

Digital Twins: How it
impacts healthcare

An approach paper



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Digital Twins

How it impacts healthcare

Healthcare in India

In terms of revenue and jobs, healthcare has become one of India's most important industries. Hospitals, medical supplies, clinical trials, outsourcing, telemedicine, medical tourism, health insurance, and medical equipment are all part of the healthcare industry. The Indian healthcare sector is expanding rapidly as a result of expanding coverage, facilities, and public and private sector spending.

India's healthcare delivery system is divided into two categories. The government, or public healthcare system, has a small number of secondary and tertiary care institutions in major cities and focuses on delivering basic healthcare in rural areas through primary healthcare centres (PHCs).

The majority of secondary, tertiary, and quaternary care facilities are operated by the private sector, with a concentration in metros and tier I and tier II cities. The large pool of well-trained medical professionals in India is India's competitive advantage. In comparison to its Asian and Western counterparts, India is also cost effective. Surgery in India costs about a tenth of what it does in the United States. India's healthcare is undergoing a transformation, with the use of technology, deliverables, and newer applications to expand the scope of its services. Hospitals that were previously restricted to a specific geographic region with minimal facilities and services are now expanding, owing to foreign investment in the sector. The growth of the hospital and diagnostic sector is heavily influenced by foreign investors. The hospital industry in India, which accounts for 80% of the total healthcare sector, is seeing a lot of interest from both international and domestic investors.

India has seen significant improvement in healthcare. On January 13, 2016, India celebrated five years as a "polio-free nation." Given the odds against achieving this status, it was a remarkable achievement. India, according to the Global Polio Eradication Initiative (GPEI), is the most challenging area in the world to eradicate wild polio virus (WPV) transmission and sustain it for five years. For all GPEI stakeholders, India's progress toward polio-free status was a huge morale boost. The success of this mass health programme hinged on unprecedented government ownership and dedication.

Digital Health

The future of healthcare lies in working hand-in-hand with technology and healthcare workers have to embrace emerging healthcare technologies in order to stay relevant in the coming years. So, our task is to turn to technologies with an open mind and to prepare for the changing world with as much knowledge as possible. Technology can only aid and improve our lives if we stand on its shoulder and if we are always (at least) two steps ahead of it. According to McKinsey, "The use of emerging technologies to enhance health or care delivery is known as digital health. They were able to categorise digital health innovations into nine "value pools" across five

key categories thanks to their vast expertise in business development and healthcare: R&D, health and disease prevention, screening and diagnosis, treatment delivery, and finance and operations are only a few of the areas where you can get involved. As we look at emerging technologies, there is one area that has an immediate and long-standing impact on healthcare. One of those concepts is Digital Twins.

What is a Digital Twin?

A digital twin is the creation or collection of digital data that represents a physical object. Engineering and the creation of engineering drawings and graphics can be traced back to the beginnings of the digital twin concept. The development of Digital Twins is the result of ongoing product design and engineering improvements. From hand drafting to computer aided drafting/computer aided design (CAD) to model-based systems engineering, product drawings and engineering specifications have progressed (MBSE).

How does the concept work?

Industry is being transformed by digital twins, which are exact virtual replicas of machines or systems. These sophisticated computer models, which are driven by real-time data gathered from sensors, mirror almost every aspect of a product, process, or service. Digital twins are already being used by a number of major corporations to identify problems and improve productivity.

There is still a lot of work to be done in order to fully understand the potential of digital twins. There are no common practises, standards, or norms, so each model is created from the ground up. Data from thousands of sensors that track vibration, temperature, force, speed, and power, for example, can be difficult to aggregate. Furthermore, data can be dispersed among many owners and stored in a variety of formats.

Digital twins are being redefined as digital replications of living and non-living entities that allow data to be seamlessly transmitted between the physical and virtual worlds. They were originally designed to enhance manufacturing processes. Digital twins make it easier to track, understand, and optimise the functions of all physical entities, and they give humans constant feedback to improve quality of life and well-being.

The 'digital twin,' which was coined almost 20 years ago but only recently gained widespread popularity as digital infrastructure becomes increasingly embedded in our industries, cities, and communities, is the latest term to be added to this collection of metaphors.

Individual physical objects are paired with digital models that dynamically represent the status of those artefacts, and this is what Digital Twins stand for. Digital Twins are an emerging technology that is based on in silico representations of an individual that dynamically reflect molecular status, physiological status, and lifestyle over time when applied to people.

We use Digital Twins to test the theory that one might have access to extremely detailed bio-physical and lifestyle data on a person over time. This viewpoint redefines the concept of 'normalcy' or 'health' as a set of patterns that are consistent for a specific individual against the backdrop of population patterns.

The growing availability of molecular readout technologies and adequate computational power allows for the creation of such personalised models, which can be supplemented with continuously monitored health and lifestyle parameters. This would ultimately lead to the creation of a digital representation of an individual patient, referred to as a "virtual patient" or even an "in-silico-self."

Digital Twin approaches in health care have the potential to vastly increase the resolution and the comprehensiveness at which one can define normality and disease. The 'virtual self' models will provide a detailed map that allows to better pinpoint deviations from the normal.

Impact of Digital twins in healthcare

The digital twin is going to have a massive impact in Healthcare sector, by using this technology we'll able to perform all the complex analyses and practice medicines based analyses at the best. Below are few examples of how it can be used

Personalised Treatment Plans

The immediate impact of digital twins is on the line of treatment. Today a lot of medical treatment is decided by experience of the doctors. In some cases, these experiences are captured and validated by clinical studies and then protocols established. While these have been great advancements, but still, they don't take into account how the individual would react to this treatment. These are often depicted in TV serials like "House" or "The Good Doctor" but often miss the point that the effectiveness of the treatment is best if it is individualised.

Digital Twins would help the doctor administer different treatment courses as simulation to the digital twin of the patient. This would help the doctor to decide on the right line of treatment. Imagine the impact of this on cardiology or on oncology. This will fundamentally change the way care is delivered

Integrated Care

Healthcare is an ecosystem play. There are many stakeholders that determine the health of the individual. Digital Twins will ensure that different stakeholders come together in a single treatment plan.

Different department will practice the same work under this technology, Organisation, working bodies and Government together will efficiently use 3D modelling in coming 3-4 years to work for this technology. This system requires different stake holder and they all should work together.

This technology can be widely used in Diagnostic and Treatment system support system. Drug development will improve with higher accuracy, which will result in reduction in time and efforts and will increase accuracy. Technically it will help in Surgery simulation, complex surgery, doctors can analyse the patient's risk and side effect easily.

Impact on Drug Discovery

We have already seen how quickly the leading drug discovery processes were able to identify vaccine candidates for Covid. This was essentially possible by a combination of sharing medical data, use of advanced technology and effective investment by the government in both covering the risks and ensuring capital was available.

As discussed earlier, Drug discovery will see a massive boost. In addition precision diagnostics will increase leading to safer and more effective ways of conducting diagnostics. Digital Twin Technology has a ability to predict in advance the risk associated with medical devices and how the operations will be performed with those Instrument, reliability issues in the device etc.

How do we get started?

While there are immense benefits of digital twins here are a few steps that need to be taken to make this a reality in India.

- **Building the right business case**

We have seen many technologies in healthcare that fail to live up to the massive potential. Some of them never leave the lab and often end up as science projects. In order for digital twins to be a viable option, healthcare organisations need to work on the business case. While the case for clinical efficiency is clear, would it be viable to use this technology and if there is a market for it.

- **Building the right processes**

While business case is a strategic move, operationally one might have to look at the current clinical decision-making process and see if Digital Twins can be incorporated as part of it. In India the clinical decision making is dependent on the skill and will of the doctor. Supplementing it with basic clinical decision support system itself has been a challenge. Is Digital Twin a bridge too far? Now that has to be analysed in parallel

- **Talent**

While Strategy and Process are key, Talent that understands Digital twins is very important. This concept is a multi-disciplinary concept and needs talent that has a combination of medical knowledge, engineering, Bio-Medical Devices, Bio technology and IT.

People need to understand the working system, the core domain and their technicality, like proper healthcare practices and process, brief knowledge of the subject, need to understand the working of sensors, as there will be lot of complex engineering practice involved in the process, which will help in feedback data, ability to innovate, good communication, Knowledge of the subject, the live data understanding.

- **Standards for technology**

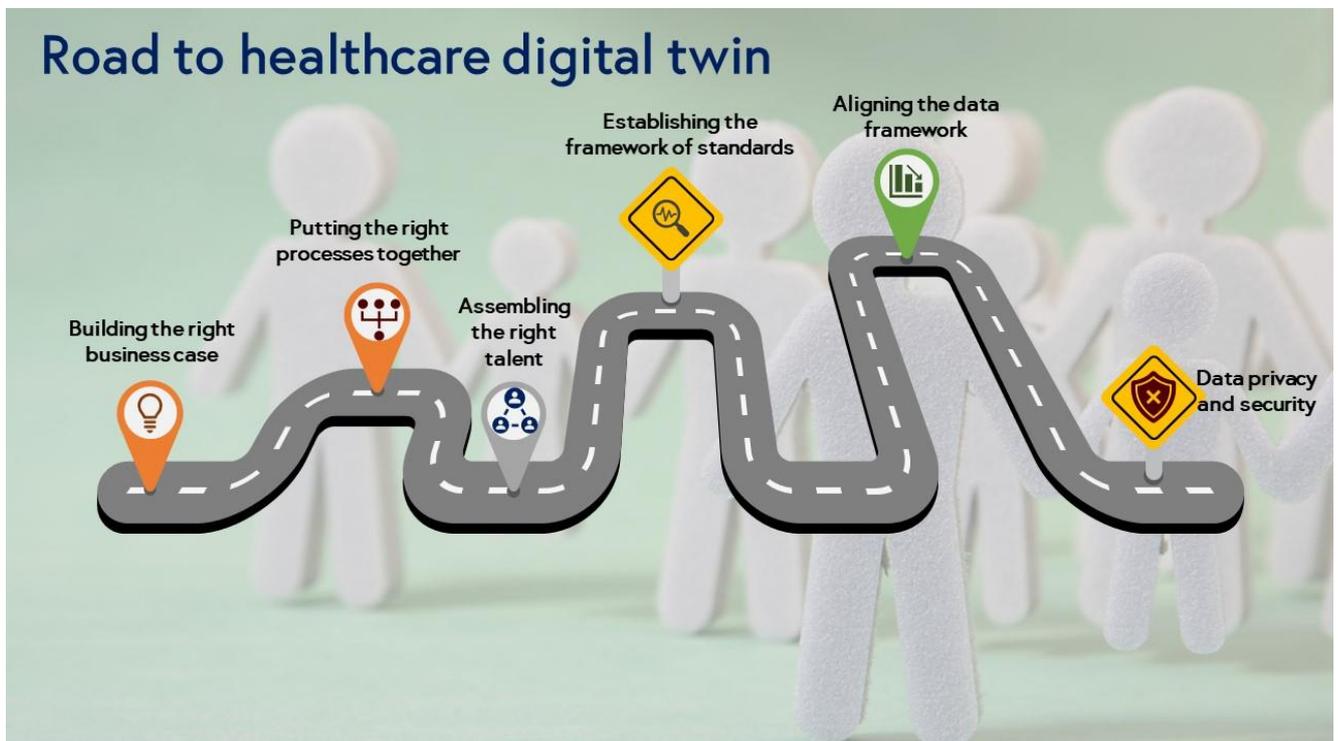
The key to success here is establishing standards for the construct of digital twins. Some of this work is already underway with setting up of the National Digital Health Strategy. Also, with the development of the India stack we do see an integrated framework that can be used to develop Digital Twins.

- **Data**

Data Strategy and Governance would be the key. Especially personal data. Multiple data from multiple sources required to put in together. Getting a right data is a first concern. Need to understand things medically, digitally on a basis of machines and automation. Should be documented over a period of time. Currently as per his experience this eco-system is nowhere close to above mentioned points.

- **Data Privacy and Cyber Security**

A lot has been said about protecting the privacy of the patient. Data is the fuel that would feed this system. While there has been an increased awareness on the rights of data subjects, but India would need a comprehensive policy on data. Similarly protecting the system will be a key concern going forward.



Conclusion

In conclusion, Digital Twins are going to benefit the service providers and will help in intervention. The Recovery rate will be fast, the cost will be very low and it will enhance the Healthcare system."

Many big med tech companies like Philips, Siemens Healthineers and GE are working on digital twins. In order to reach their goal, these companies will need the vital assets which are patients' data.

As a result of this paper, we'd like to conclude that digital twins is a relatively new area for which little research has been conducted. However, because of its applications, it has the potential to expand significantly in the future. It's still very much a grey zone that needs delicate attention. Ideally, the concept will materialise in favour of patients and make them the point-of-care.

Obviously, many factors would have to come into play for such an idea to become a reality. These factors may include financial capital to know patients can even afford the technology. But in our opinion, digital health has a potential that could revolutionise medicine- it could enable us to predict which patients would become ill weeks or months in advance, how a specific patient would respond to a particular treatment, and which patients would benefit the most.

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References

1. <https://www.mckinsey.com/industries/pharmaceuticals-and-medical-products/our-insights/healthtech-in-the-fast-lane-what-is-fueling-investor-excitement>
2. <https://www.forbes.com/sites/bernardmarr/2017/03/06/what-is-digital-twin-technology-and-why-is-it-so-important/?sh=4d6833002e2a>
3. <https://journals.sagepub.com/doi/full/10.1177/2399808318796416>
4. <https://www.nature.com/articles/d41586-019-02849-1?sf220071546=1>
5. <https://www.sciencedirect.com/science/article/pii/S2405896315003808>
6. <https://www.healthcare-in-india.net>
7. <https://www.frontiersin.org/articles/10.3389/fgene.2018.00031/full>
8. <https://www.sciencedirect.com/science/article/abs/pii/S0007850619300502>

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