**Driving Digital Revolution
in Indian Healthcare**

IHX Blog

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**Healthcare Revolution: How We Will be Living
Better By 2030**

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In 1901, average life expectancy in USA was 49 years, and in India 23 years. Fast forward a century, in 2001 Americans lived for an average 77 years and Indians 62 years. The global population increased from 1.6 billion to 6.1 billion! We have learnt to live longer. We have even changed how we die: a massive shift from infectious diseases (Pneumonia, Tuberculosis, Gastrointestinal infections etc.) to Non-Communicable Diseases (Heart Disease, Cancer, Non-infectious Airway diseases etc.) as the most common causes of death has been recorded in the United States.
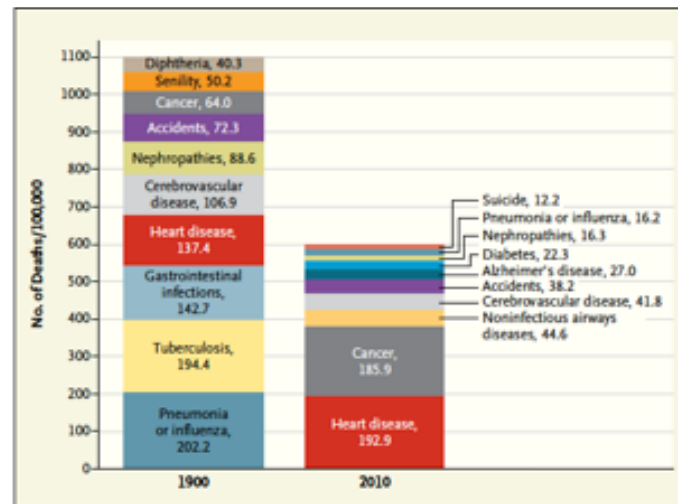
Top 10 Causes of Death: 1900 vs. 2010.

From N Engl J Med 366;25

What have we learned about healthcare innovation from this dramatic century? First, innovations in other seemingly unrelated fields (e.g., chemistry, metallurgy, electronics, quantum physics etc.) are often major contributors to healthcare advances. Therefore, for predicting future of healthcare, one will have to watch the relevant non-healthcare trends very carefully. Secondly, innovations in healthcare have much slower ramp up curves than in other industries like manufacturing and technology. New techniques and technologies need to be understood by the doctors, tried carefully and then adopted. Typically, it takes 15–20 years for a new innovation to become mainstream in modern medicine. Thirdly, while serendipity sometimes plays a role in innovation (e.g., Fleming noticing effect of penicillin on bacteria accidentally), more often it is intense curiosity and determined effort made by hundreds of people over long periods of time which led to significant advances in healthcare.

We have made more gains in our health during the 20th century than the preceding 20,000 years. This has been made possible due to overall advance in our knowledge across various fields and mastery over the materials. These changes are accelerating, not slowing down and we now have 8 billion people connected via the internet and mobile telephony systems generating large quantities of data that can be analysed by huge data server farms running sophisticated artificial intelligence algorithms.

Here we explore some of the major technology trends that have emerged over the last 20 years, and how they might help shape healthcare over the next decade. Instead of predicting what a technology will do, we take the perspective of a healthcare user (i.e., a patient) or a professional (i.e., a doctor), and examine how healthcare might change using the technologies that have emerged or are emerging.

Let us think of a doctor speaking with a patient. Typically, the patient describes his symptoms from memory and in some situations, doctors have to reconstruct events from sketchy information (e.g., the exact nature of body movements during an epileptic seizure). This will change over the next 10 years. Patients will record events like seizures on video, and AI systems will analyse the images and doctors will get a list of possible diagnoses to choose from. Similarly, just the gait (a persons' manner of walking) of a patient can be diagnostic of many disorders (e.g., small shuffling steps of Parkinson's disease) and video systems operating in doctors' clinics will help diagnose these disorders easily. Voice and manner of speaking are other obvious data points that patients produce (e.g., patients with depression have characteristic speech patterns) and advances in voice recognition systems will empower doctors to decode the underlying problems without having to become linguistic experts.

For examination of the patients' body, the tools that doctors use today are at least a century old, if not more. The stethoscope (invented 1816), sphygmomanometer (1881), and thermometer (1714!) are all antiquated relics that should be sent to museums quickly as the world moves to more modern devices for examining patients. A sound monitoring system will record patient's heart sounds, lung sounds, bowel sounds, joint sounds etc. and compare them with large datasets of millions of similar sounds using AI algorithms and give doctors a real-time interpretation of these sounds. Similarly, image recording and recognition systems (e.g., the phone camera — duh!) will get empowered with backend AI algorithms that will help doctor evaluate patient body structures, facial expressions, skin lesions like suspected melanomas and many more. Video recording and analysing systems will enable insights into patients' movements like gait, tremors, hand-eye coordination etc. In fact, all of the above are invitations for some start-ups to invade into the doctors' office and replace centuries old tools with newer ones that empower the doctors' decision making in a seamless manner.

All of patients' history and examination culminates into a medical diagnosis which identifies the underlying disease. As we learn more about medicine, we realize that the traditional disease categories need to be revised to consider the additional information that we gain from molecular, imaging, therapeutic and temporal patterns of many diseases. As clinical data of millions of patients gets compiled into unified databases which can deploy novel AI algorithms to detect patterns that are undetectable by humans, our understanding of diseases will become more detailed and real-time. Patients will be able to get predicted trajectories of their diseases (e.g., when a diabetic might expect to get a retinopathy) and take necessary steps to change those trajectories.

Treatment of disease involves either a surgical procedure or medications. Most surgeries are done for one of four reasons: fix-it (e.g., bone fracture), remove-it (e.g., brain cancer), replace-it (e.g., failed kidneys) or augment-it (e.g., larger breasts). Over the next decade, the first two will continue to be important, but the real revolution will happen in the last two as replacement and augmentation becomes mainstream. Newer implantable devices will augment various human capabilities including vision, hearing, memory, walking, eating, drinking and many others. Expansion of human capabilities through surgical procedures will become common. Medical treatments will become more targeted and more expensive as molecular therapies become more effective and common.

A big change in medicine will happen through the gaming industry. Games have a proven ability to hold players' attention, change behaviour and enable collaboration across millions of players around the world to reach a common goal– all in real time. These capabilities will start entering the healthcare system and transform how we deal with our ailments. Our battles with illness will become more collaborative and social as against the lonely struggles patients face today. Healthcare variants of Minecraft and Fortnite (which has 250 million players globally) will emerge with new type of medical 'enemies' and new weapons to kill them.

Robots will invade healthcare by taking care of the elderly by giving them physical and emotional support. Anyone who is less than 50 years of age while entering the third decade of this century can expect to have robots to assist him or her as they enter into their twilight years.

In a nutshell, if we want to visualize the key trends that are going to pave the way for healthcare delivery in 2030, we can look at five broad areas:

- First, we will all get digitalized and Dr Eric Topol's vision of Homo digitus will become real. All our personal health data will be digital on a cloud, controlled by us individually and represented by various types of Avatars. Our avatars will become our surrogates
- Second, a new branch of medicine called Algorithmic Medicine will emerge. Doctors will collaborate with data scientists to design various types of algorithms (pattern matching, predictive, recommender systems etc.) which will consume digital health data of millions of individuals and give personalized medical recommendations to doctors. Doctors will have more time to spend with their patients to help them make the right choices given by the algorithms
- Third, Health Games will emerge as a new form of social engagement and millions of people will play these games to help each other and get better
- Fourth, Augmentation Surgery will go mainstream and move beyond physical enhancements (e.g., breast implants, hair transplants, cosmetic dentistry) into enhancing capabilities like walking, memory, focused attention, vision and hearing. A wide range of new devices for such enhancements will be invented. If regulatory obstacles are found, individuals will fly or Hyperloop to unregulated jurisdictions to get the enhancements done. Surgeries to fix-it, remove-it and replace-it will become more minimally invasive and more multi-disciplinary and will form the core of the hospitals of 2030
- Finally, empathic robots will compete with dogs for our love, and give a lot of love and attention in return. Unlike dogs, these friendly robots will be able to fetch our food and medicines, take us for a walk, play games with us and call 911 if there is an emergency and beam a live-stream of our situation if we are in trouble. These *empathobots* will become our second-best friends

This article will be incomplete, if we stop here without talking about how technology will help us in becoming more inclusive in healthcare delivery. As we speak about such unprecedented advancement in healthcare, we cannot ignore the fact that these technologies will not come cheap, at least not in the near future. This is where we need to think how we can make healthcare more affordable, more inclusive for all sections of the society. With patient data already in the cloud systems with their digital avatar, understanding patients' health risk will be more accurate; AI algorithms will help insurers to come up with better premium, attain better profitability. In-return, if they are able to assess the risk accurately, they will be able to bring in more people under the insurance umbrella, without hurting their profitability. With AI assisting doctors with correct diagnosis and treatment recommendations, the cost of healthcare will also go down, eliminating the requirement of unnecessary tests, or wrong treatment. Anonymised health data of large patient groups available digitally, will not only help to predict epidemics, or new pathogens, but also help the Government device better policies.

We are living in exciting times, and look forward to another dramatic decade of change in healthcare.