Editorial

Artificial Intelligence-powered Healthcare for India: Promises, opportunities and challenges

In a country of 1.4 billion people, providing quality healthcare to every citizen has long seemed an insurmountable challenge. However, recent advances in artificial intelligence (AI) and machine learning (ML), coupled with India's robust digital infrastructure and widespread smartphone adoption, offer an unprecedented opportunity to democratize access to healthcare information and expertise.[1] AI-powered systems have the potential to address the critical shortage of healthcare professionals, democratize access to the latest medical knowledge, considerably reduce healthcare costs, and personalize healthcare in ways that human doctors often cannot.

THE PROMISES

Providing quality healthcare to every citizen of India has been an unachieved healthcare goal. As technology investor Vinod Khosla recently noted, it is now possible to provide 'a free primary care physician for every Indian, available 24/7,' through AI-powered systems.[2] India has already demonstrated its capacity for digital transformation with projects such as Aadhaar and unified payments interface (UPI), showing the scalability of technology that transcends geographical and socioeconomic barriers.[1]

The promise of AI-powered healthcare, with every Indian having access to high-quality medical advice at their fingertips, has moved beyond science fiction to an achievable goal. There are now good examples of conversational AI agents that can interact via text or voice with patients, provide initial diagnoses, and offer personalized health recommendations.[3,4] This vision is particularly powerful because it also reaches rural areas with lower literacy levels. The widespread availability of inexpensive smartphones, even among those who cannot read or write, presents a unique opportunity. Voice-based AI systems can interact with users in their native languages, breaking down barriers that have long kept quality healthcare information out of reach for millions.

It is important to clarify that such AI-powered systems are designed to augment and extend the reach of our healthcare system, not to replace real doctors,[5–7] who do far more than what AI systems can accomplish. In Khosla's vision, about 80% of a doctor's day-to-day tasks can be performed by AI agents and models, freeing up time for more important work.

THE OPPORTUNITIES

Addressing the healthcare professional shortage

There is a shortage of qualified healthcare professionals. AI-powered systems can work in autonomous or semi-autonomous modes to ensure that basic health queries are answered promptly, increasing ease of access. Empowering less-trained healthcare personnel through knowledge or decision support is another important application. Unburdening qualified healthcare professionals is also a crucial step towards increasing patient access. This extends to providing health information, as discussed below.

Democratizing access to health knowledge and trusted information

Staying updated with new guidelines or options is difficult for healthcare professionals. The situation is much worse for lay people seeking health information. Knowledge support systems with contextual capacity to tailor content to user types are now possible. These systems can ensure that reliable and appropriate information is

disseminated widely while minimizing misinformation. Overburdened physicians typically have limited time to communicate with patients, which may lead to perceptions of them being brusque or uncaring. Recent research from Google on their AMIE (articulate medical intelligence explorer) system has shown that AI can generate highly empathetic responses to health queries, sometimes even outperforming human primary care physicians in this regard.[4] This is crucial in a country such as India, where cultural sensitivity and empathy are essential to building trust in healthcare systems.

Reducing healthcare costs

Efficiencies within the healthcare system can be improved by appropriate use of AI, thereby reducing costs. An important example is in areas where humans perform repetitive tasks following a prescribed script. AI-based conversational agents, with the capacity to administer questionnaires and check for specific answers while holding a wider conversation with the patient, are now being used to implement well-defined treatment protocols.

Customization

In a diverse country such as India, a technically correct answer may not be fit for purpose due to wide variations in health system capacity and resources. For example, there is no benefit in ordering investigations or prescribing drugs that are either unavailable or unaffordable for the patient. There is an unmet opportunity for AI systems that can tailor responses not just to the medical condition and resources, but also to local contexts that include languages and customs. Dietary advice, for example, must be provided in a locally understandable form and aligned with regional preferences. There are examples of 'wicked' problems, where neither the question nor the answer is fully clear.

Understanding needs must precede development of solutions

While it is likely that we will see the development of AI-based solutions to capitalize on the opportunities listed above, implementation will require a detailed understanding of the underlying needs. This requires deep engagement between those who understand the problem and those developing the solutions. We provide two use-cases to illustrate this point: the first is home-based care for specific conditions with near-autonomous health knowledge support to unqualified caregivers, and the second is supervised use during specialized medical care.

Palliative care: A use-case where shortages, trusted information, costs, and customization come together

As India's population ages, an increasing number of patients with terminal diseases will require palliative home-based care. The number of qualified professionals with the requisite knowledge base is grossly inadequate, while there is typically high demand for information by caregivers. Affordability and incorporation of context will be critical in meeting this need since goals of treatment vary, as do the available resources. An AI-based solution, with limited knowledge but promoting adherence to a locally developed set of guidelines or standard operating protocols (SOPs), will be far more useful than, say, ChatGPT, which has excellent broad-based knowledge of global practices. Importantly, this is a setting where the caregiver typically has limited knowledge to discriminate between appropriate advice, correct but contextually inappropriate advice, incorrect advice, and frank hallucination by the AI. Thus, it is important to follow a well-defined script, with escalation if the answer is not within the script.

AI-powered systems do have the potential to bridge these gaps, but design is critical. Using advanced language models and retrieval-augmented generation (RAG) systems, AI can provide accurate, empathetic and tailored palliative care advice. When a caregiver asks a question, the system first retrieves relevant information from a trusted corpus of healthcare data, ensuring factual accuracy. This information is then processed by a generative AI model (large language model, LLM) to generate a response that is not only informative but also empathetic and easy to understand. While this does not meet the AI equivalent of a well-trained palliative care professional, it meets a utility goal relevant for improving the quality life of patients and their caregivers.

Radiology use-case: Worklist prioritization and triaging of studies

Another critical area where AI can make an important impact is in radiology, particularly in worklist prioritization and triage.[7–10] AI has demonstrated superhuman capacity in analysing images and is thus particularly suitable for medical imaging applications. It has been shown that AI can improve accuracy for radiologists, with the greatest gains seen among non-experts. Several radiology AI vendors offer algorithms that can prioritize a radiologist's worklist, pushing urgent cases such as head CT scans indicating intracranial bleeds to the top of the queue for immediate reading. This is crucial in scenarios where timely intervention, such as decompression surgery, is necessary and can also reduce errors or delays.

However, this comes at a cost even if the AI model is made available free by the AI model vendor. Integration with existing PACS (picture archiving and communication systems) or radiology information systems (RIS) is non-trivial, requiring considerable investments in time, money, and retraining of radiologists to adapt to new AI-assisted workflows. While AI has demonstrated its benefits in this area and quality solutions are emerging, a different perspective is to ask whether this is the optimal solution for the local context.

In populous low- and middle-income countries (LMICs) such as India, an alternative human-centered approach may be more feasible and cost-effective than AI in the short term. Upskilling radiology technicians (rad techs) who are not doctors but are experienced in viewing radiology images to identify urgent triage triggers could be a more practical solution. This approach leverages the abundant availability of rad techs in India and the relatively low cost of upskilling them for 'stat triage',[11] compared to the expenses associated with developing, integrating, and maintaining AI algorithms.

The choice between a human-centred triage system or an AI system will depend on a mix of considerations, including availability, economic and technical factors. Hybrid systems with gradual testing and integration of AI, as infrastructure and training capabilities evolve, combine the strengths of both human and artificial intelligence and may be a pragmatic option.

THE WAY FORWARD

The privilege of quality healthcare access cannot be scaled from only a few to everyone, without the use of AI. However, this is just one part of a larger digital transformation of society.[12] Thus, beyond technical challenges within health or AI, it also faces the core challenges entrenched in societal structures, including technological infrastructure, digital literacy, digital governance and balancing data privacy with data access. Together, these form digital determinants of health that need to be considered alongside technology and medicine.[12] It is expected that we will see investment in large-scale digital public goods for health, as we have previously seen for Aadhaar and UPI.[1] We have the technological expertise, the scale to generate vast amounts of diverse health data, and a pressing need that can drive innovation.[13,14]

To conclude, we must invest in health-AI research, foster interdisciplinary partnerships and create a regulatory framework that encourages innovation while protecting and promoting patient interests. Medical institutions must be an important part of developing, deploying, testing, and refining health-AI solutions to ensure that they solve more problems than they create. A dynamic human-AI partnership leveraging the strengths and weaknesses of each, is the way forward.

Conflicts of interest. None declared

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