Digitisation of medicine: A welcome step?

Murali Poduval

Orthopaedics is a very technology intensive discipline. We are increasingly aware of technological improvements in the surgical sphere, the availability of more interactive navigation systems, simplified surgical tools and flexible implant choices, personalised implants, software-enabled scheduling and follow up, templating and planning tools: the list is endless and ever evolving.

Some years ago, I wrote a review entitled "Medicine as a corporate enterprise- A welcome step?" (1) In this review we investigated the pros and cons of the corporate structure that was taking over the practice of medicine. A decade later, I am writing on a topic that is taking medicine by storm, the digitisation of medicine. The digital enabling of medicine has arrived. It has invaded the workplace of not only the physician, but also the nurse, the therapist, the lab and every sphere of medical care. Digital medicine goes far beyond just technology as an instrument; it makes technology more human in its applications, potentially taking over some of the functions that were the exclusive right of a healthcare practitioner.

Healthcare has lagged behind other disciplines because of the uniqueness and complexity of clinical practice. There is tremendous variability between patients, between practitioners and between institutions. This makes it incredibly hard to reliably substitute or supplement the various aspects of decision making and planning that a clinician makes on a day-to-day basis. We have seen, over the years, the advent of EHR and EMR that have facilitated the running of large hospitals and streamlined the maintenance of patient databases whilst enabling tracking the patient's hospital journey. Individual physician behaviour and clinical acumen is however a very different scenario.

The rapid strides in machine learning, digital learning and artificial intelligence have now started removing much of these hurdles. The unique ability of these technologies to learn tasks, reproduce them and to improve with increasing usage is leveraged in many applications. Spurred by the acquisition and availability of "big data", decision support systems for doctors are now becoming a reality. Connectivity and accessibility in combination with predictive analytics are likely to make healthcare more efficient, cost effective, accessible and outcome oriented. In a white paper on the future of medical devices (3), IBM describes the users of medical devices as two broad groups of consumers, one is the motivated healthy individual who uses the health device to monitor and maintain health. The other group is the Chronically Monitored, suffering from chronic lifelong diseases needing monitoring. They are older and need the devices to keep going. An intermediate group is the information seeker. This group of patients has a potentially serious health risk or a condition that can be difficult to manage. The information seeker is the most efficient user of medical devices in the quest for health.(3)

The use of predictive analytics may be the ultimate enabler in the digital pathway of medicine. Predictive analytics is facilitated by the use of predictive tools to access and manipulate big data to gain insights and anticipate possible issues with increasing precision. (2) Applied to medicine, one could call it predictive medicine. The ability to integrate known disease characteristics with a specific patient's health status to predict personalised therapy, response to treatment and to design future treatment protocols. It is a winner all the way for all the stakeholders. The patient benefits the most from better treatment, better access, decreased costs and fewer inpatient stays. The hospital benefits from better outcomes and decreased recurrent costs. The insurer benefits from the decrease in costs and better documented
outcomes.

Thus, the end user in the digital pathway may be the physician, the patient or the hospital/insurance provider. We could then envision this service as a product to enhance and optimise the delivery of healthcare across all domains. The various aspects of digital medicine include administration, telemedicine, m- Health and other technologies that may come in play in day-to-day administration and maintenance of medical care.

[1]Tata Consultancy Services, Mumbai
Address of Correspondence
Dr Murali Poduval, MS, DNB, PGDM (Healthcare Admin)
Consultant Orthopedic Surgeon, Senior Consultant
Tata Consultancy Services, Mumbai
Email: murali.poduval@tcs.com

Telemedicine links less accessible areas to specialised medical care. In India, this is an invaluable tool to link primary and district health services to the central tertiary care teaching hospitals. This not only increases the accessibility of care but also the quality of services. It goes a long way in decreasing the overcrowding of medical services in the secondary and tertiary health care systems. Under the Digital India initiative, much is being done to bring e-health, including online

consultations and follow up to the general population. Linkage of Adhaar to patient registrations is being implemented at some major hospitals. (4) These technologies that deal with medical information that is shared or transmitted electronically between individuals and sites to improve a patient's clinical health status are termed as distance health technologies. Four distinct areas or application domains can be identified in the organisation of distance health systems which include real-time interactions, asynchronous applications which are not real time, remote patient monitoring technologies and mobile health domains. Each of these has a specific application which may overlap in usage space.(5)

Health tracking through mobile applications is used to monitor patients with chronic illnesses. As longevity increases, the burden of chronic diseases has also increased. This brings with it a need to keep track of the patient's wellbeing and the efficacy of a therapy administered to the patient. There is also a need to curtail rising costs of treatment and reduce re-admission rates. Mobile phones give a cheap and versatile supplement to regular hospital visits. There are a host of wearables in the market used by enthusiasts to monitor and maintain their own health. The regular check of weight, activity levels and basic health parameters have become a part of the daily routine of almost every individual with access to these technologies. These wearables powered by unique low cost sensors like accelerometers and gyroscopes are now being harnessed in the management of a number of chronic diseases. Real time and continuous monitoring are emphasised in chronic diseases like Parkinson, stroke, cardiovascular diseases and in chronic musculoskeletal ailments like back pain and osteoarthritis. Wearables coupled with mobile apps help patients take responsibility for their own treatment whilst keeping the physician updated on a regular basis of the status of the patient. Regular medication reminders and physiotherapy motivators are part of these solutions that are available on the cell phone application stores by the dozens. Google, Yahoo, Apple, IBM medical device manufacturers, start-ups and pharmaceuticals are all in the fray to find the perfect hardware solution and the perfect algorithm to match the solution. The magic of artificial intelligence and the promise of machine learning is creating a future sphere of immense potential. The IBM Watson project uses cognitive computing to sift through constantly updated data to assist in personalised decision making for therapeutics and development in various domains, especially cancer and drug discovery. This ever-evolving system is a benchmark for cognitive computing but the not the only one of its kind in current times. Powered by immense computing ability and accurate inputs of data which is constantly updated, such systems like Watson can generate extremely useful inputs for the clinician and the researcher. It must however be understood that the core of all machine learning is the input of accurate data. The oft quoted principle of "garbage in, garbage out" is to be kept in mind. However, we can see on the "not so far" horizon, the advent of better deep learning systems that overcome the handicap of needing to input volumes of accurately deciphered medical datasets to get meaningful output.

It is envisioned that the doctor may well become the pilot of healthcare delivery, overseeing the dashboard of data which will add to his clinical acumen and decision making power.(6) He will be empowered by the analyses provided by dedicated algorithms that he himself will help create as per his needs. He will be confident of his decisions on the strength of the data and the analyses provided to him supporting his decision. Will it take away his essential duties and replace his job of making a diagnosis and providing real time decisions on treatment? The answer is no. It is more realistic to understand that these systems would provide a doctor with an ecosystem to do what he does the best, care for the patient. He would be relieved by what is often described as "scut work" of documentation and analyses of reams of reports. (7) He would be provided with a concise dashboard of reports supplemented by real time analyses of a patient condition which would make his decision making simpler and more effective and the personalisation of therapy more efficient and predictable. He would be able to take fewer patients in his consulting hours, and each clinical visit with a patient would be a better utilisation of his time and constructive use of his abilities. With the advent of outcome based payments, and the push for better patient reported outcomes on healthcare practices, the ability to curtail costs becomes more and more complex. Efficiency and patient centricity being the essential attributes, achieving cost-accountability and efficiency becomes a difficult target to achieve. Digital medicine makes it possible to carry out Risk Based Monitoring of selected patient populations identified with specific risk factors, to enable early interventions and more predictable outcomes. The patient's involvement in his own health is enhanced. Identification and attention to co-morbidities with the implementation of suitable lifestyle interventions can be prioritised in a phased and efficient manner. In a manner one could say this is an "incentive-based wellness programme." The incentive being the involvement in one's own health and fewer hospital visits with lower health costs. To be able to achieve this one needs tools that are economical and efficient, and easy to use for the physician and the patient. The era of transition of the wearable healthcare monitor to serve as a tool for this purpose has arrived with the adaptation of the mobile phone interface and smartwatches to serve these purposes. A number of tools have been developed to help clinicians predict the hospital stay and the likelihood of early discharge following joint replacement surgery. Other predictive analytic tools predict the postoperative pain and outcomes following joint replacement. Models and algorithms are being developed to determine the need for back surgery and predictors of successful outcome. We can expect these tools to become more refined and useful in the near future with the deployment of better algorithms in the rapidly developing technology sphere.

Zheng et al (8) reported on a novel online decision support system to help patients decide for knee arthroplasty. The tool enabled patients to make an informed, timely and data/evidence driven decision for surgery. The sample was small, but the tool demonstrated easy usability and high satisfaction with no technology blocks amongst the elderly populace. Olzak et al (9) have written about an artificial intelligence-based approach for reading orthopaedic trauma radiographs. The method was found over 99 percent accurate in identifying laterality and body part and over 83 percent accurate in detecting a fracture. Under similar conditions the performance was at par with two senior orthopaedic surgeons. Oh et al used a machine learning method using data from CT scans and clinical data to predict the pathological femoral fractures in patients with lung cancer. Machine learning has been used to optimise implant design (10) A large amount of interest is being created in the orthopaedic community about the application of machine learning and cognitive computing in our clinical practices. The Journal of Arthroplasty has dedicated two recent issues to technology. Stefano Bini has written an excellent review on the impact of machine learning, deep learning and cognitive computing on healthcare delivery. He has summarised beautifully that AI may be at the peak of the Gartner Hype Cycle but is unlikely to fall deep into the trough of disillusionment before coming out into enlightenment and productivity. He predicts that AI for predictive analytics and cognitive computing is going to be the new "normal".(11) O'Donnell writes of three ways to bring augmented intelligence to the life sciences. (12) These include a sense of purpose, transparency and skill. She states that the industry suffers from a sense of information overload and that AI and cognitive capabilities would bring insights in front to enable value-based decisions. She also points out the need for a collaborative effort to use technology to help humans deliver and receive better care. This would involve training not only the system but also the user. (12)

Digital medicine is here to stay, and the future belongs to those who are willing to adapt to the change, to those who will collaborate in making this evolutionary change in the way healthcare is delivered, received and interpreted.

Acknowledgements

I would like to acknowledge the active insights and inputs of my colleague Dr Sanjay M Kimbahune, Senior Scientist, Embedded Systems and Robotics, Tata Consultancy Services , Mumbai, in preparation of this manuscript.

References

1. Poduval M, Poduval J., (2008), Medicine as a Corporate Enterprise: A Welcome Step? In: Medicine, Mental Health, Science, Religion, and Well-being (A.R. Singh and S.A. Singh eds.), MSM, 6, Jan - Dec 2008, p157-174.
2. Elton J, Ural A. "Predictive Medicine Depends On Analytics." Harvard Business Review. (2014) Oct 14;:1–4. Available from: https://hbr.org/2014/10/predictivemedicine- depends-on-analytics . Accessed on July 24 2018.
3 Fraser H, Kwon Y, Neuer M. "The future of connected health devices". IBM Global Business Services Executive Report. 2011 Mar pp. 1–20. Available from: https:// www-935.ibm.com/services/us/gbs/thoughtleadership/ibv-connected-healthdevices. html . Accessed 24 July 2018.
4. http://www.digitalindia.gov.in/rural accessed on 30.07.2018
5. Schaffer JL,Rasmussen PA, Faiman MR. The Emergence of Distance Health Technologies. J Arthroplasty.; 2018 Aug 1;33(8):2345–51.
6. Woodson J., "Decades Ago, Pilots Learned to "Fly by Instruments." Doctors need to do the same". Harvard Business Review (2018) Mar 15;:1–5. Available from:

https://hbr.org/2018/03/decades-ago-pilots-learned-to-fly-by-instruments-doctorsneed- to- do-the-same accessed 24.07.2018

7. BUSH J. "How AI Is Taking the Scut Work Out of Health Care" Harvard Business Review (2018) Mar 5;:1–4. Available from: https://hbr.org/2018/03/how-ai-is- takingthe-

scut-work-out-of-health-care

8. Zheng, H., Rosal, M. C., Li, W., Borg, A., Yang, W., Ayers, D. C., & Franklin, P. D. (2018). A Web-Based Treatment Decision Support Tool for Patients With Advanced Knee Arthritis: Evaluation of User Interface and Content Design. JMIR Human Factors, 5(2), e17.
9. Olczak, J., Fahlberg, N., Maki, A., Razavian, A. S., Jilert, A., Stark, A., … Gordon, M. (2017). Artificial intelligence for analyzing orthopedic trauma radiographs: Deep learning algorithms—are they on par with humans for diagnosing fractures? Acta Orthopaedica, 88(6), 581–586.
10. Cilla M, Borgiani E, Martınez J, Duda GN, Checa S (2017) Machine learning techniques for the optimization of joint replacements: Application to a short-stem hip implant. PLoS ONE 12(9): e0183755.

11) Bini, Stefano A. : Artificial Intelligence, Machine Learning, Deep Learning, and Cognitive Computing: What Do These Terms Mean and How Will They Impact Health Care? The Journal of Arthroplasty , 33(8), 2358 - 2361.

12. O'Donnell L, Three Principles to bring augmented intelligence to life sciences ; Watson Health Perspectives , available at https://www.ibm.com/blogs/watson-health/three-principles-for-bringing-ai-to-life-sciences/ accessed 24/08/2018

Conflict of Interest: NIL
Source of Support: NIL

How to Cite this Article

Poduval M. Digitisation of medicine: A welcome step? Journal of Clinical Orthopaedics Jan -June 2018; 3(1):2-4