

Integrating Technologies: An Affordable Health Care System in Digital India

India is a country with 1.428 billion population making 17.76% of world's population.^[1] Added to that, our challenges are diversity and heterogeneity of culture, tradition, diets, and religion. Hence, a strong, organized, and efficient health-care system is of paramount importance to the country's economic well-being.

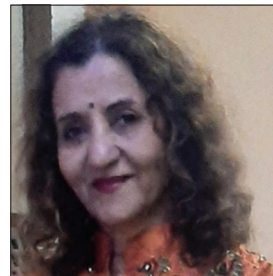
Health care is a humongous ever-flourishing industry in India. As technology, diagnostics and therapeutics are evolving so are the increased challenges of prevention and reaching out to marginalized groups with administration of treatment and after-care services.

Health care is a broad-spectrum speciality ranging from intricate diagnostics such as imaging and therapeutics on the one end to basic mobile van camp services on the other. Accessibility and affordability to health care also varies significantly among urban and rural population, with marginalized communities being almost deprived from these services. Integrated health-care ecosystem is a need of the era and demands a systematic and comprehensive approach addressing its different aspects including heightened health awareness, thus strengthening preventive medicine, focusing on primary health-care domains, developing health-care infrastructure and involving private sectors, etc.

Digitization comes as a boon in adversity. New-age technologies such as artificial intelligence (AI), robotics, and internet of things (IoT) are ever welcoming for further advancement of health-care sector in digital India. In the words of John McCarthy, "Artificial intelligence is science and engineering of making intelligent machines especially intelligent computer program."^[2]

Applications of AI in health care are a topic worthy of one separate discussion owing to its tremendous possibilities in modern Indian health care. It can take care of large amount of health sector data and provide significant inferences within seconds. Various AI-powered health applications can help in speedy disease detection and treatment. AI can predict various health trends, thus helping in efficient allocation of health resources and compression of morbidities.

As an obstetrician, AI is useful in multiple aspects of obstetric care including both diagnostics and therapeutics.^[3] For example, computerized fetal cardiotocography can detect abnormal records well in time, resulting in timely intervention and improved maternal and fetal outcome as shown by Alfirevic *et al.*^[4]



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Various AI-based risk prediction calculators for preeclampsia and aneuploidies help in appropriate counseling and management of many mothers-to-be. The International Society of Ultrasound in Obstetrics and Gynecology (ISUOG) held a special session in 2020, they stated that AI-based software automatically detects the best spatial planes and soon will provide diagnosis alongside measurements.^[5]

AI plays a vital role in gynecological care as well. Various cervical cancer screening methods including Papanicolaou smear, visual inspection under acetic acid, and colposcopy appearances are now being evaluated using vast artificial neural network to enhance yield and improve reproducibility.^[6] The use of magnetic resonance imaging-based three-dimensional models for planning surgery in difficult cases such as deep infiltrating endometriosis has revolutionized patient care. Real-time imaging-based conformal radiotherapy techniques protect nearby organs in malignancy patients.^[7] Continuous subcutaneous insulin infusion performs continuous blood glucose monitoring and provides insulin according to preset infusion rates.

AI plays an important role in every stage of life including "midlife" and postmenopausal health. AI helps postmenopausal osteoporosis in various aspects ranging from high-resolution imaging and fracture risk estimation to therapeutics. Pelvic floor function can be comprehensively assessed by AI-based ultrasounds in postpartum and menopausal patients as recommended by the International Urogynecological Association and ISUOG.^[8-11] Transperineal ultrasound can make an effective biofeedback tool in menopausal females.^[12] AI-based cardiac screening methods provide reliable risk prediction for future cardiac risks in postmenopausal females.

Robotics makes a shining milestone in modern health-care era. Robotic surgeries provide substantial

precision with minimal blood loss, thus improving surgical outcomes. Robots can also be stationed in physical and medical rehabilitation centers as trainers. Robots can work as a clinic assistant to perform those repetitive tasks such as vitals monitoring and blood sugar measurements so that clinicians are free for core patient care. Robots can also become a health assistant for old-age patients who stay alone for significant time of the day.

IoT forms yet another versatile gem in crown of modern health care. IoT-enabled devices such as smartwatches and multiparameter monitors can provide 24 × 7 monitoring of various parameters including level of physical activity, sleep, and blood sugar for holistic monitoring of pregnancy.^[13] Recently coming portable electrocardiography devices can detect adverse cardiac events in time and avail timely care. IoT-enabled telemedicine consultations can provide health care in remote areas. Continuous blood sugar monitoring and drug delivery is another breakthrough in the role of AI.

These technologies have made it possible to share the bulk of medical knowledge and experiences among various medical personnel in the form of video lectures, Continued Medical Education Programs, and conferences. Standard references can be searched on any topic in fraction of seconds. Advanced multidimensional models and AI-based simulators (e.g., laparoscopic/robotic simulators) provide a sharp hike to learning curve of medical trainees even with difficult procedures.

Implementation of these technologies in Indian health care can be improved with the following measures such as digital awareness and training, infrastructure development, multisectoral involvement, and regulatory digital health-care policies.

Ayushman Bharat Digital Mission is one such step. It has been started by the National Health Authority and includes five major interventions including unique Ayushman Bharat Health Account number and registration of health-care facility and providers. This program will help to cater huge population health-care demands of India to a significant extent.

India is a mixed bag of challenges and opportunities. The COVID-19 pandemic further exaggerated various shortcomings of our health system yet improved us in some. Awareness about hygiene and sanitation has rather improved after the pandemic making people more acceptable to need for sanitizers, masks, and social distancing. This further highlights public health awareness as an important preventive strategy for various health issues. Deficit of an integrated and efficient health-care infrastructure further peaked during

the COVID-19 pandemic. It demanded development in technologies to bring about digitization of health-care system for more number of intensive care unit beds and more trained health-care personnel. The pandemic also presented a need for effective research including effective vaccines and adequate preventive and therapeutic measures.

In a nutshell, digitalization of health-care ecosystem can integrate various stakeholders pertaining to medical services on a common platform, filling their communication voids while decreasing their geographical distances to just one click away. Integration of these newer technologies can transform health-care facilities in India for betterment, improving affordability and accessibility in underprivileged remote areas, thus revolutionizing health care and boosting patient satisfaction.

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