

Overview

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While trekking in the Himalayas, one early morning, I had to stop to allow four persons to pass. They were carrying a wooden cot and strapped to the cot was a 50 years old man with a plaster splint and dressing window suggestive of a compound fracture. He was clearly being carried to the hospital. The procession had already travelled a few kilometers, but still, it would take another kilometer to reach the road and vehicle. Transit time from home to the hospital would be 2–3 h on a minimum and around the same for return. A simple wound dressing, which would ordinarily take 10 min, had now cost five man-days and 50 times the original price. That was a motivating moment for me to look for a solution to cut down such unnecessary cost of healthcare provision. Many of the authors in this book have had similar experiences.

Costs of healthcare delivery are not always the same as costs incurred to achieve good health. The cost of travel to a health facility and back, though rarely considered, is a major impediment for those located in remote locations. Lack of care providers locally, along with other poor health infrastructure, often exacerbates health disparities. While expectedly a major problem in the developing world, which suffers from infrastructure weakness, especially poor transport networks, remote and underserved areas exist in almost every country. This specially includes the United States, Canada, and Australia, which have large swathes of rural areas.

A 2015 Indian movie, *Manjhi*, described the true story of a man who single handedly cut a road across a mountain in remorse after his wife died; he had been unable to get her to the hospital in time. He did not want others to suffer the same fate.¹ In today's time, a simple mobile device could have provided this much needed support through telehealth, which can literally help one to cross mountains with minimal effort.

Telehealth, literally means “healing at a distance.” It is increasingly viewed as a mechanism to deliver more efficient and patient-centered healthcare services to individuals who face physical and financial barriers to access quality healthcare support. Advances in Information and Communication Technology (ICT) coupled with demand for novel approaches to care has enabled GPs, nurses, and other health workers in the community to collaborate and address health disparities through deployment of telehealth technology. Even while initially, the objective was to save costs and time spent on physical travel by patients or health providers, sometimes both; today, information processing and Internet have widened the scope to a range of solutions, some of which were never even imagined in the past. Like the TV remote, it is increasingly more than just a convenience. Many patients are already hooked on, but the healthcare fraternity needs to understand how it works.

Telehealth is only one of the many areas where ICT is supporting healthcare, though admittedly one of the most promising ones. To fully utilize the benefits, a better understanding of ICT itself is first required. ICT has two components. The first is Information Technology (IT), which is actually information processing, and the other component is Communication (C), which means transmission of information, but also involves technology.

Information processing follows four discrete steps known with the acronym DIKW (Fig. 1). The very basic is **data**, a jargon of bits and bytes initially created through input devices, stored in the form of memory at various places and transmitted or communicated. Humanly understandable data is **information**. The Internet, for example, is a constant flow

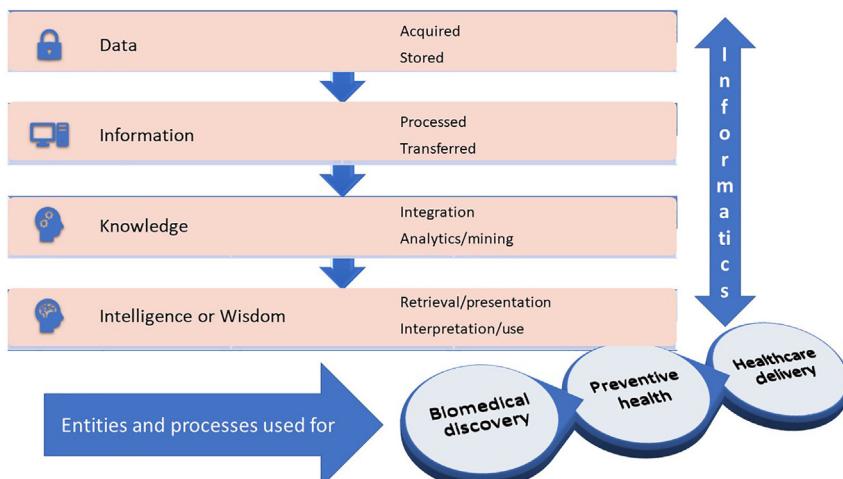


FIG. 1 Data flow in health IT systems.

of information across billions of devices. Useful information becomes **knowledge**, and finally, garnering benefits of knowledge is what can be called intelligence or **wisdom**, which can translate to appropriate action, meaning better healthcare delivery in the current context.

Healthcare has been among the last to fully utilize the benefits of the ICT revolution, which has resulted in a sea change in other sectors. Take the aviation sector as an example. The 2014 figure of 100,000 flights every day is rising.² Airlines spend 17% of their budget on ICT. This budget seems justified as it allows seamless ticket bookings, enables millions of pieces of luggage to reach their destination in tandem with the passenger, and ensures flights take off and land on time and, most importantly, with complete safety. Similarly, weather prediction, which used to be a joke, advanced far in accuracy with the introduction of super computers and high-level calculations.

Although, the body's processes are far more complex than the weather, similar or even greater advances in healthcare are possible by using similar technologies. Processing skills of today's PCs and smartphones are no less than super computers. Telehealth is only one of the many benefits of such injection of technology as described in the case of the Aravind Eye Hospitals³ (Box 1).

We first briefly describe what telemedicine and telehealth mean—exact definitions are in the next chapter. **Telemedicine** is a provision of clinical care remotely, using clinical processes such as teleconsultation, telediagnosis, etc. **Telehealth** not only incorporates telemedicine but also goes beyond, with additional indirect benefits. These include understanding health indices, providing preventive health support and medical education—remotely delivered for professionals as well as public—and

BOX 1

A r a v i n d e y e - c a r e s y s t e m

The Aravind group of eye hospitals from South India introduced assembly line techniques to eye surgery, managing to notch up over 300,000 cases per year at extremely and unparalleled low costs.

Patients are remotely identified, investigated, and then brought to the hospital in groups for the actual procedure—say a cataract. Then, they are sent back the same day for later remote stitch removal and glasses. The fees charged include transportation. Complication rates are lower than anywhere in the world. Telehealth processes, some of them developed in-house, assist this rapid and efficient turnover. They were the pioneers of teleophthalmology in India.

correcting a shortage of essential supplies etc. Electronic health (eHealth) is a term used for whenever any form of electronics is involved for health provision, support, or management.⁴ (WHO is now trying to gather a consensus to use the term Digital Health instead.) eHealth also incorporates CDSS, analytics, and many other tools, which go towards creating a broad-based personal and public health strategy. Telemedicine and telehealth, even while having variations, are used as interconvertible terms. At many places, we use the term **telecare**, which, though self-explanatory, as yet does not have a published reference.

Another term is mobile health (**mHealth**), which is similar, but is restricted to the process, that is, electronic healthcare delivery through mobile devices. Mobile usage has outnumbered computers. Besides being mobile and handy, features like location identification and sharing, messaging service, gyroscope, movement sensors and built-in camera have expanded the scope to special health apps like fitness trackers and wellness support enabling patient-centered care and sometimes, obviate the need of a health provider. mHealth has expanded the scope beyond traditional telehealth, justifying a separate name and an exclusive chapter in this book.

The world's over seven billion and rising population incorporates anthropological, societal, and cultural differences besides the variation in the environment, economic capability, institutional support for health, etc. There are, hence, a relatively unlimited number of health problems with as many treatment processes. Chronic diseases and increasing life span mean even greater challenges for the patient and the provider. Care provision is rising in complexity. Insurance rarely compensates for the lack of easy access to the provider, though that may be changing.

Till lately, healthcare delivery used to remain concentrated in the hands of health professionals. However, a persons' health is rarely personal; it does affect others around him. Hence, many well-wishers and family try to step in to provide solutions. Going to the doctor is expensive and involves time and effort. Many who are not trained in healthcare, especially ICT professionals, have found it a lucrative market and try to provide solutions. Only a few of these can be recommended and identifying the better ones is another rationale behind this book.

Most clinicians have not been very supportive of telehealth. Catering to it requires additional learning, there is a higher expenditure on time and effort due to frequent interruptions, and despite everything, information remains incomplete. There are also legal hurdles related to open data sharing and patient privacy. The public is more enthusiastic; 76% of US citizens, for example, prefer telecare over a physician.⁵ They use trusted search engines and social networking tools for information and communicate through e-mail, WhatsApp, and Skype. All may be called a special category of telehealth, but these are frowned upon by clinicians for the

lack of security and privacy. Such solutions may even be harmful when there are issues related to accuracy and validity of the gathered knowledge. Clinicians find patients who gather information from the Internet and other sources a problem (Fig. 2).

Some support for telehealth is creeping in, such as day to day care for the aged as well as in chronic diseases where a daily trip to the doctor would make the costs prohibitive. As also, during emergencies.

ICT systems can help reduce the rising complexity of healthcare delivery through knowledge systems and checkbacks. And since telehealth requires working with an ICT system, incorporating knowledge systems, checkbacks, and other such can be seamless. However, knowledge about ICT-based healthcare support then becomes important. In 2006, there were 26,000 EMRs in the United States. Using one needed an understanding of its processes and workflows. As of 2017, there are around 325,000 apps.⁶ These also keep on changing with variations, issues, and bugs offering complexity in adoption and implementation. Patients are going to use them and ask the provider on their benefits and issues.

Overall, 75% of ICT projects do not reach the desired level of success; in healthcare the failure rate is even higher. Fortunately, success rate is improving.⁷ Rapid advances have lowered costs of ICT implementation, made it easier to use, and widened reach but still the initial investors who lost out are wary.

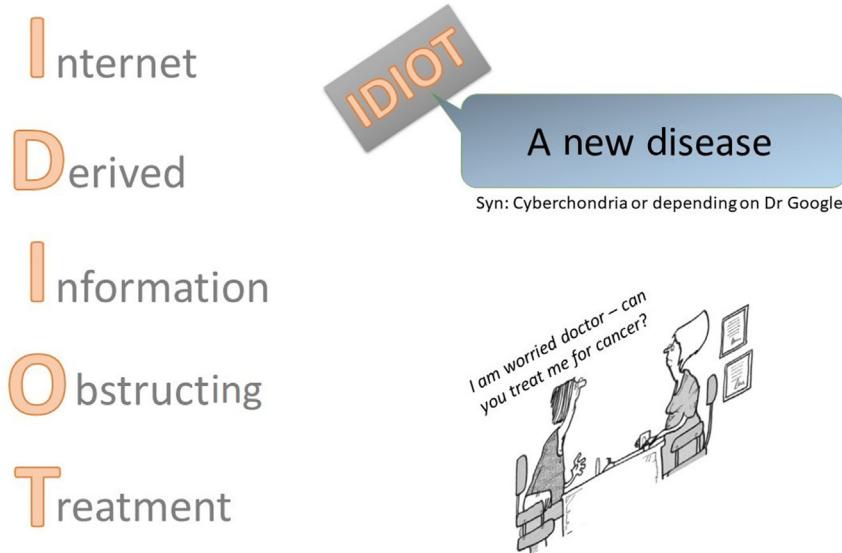


FIG. 2 Poster at a GP's clinic reflecting a certain tiredness with Internet-derived knowledge. Courtesy Dr. T.P. Singh, New Delhi, India.

The few successful telehealth projects have been those wherein ICT was used to supplement, rather than replace the care provider, a small cog in the larger picture as seen in the exemplified case of Aravind Hospitals.³

One reason for the lack of general success of ICT in healthcare has been hype related to the technology. ICT has many unpredicted side effects. A change management approach helps make ICT incorporation easy ([Fig. 3](#)). The most important component is people; they have to be orientated, motivated, and trained. This sometimes needs additional incentives, as such training is over and above what is routinely taught during medical school.

Fortunately, the perception that the older generation is less accommodative to change can now be challenged after seeing the widespread usage of smart mobiles. Better and easy to use software systems, read technology as shown in [Fig. 3](#), do help ease adoption. If the change is gradual, for example, extending the use of familiar day-to-day applications like WhatsApp, e-mail, or video conferencing, success is assured. Additional incremental use, like extended use of familiar applications as mentioned earlier, is what can be called an evolutionary change. A project mode, on the other hand, is revolutionary. Revolutions tend to force change, which leads to resistance. This book is an effort towards an evolutionary change.

This book has four main sections, broken into 15 chapters with 101 subsections written by 40 main authors, as well as a few additional coauthors. The authors came from across the globe, many from places where English is a foreign language. During editing, there was a fear of losing in translation, the essence of what the original author wanted to convey. Retaining consistency of the terms deployed was also challenging, besides a need to remove areas of duplicity between various submissions, for example, definitions. Some of these duplications persist because there were chances of interrupting a seamless flow of information. The attempt has focused toward an easier read, and better understanding.

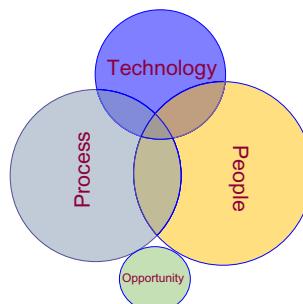


FIG. 3 Success of any new **technology** project, specially using ICT, depends on a complex interplay of **processes**, which need to be added or changed, and the **people** working with it. Luck or opportunity also plays a role. (Size of the circles approximately reflects the relative role that each component plays.)

The first section is **basics** wherein after the current overview; [Chapter 2](#) defines telehealth, its build-up through history and some of its learnings, and the overall importance of telecare in the existing health systems. It ends with what the future beholds. [Chapter 3](#) details the creation of health-related data, its storage in the form of EHRs, and how to utilize it further. [Chapter 4](#) talks about the other components of technology behind telehealth, its implementation, and related protocols and standards.

The second section, **working together**, talks about how patients, clinicians, and other care providers can work together for efficient health delivery. [Chapter 5](#) covers the creation of a healthcare team without the consideration of physical barriers; [Chapter 6](#) looks at this from the individual patient's perspective—what can be called patient-centered care; [Chapter 7](#) looks at telehealth projects, either standalone or what is rather a preferable incorporation of remote support in any organization or care support system; and finally, [Chapter 8](#) is about how tele itself has all the tools for advanced training and creation of tele-enabled workforce. Distance education is now possible and has been found useful for all grades of health professionals, starting from the village-level worker to the high-end specialist.

The third section is about **telemedicine** in its classic sense. [Chapter 9](#) is dealing with solutions at the primary care level; [Chapter 10](#) covers special solutions and components required among individual specialities; and [Chapter 11](#) caters to individual situations wherein telecare is maybe the only or at least the ideal solution. Examples are problems like disasters and less accessible places like prisons, ships, and aviation. [Chapter 12](#) is about mHealth, its nuances and how mobiles are and can be used for health support.

The last section deals with **issues and the future**. [Chapter 13](#) incorporates legal and ethical issues; [Chapter 14](#) discusses advances with an eye to the future like telehomecare, blockchain, robotics, AI, IoT, and AR/VR. The book ends with specific case studies and their learnings from the developing and the developed world.

There is a combined **glossary** of acronyms and common terms, which are used across multiple chapters. References are also placed at the end to avoid duplication. Since this is designed as a textbook, we avoid too many detailed references.

Technology is changing very rapidly. It is almost like a race for new ideas and innovations. For a book like this, to keep up with the latest changes is challenging as we all know that some of them may not even see the light of the day. The only way to compensate is to try to do revisions earlier rather than later, which we hope to do. Interestingly, this chapter was deliberately written last, and even while we were doing the final revision, WHO announced that the term digital health will be preferred to eHealth.

In conclusion

The author recently received a call routed through a web search engine. “Can your telemedicine solution cure my cold?” It was a difficult question to answer, as medical care by itself is yet to deliver for a cold. However, telehealth does offer innovative and holistic solutions for a multitude of diseases humanity is faced with, without the constraints of time and distance.