-in validation checks.
- Conduct regular audits on datasets and algorithms to produce reliable results.

Data security

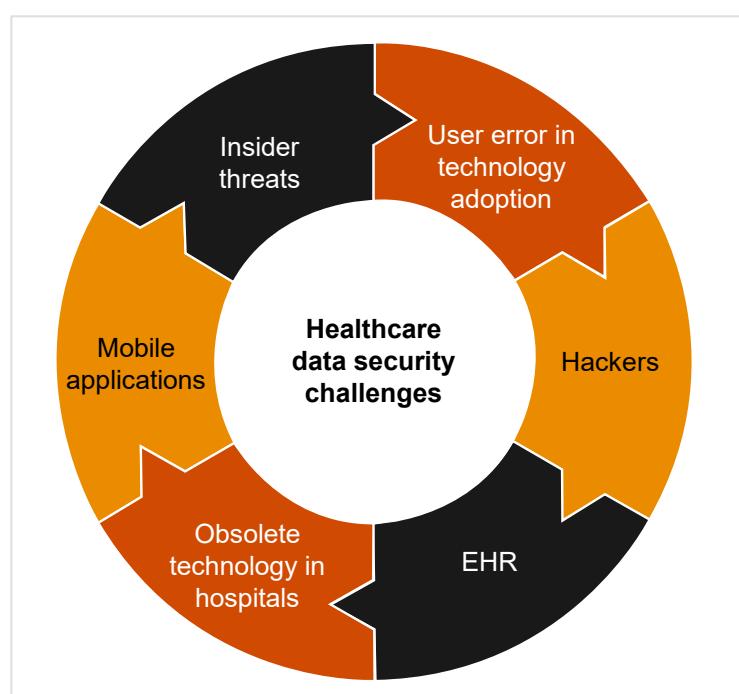
Factors which impact data security are:

- Lack of protocols which can protect data from unauthorised users during the training process.
- If the datasets are not being secured properly, it may lead to data breach, cyber-attacks and leaking of potential sensitive information.
- Unauthorised or unethical use of data can result in legal consequences.
- Trained AI models need to be secured since any breach may lead to the risk of intellectual property theft.
- Data thieves can exploit shared medical data networks by gaining access to medical histories.

To address these challenges, several approaches can be adopted:

- implementing robust encryption techniques to protect sensitive data during storage and transmission by an authorised user
- implementing access control to restrict user's access to data
- conducting regular audits on GenAI systems to identify potential risks
- providing comprehensive training on data security best practices
- complying with regulations and standards like the DPDP Act in India.

Data security challenges



Model bias

Model bias refers to the tendency of AI algorithms to generate inaccurate or unfair results due to biases present in the data used for training.

In healthcare, model biases can have significant implications on GenAI systems which are used for diagnostic purposes, treatment recommendations and patient care. Some of the key challenges related to model bias in GenAI for healthcare are:

- biased training data leads to biased predictions by an AI model
- biased algorithms lead to incorrect diagnoses or recommendations affecting certain demographic groups
- biased data raises ethical issues regarding fairness, justice and equitable access to healthcare services
- lack of transparency in a model delays the decision-making process as users need to understand how decisions are made.

Addressing these challenges requires concerted efforts from various stakeholders:

- Ensure training datasets are diverse, inclusive, and representative of different groups and population.
- Adopt techniques such as data augmentation and synthetic data generation to address imbalance in training data.
- Define metrics to assess the performance of AI models across population and groups.
- Continuous review of datasets to identify biases and train the model to address the biases.
- Develop standards and guidelines in consultation with healthcare SMEs.

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For clinical use cases, we need large, validated and unbiased test datasets to train GenAI models. In addition, we need the ability to review and validate these models before launch, and constantly monitor and update the models based on new data. Clinical models should also be subject to external reviews and approvals in accordance with relevant clinical guidelines.

– Rizwan Koita, Co-founder and Director, Koita Foundation

Recent cyber incidents

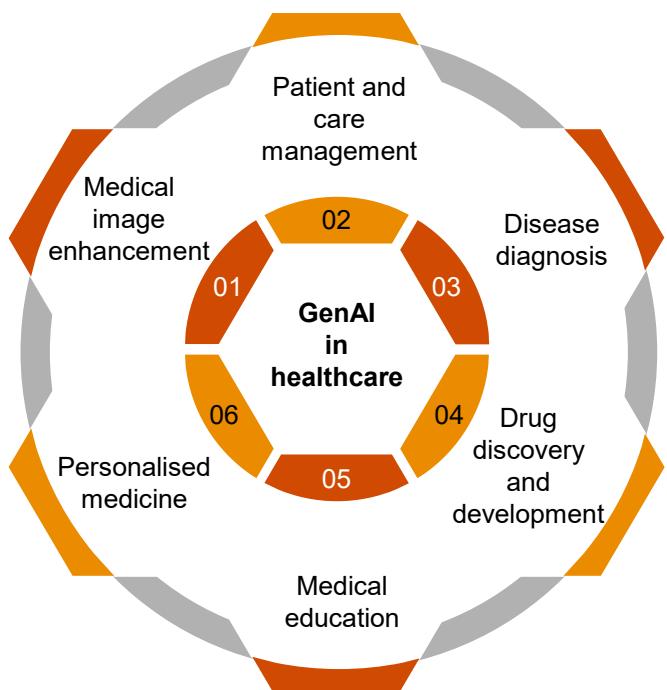
Vulnerabilities related to data pose greater risk to the healthcare sector as AI-powered systems can potentially lead to privacy violations, data manipulation, bias and fairness concerns which can compromise the overall output of AI algorithms.

These incidents can disrupt healthcare services, compromise patient privacy and impact patient safety if GenAI systems encounter a breach. Therefore, it's crucial for healthcare organisations to prioritise various cybersecurity measures such as implementing robust encryption techniques, updating software on a regular basis, conducting security audits frequently and providing necessary trainings to the employees regarding latest cybersecurity industry practices.



07 PwC's GenAI framework for healthcare

The synergy between consulting firms and healthcare organisations can serve as a catalyst in leveraging the potential of GenAI to revolutionise healthcare delivery, promote innovation and foster a culture where GenAI can improve healthcare services. PwC's community of solvers – comprising consultants, engineers, developers, data scientists and design specialists – with knowledge and experience in healthcare can help in implementing and providing oversight over GenAI. We are already working on multiple GenAI use cases, both for clients and in-house.



Medical image enhancements

- Enhanced diagnostic capabilities
- Improving visibility of subtle details and facilitating precise assessments by clinicians
- Reduction in the need for potential invasive procedures

01

Patient and care management

- Reduction in time spent by clinicians in creation of patient care plans
- Forecasting patient's healthcare journey through historical data
- Enabling more tailored patient engagement through GenAI-powered virtual assistants

02

Disease diagnosis

- Analysing medical history and symptoms to enhance precision in diagnoses
- Pattern identification by analysing volumes of data, aiding in faster disease prediction and prevention
- Generation of faster and accurate insights from medical records

03

Drug discovery and development

- Integration and analysis of diverse data sources to generate comprehensive insights for developing targeted therapies
- Redesigning traditional drug discovery value chain to expedite experiment turnaround times
- Prediction of possible drug interactions by evaluating safety and effectiveness of drug combinations

04

Medical education

- AI-based educational resources to provide individualised healthcare information for fostering health literacy and enabling better decision making by patients
- Enhancing medical students' learning experience by simulating realistic scenarios for applying theoretical knowledge
- Creation of personalised education paths for self-paced learning and tailored feedback

05

Personalised medicine

- Evidence-driven, personalised treatment plans for unique needs of patients
- Improvement of treatment outcomes by predicting individual's response to medications

06

Human intervention is indispensable to ensure accuracy and a competitive edge to the client. Many business problems need customised solutions based on the understanding of the culture of the organisation and the expectations of the stakeholders. PwC's team can collaborate with healthcare providers and develop effective process and solutions for them. Some of the ways in which we can help healthcare service institutions are:

- Our team of specialists can utilise research and analysis tools to enhance their solving skills capabilities and provide innovative and robust strategies to the clients.
- They can help build predictive models which can predict market trends and demand fluctuations and the insights can be integrated to improve business processes.
- Gen AI can be seen as a tool that would help healthcare clients by enhancing their decision-making support, with PwC resources backing it with accurate and reliable evidence through research on better customer experiences and outcomes
- Accurate and reliable data is needed to train AI/ML models. PwC resources can be instrumental to vet these data sources and generate unbiased recommendations.
- Our team can also design strategies to automate mundane tasks using GenAI and enhance employee efficiency.

PwC's GenAI for healthcare framework can be adopted by the healthcare industry to facilitate its digital transformation journey and develop solutions based on the healthcare provider's technological maturity, capability and requirements.

PwC's GenAI approach for healthcare transformation

Our framework

The GenAI healthcare transformation framework is followed along with use-case prioritisation so as not to miss out on key dimensions related to people, process and technology in accordance with compliance requirements.

Business decisions and analytics

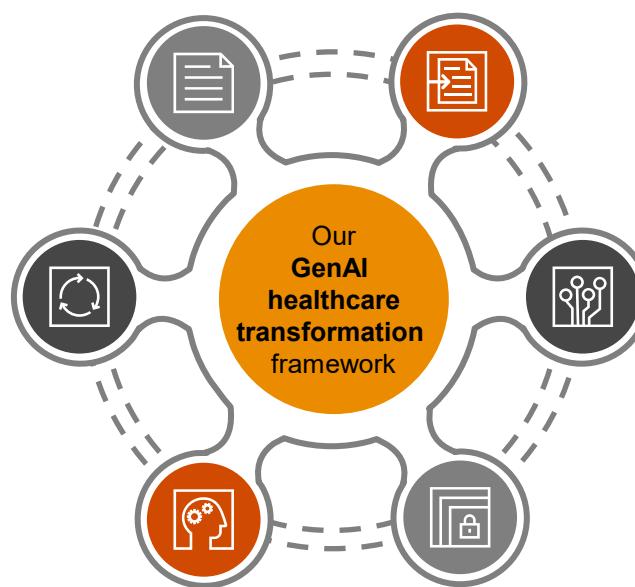
- Align with corporate and business unit strategy.
- Identify and prioritise core health and non-health use cases.
- Define KPIs to drive patient value and uplift population health.
- Create a documented use case inventory which illustrates the power of GenAI in healthcare industry.

Data and information

- Extract and store unstructured and large volumes of clinical and non-clinical data.
- Secure data and manage privacy.
- Prepare data for GenAI training.
- Prepare pipelines for continuous training with latest available health data.

Process and integration

- Be agile and focus on co-creation of values with all stakeholders in the healthcare value chain.
- Streamline metrics and improve interactions between GenAI teams and stakeholders to refine the underlying LLMs.



Technology and infrastructure

- Select scalable, large language platforms which addresses the intricacies of healthcare.
- Modernise unstructured patient and diagnostic data platforms to enable AI.
- Develop digital, user-centric applications for patients, doctors and other stakeholders.

Organisation, culture and talent

- Develop operating model with clarity on roles and responsibilities.
- Collate unstructured health data and develop GenAI skills.
- Introduce new skills to reimagine AI-driven healthcare delivery.
- Support cultural transformation and change management of patients and providers through proactive strategies.

Governance, cybersecurity and privacy

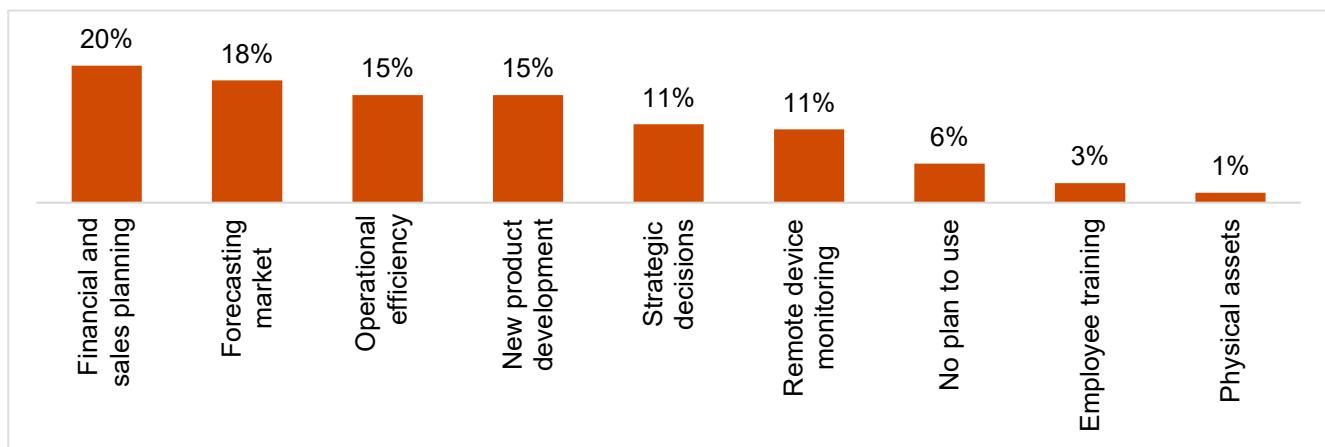
- Develop a governance mechanism that recognises and mitigates healthcare-related human and technology risks, such as patient privacy and other global regulatory obligations.
- Build trust with patients and doctors through transparency and keeping 'human-in-the-loop'.
- Apply cybersecurity and privacy risk-based controls to enhance health data confidentiality, integrity and availability.



08 The road ahead

Rapid technological innovation has enabled the healthcare ecosystem to evolve, adapt, and become more accessible and affordable. In India, multiple factors²⁵ such as the government's impetus to adopt digital technology, forecasts about population growth and various health indices (e.g. fertility and morbidity rates), amplified by the repercussions of the COVID-19 pandemic, have increased the momentum of the transformation of the healthcare landscape through digitalisation.

As per PwC analysis, most organisations feel that GenAI can be leveraged extensively in domains like financial services, sales and marketing, forecasting market conditions, enhancing supply chain and operations and new product development in the near future.



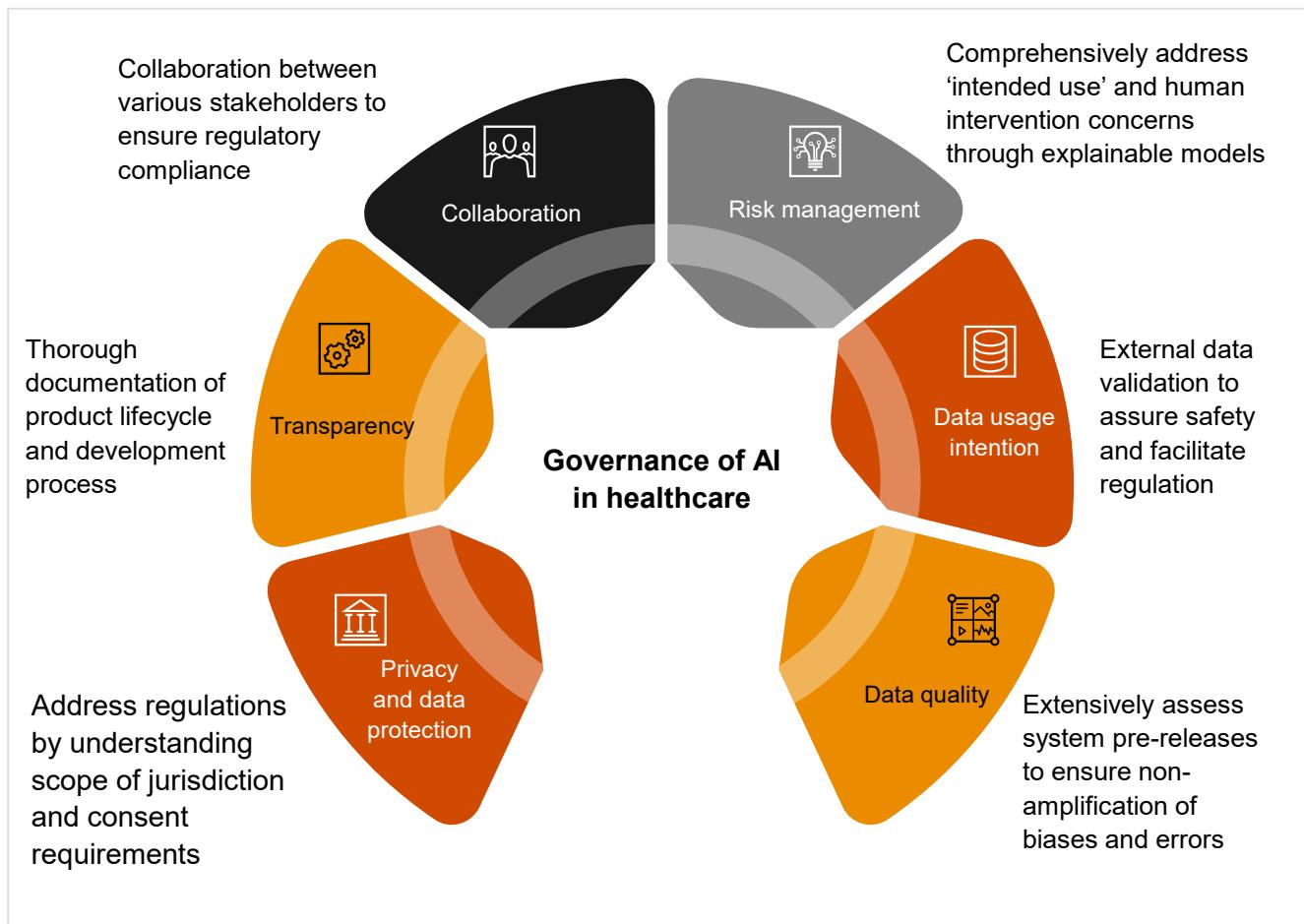
Source: PwC analysis

25. Digital health in India – statistics & facts (<https://www.statista.com/topics/7140/digital-health-in-india/#topicOverview>)

The future of GenAI in healthcare involves advancements in precision medicine tailored to individual genetic profiles, the integration of AI into telehealth platforms for more accessible and personalised care, the development of sophisticated AI-driven diagnostic tools for early disease detection, and the continued enhancement of robotic-assisted surgeries for precision and efficiency. Additionally, the collaboration between AI and wearable technologies is expected to play a pivotal role in continuous health monitoring, providing real-time insights and enabling proactive interventions.

GenAI solutions can play a pivotal role in the transformation journey of healthcare through its wide applicability in care delivery, healthcare operational excellence, R&D and patient education. However, responsible development of these AI-enabled solutions is crucial to ensure concerns pertaining to cyberthreats, biases and data compliance requirements are adequately addressed. The World Health Organization (WHO)²⁶ has identified six parameters for governing implementation of AI technologies in healthcare:

Governance of AI in healthcare – World Health Organization



When it comes to adopting a new technology in any industry, most organisations find it challenging to envisage how to get started, which tools and applications would be most impactful for their sector, and what should be the ideal next steps. Similarly, as healthcare organisations proceed on their GenAI journey, adhering to a framework to enable this transformation and fostering awareness and adoption within the organisation is vital. This is where they can leverage PwC's GenAI for healthcare framework to facilitate adoption in a smooth and streamlined manner.

The adoption of GenAI by the healthcare industry will accelerate its digital transformation journey by providing a tool that can help develop solutions quicker and at scale, leapfrogging things at a previously unimaginable pace. Players in the healthcare ecosystem can ride the winds of change as long as they have a razor-sharp focus on ramping up their capabilities in data, information and knowledge management, technology and digital, but most crucially by creating a workforce that is agile and resilient. This will enable them to keep up with the exponential rate of disruption that is fundamentally forcing organisations to question the status quo and rethink their business and operating models.

26. World Health Organization news release (<https://www.who.int/news/item/19-10-2023-who-outlines-considerations-for-regulation-of-artificial-intelligence-for-health>)

About our survey

As part of our study, we reached out to various experts across the healthcare industry to understand the perspective of healthcare professionals in terms of GenAI adoption, use cases, challenges and future roadmap. The survey was conducted in 2024 and insights derived from it have been used, where indicated, in this report.

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