



Chaim Lotan

The future of digital health

Digital technology is rapidly advancing and affects almost every aspect of our lives, including how we, and physicians, manage our healthcare. These advances bring many benefits, from the ability to more closely monitor patients with particular medical needs, to more efficient or convenient consultations with physicians and specialists. However, the development of huge numbers of new healthcare devices, applications and systems brings with it vast quantities of data, which raises many questions and challenges that will need to be answered. *Confluence* spoke with Professor Chaim Lotan, Director of the Heart Institute, Hadassah-Hebrew University Medical Centre, to discuss these issues and what digital technology means for the future of medicine.



How would you define digital health?

Chaim Lotan (CL): It is actually very hard to define digital health, because it is an evolving topic encompassing the interaction between big data from many sources, and the use of new tools via the internet and cellular phones etc. This totally changes the classic doctor–patient relationship, leading to an entirely new way of practicing medicine.

We are right at the very beginning of a revolution. On one hand, the more we dig into digital health, the more potential we see. On the other hand, there are numerous unresolved issues that need to be addressed. The digital health revolution started with telemedicine – using telecommunication and information technologies to enable remote healthcare delivery. Today, with the internet dominating our lives, digital health means that the wellbeing of the patients is not only the domain of physicians, but it is accessible to everyone, and primarily to patients themselves. Sometimes the patient does not have to come into the clinic, they

can talk to the doctor over the phone or send pictures, they can get a prescription sent over the internet to the pharmacy, and then get the pharmacy to send it to their home, so the patient can get the entire circle of care without ever being physically seen by the physician.

I see the digital revolution on a daily basis. For example, if the Fellow has a problematic ECG at night in the cath lab, he takes a picture and within a second, using WhatsApp, I can see it from home and help him. The entire way of practising medicine today is changing.

It is also changing physicians' relationship with industry. Traditionally at scientific meetings we would have attendees from companies such as Medtronic, Boston Scientific and Abbott. However, today when you have a meeting in the cardiology world and you also have Yahoo, Google, Samsung and Qualcomm as attendees, because healthcare – and life – is becoming so linked together. The social network companies, the big data companies, the drug companies and the device companies are all starting to work together to realise the potential of digital healthcare.

Do you think that this availability of information makes things easier or more difficult for physicians?

CL: It can make things both easier and more challenging. For example, the other day I saw a lady who asked about a rare condition called postpartum cardiomyopathy, where women get dilatation of the heart and weakening of the

fig. 1

Examples of monitoring devices.

A) CareLink® remote monitoring network

B) Reveal LINQ™ insertable cardiac monitoring system

heart muscles immediately after labour. She had it several years ago and came to consult about a second pregnancy. It is a very rare disease and I would see such a patient maybe once every year or two – it is certainly not a condition one reads about on a daily basis. This patient was asking me questions based on the most recent literature about the disease, and she actually knew much more about it than I ever will know, so I was kind of embarrassed. On the one hand, she had the publications, however, she didn't have knowledge to analyse and interpret the data, which means that a totally new type of patient/physician interaction is required.

Patients know about their own health, sometimes even better than physicians, because they have access to so much information. Patients can read about their disease and know as much as their physician knows, so the role of controlling the disease is moving from the doctor to the patient. However, the challenge here is that having access to the information is not the same as being able to understand what it means. This means that the communication between the physician and the patient is also changing.

Are there any wearable devices or smartphone applications that can help with patient care?

CL: There are about 200,000 health applications today and a high volume of applications being developed. Applications started from the wellness side and then we were flooded with wearable devices that could monitor everything in your life: blood pressure, heart rate, temperature, oxygen saturation (figure 1). The question we need to answer is, how do you consolidate all of this information? Patient data previously came from hospitals, but with digital technology we can now get data on patients during their normal daily life, and this might shed light on how problems develop. We may be able to identify warning signs that tell us that something is wrong earlier on, and that the patient needs to go to the hospital. Previously, we didn't have this type of data because there was no way to collect it at home.

I have a very good friend who starts his talks on the digital world by showing that about 1.2 billion people in the world have a toothbrush, but 1.5 billion people have an advanced cell phone. This widespread access to smartphones



A



B

means that your ability to deliver healthcare is much better. There are start-up companies trying to show that smartphone applications can improve patient compliance, for example in the elderly population who don't remember if they took their pills or not, or what type of pill they should be taking. An application was developed at the Mayo Clinic to remind patients about their medication. Today in cardiology, one of the most important reasons for readmission of patients to the hospital is heart failure. Many hospitals are researching how to monitor the patient at home to prevent readmission, and one way to do this is by implanting sensors under the patient's skin. CardioMEMS (St Jude, Saint Paul, MN, USA) is a system in which a very small device is implanted in the pulmonary artery to measure the pulmonary pressure. It can detect when a patient goes into heart failure, as the pressure increases, and this is transmitted via telephone to their physician. Another company wants to put sensors that can detect flow on coronary stents that are implanted to open the artery. If a noticeable reduction in flow is detected, it will be transmitted via cell phone and could alert the doctor and the patient that there may be restenosis.

The world of sensors is very big. Sensors can be very small, and range from very simple to very sophisticated. Using a smartphone with a camera and a very powerful microphone, you can monitor many things. For example, patients have very slight variability in heart rate that needs to be mathematically analysed to detect the variation.

The variations are related to the status of the patient, sympathetic activation, mood, etc. Heart rate variability could predict changes in mood or stress and, for example, this could be an indicator of a diabetic patient whose glucose levels are not well-controlled.

In terms of development of the actual tools, the software, the devices, will this be driven predominantly by first world nations, or is it accessible to poorer nations too?

CL: I think that every country will be able to develop applications. You just need smart guys and an unmet need, and that is it. Applications can range from very easy, to very complicated. Each region in the world has their own problems and their own unmet needs, so they will be able to meet their own needs in their own countries and regions.

For example, China is one of the countries where, in the villages, there are more patients with cell phones than with toothbrushes, and they are now trying to build a network of better health using digital technologies. A colleague of mine told me that they are looking at using digital technology to bring them all the data before the consultation, some from the hospital records and some provided from the patient via their cell phone. The challenge for the doctor is how to integrate all of these data and analyse them in the approximately 8 minutes that are available per consultation.

You've mentioned that with all of these new technologies, there is a tremendous amount of data being generated. Are there any challenges associated with having access to this level of data about individual patients?

CL: How to control the data is a big issue, not only for the patient and the physician, but also the insurance companies, Health Maintenance Organisations (HMO) and governments. At the recent Innovations in Cardiovascular Interventions (ICI) meeting held in Israel, we had a long day focused on digital health, including how to handle so much data. How do you capture it? How do you analyse it? How do you bring it to the patient in a useful format? How do you bring it to the physician in such a way that he knows what is normal and what is it abnormal?

Moreover, cybersecurity is an important but underdeveloped topic in all domains of medicine at present. Today, you can monitor patients who have pacemakers without the patient coming to the hospital. You can check the pacemaker via the telephone, and adjust it if the parameters require changing. Still, I see patients coming to the clinic, usually very elderly patients who have to come with their children or their carers. When you consider why these patients are still coming to clinic, there are two issues. One is cybersecurity: for example, when it is possible to adjust a device's parameters over the internet, there is a possibility that hackers will also be able to change these – and if a patient has an implantable cardioverter-defibrillator, they could even kill the patient. The second thing is reimbursement models. Who pays for consultations that are carried out digitally? In the old model, you sold the device, the hospital paid and that was it. Now we need a total reimbursement model. Will the hospital/ patient/ HMO pay if you can show them that they save money? Who is responsible for it? I know that a lot of people are trying to build new reimbursement models for the digital age.

Another issue that we haven't yet mentioned is regulation. Even the US Food and Drug Administration (FDA) does not know how to cope with digital health today in regulatory terms. With any device there is a very precise regulatory pathway, that of both the FDA and the CE. Digital regulation is still in its infancy and there are many unanswered questions, such as who is responsible (the patient, the application, the regulator, the HMO)? When do you need regulation? When don't you need the regulation?

What about data protection issues? Who does and who should have the right to look at patients' data?

CL: Indeed, who owns the data? Is it the patient or the HMO? Are insurance companies entitled to look at it? How do you protect the patient's data? We recently learnt about a 15-year-old girl who consulted a physician via the internet for birth control pills, and the next day her father could open her file and see that she has been prescribed birth control pills, without his knowledge. How do you allow one person (the patient) to access the information while protecting it from a second person (the father)?

Also, how do you prevent hackers from accessing the data? Insurance companies would pay a lot of money to access some patient data if it points to risk factors for particular conditions. On the other hand, if an insurance company was aware that you are a compliant patient who takes your medication as prescribed and we see, for example, that your blood pressure is well-controlled, maybe you should get the medication for free, because it means that you will be less likely to be hospitalised again. Patients can be incentivised or penalised by insurance companies on the basis of such data. There are a lot of small ethical questions that are still unsolved with the entire transition to digital health.

Do you think that the changes are going to happen gradually over time, or will we see bouts of revolutions following technological advances?

CL: This is a huge revolution and I think it will be quick, but there will be hurdles. First of all, considerable amounts of money are going into digital, and the number of applications and start-ups in the field is huge. In the last year, in Israel alone, which is a relatively small country, we had about 450 digital health start-ups.

The second point is that every year there is a new iPhone and new Android phones; it is a revolution but we don't feel it because we are in the midst of it. Think back to what we had 10 years ago compared with what we have now, and then think about what we will have in 10 years from now with digital. We are going to practise a totally different kind of medicine in all fields, and cardiology will be very much affected.

As I have already mentioned, however, there are a lot of issues that I am sure will be resolved over the next few years: regulation, cybersecurity, data ownership, rights of access to data. All of this needs to be resolved, and during this process all of those questions will have to be answered.

Are there any aspects of medicine that are particularly resistant to digital technology? Do you think there needs to be a change in mind-set or are people willing to embrace it readily?

CL: I don't think any part of medicine will be able to avoid digital technology and this will start right from the medical schools and continue throughout practise. A lot of education in the medical schools

is very much affected by digital technologies and applications. People will say "Well, surgeons will do the same surgery", but this is not true. They will use things like Google Glass, through which they will be able to access all the data on the glasses and have access to a huge electronic library. This will give them the ability to adapt what they decide to do next. Today surgeons can operate from another room using a robotic system, but in the future, this may be possible even more remotely if there is a stable network. You can compare it to the laparoscopic revolution, where surgeons went from carrying out open abdominal surgery to the minimally invasive techniques. The digital health revolution will be the same and will affect every area of medicine, and definitely cardiology.

For the older generation, my generation, it will take time to adopt these new digital technologies, but it will be much easier for young people who are exposed early to social networks and to the web. For example, in a recent competition at Beersheba University about digital health platforms for medical students, about 20 ideas for start-ups that can improve education in medical schools were submitted – all of them were applications. Moreover, today, with the help of computers and digital applications, you can visualise things on your iPad, and the way that teaching is done is totally different. Like the interaction with patients, medicine will be taught on a different level and in a different way.

Do you think that anything is lost by not actually seeing the patient and not having that personal interaction with them?

CL: One of the most important questions is "What is the importance of the patient/doctor relationship?" Going back 10–15 years, a patient visiting their GP with shortness of breath would be referred to many sub-specialists: a cardiologist, a physiologist, a pulmonologist, but the patient would come and say "I lost touch among all the sub-specialists" I remember at that time we had a lot of debate; on the one hand, you need the sub-specialist expertise, but on the other hand, you need a physician who can integrate everything and offer the personal touch, i.e. a GP. The relationship between physicians and patients is a very important relationship and I think we will definitely lose something if we don't retain it.

The other element is that patients are receiving a better and a higher level of medicine, more quickly, which is what a lot of people want today. If you are a mother and your baby is crying at 2 am, there are two options. You can go to the Emergency Room, wait to be checked by an ENT to find that the baby has otitis media, then run to the pharmacy for antibiotics. Or you can send a picture – today there is a little device that connects to a cell phone and takes a picture of the eardrum – and send it to the physician, and then if you need something, it can be sent from the pharmacy to your home. Wouldn't you prefer the second option?

We will need a balance between those two. There are always pros and cons in each revolution, but I believe that the digital revolution is inevitable, and we will see how we find the balance between the role of the physicians and the use of technologies.

What do you think is the most important thing for readers to know about digital health in the future within interventional cardiology?

CL: That is a tough question, but I think that technology will allow earlier analysis and follow-up of patients. Digital health may actually allow better communication with patients because, rather than only seeing a patient every 3, 6 or 12 months in person, with digital, you may not see them physically, but you will have some form of interaction – a way to reach the patient

and for the patient reach you – before, during and after the procedure.

The entire planning of the procedure in the digital world will be different. We are going to do a valve-in-valve procedure later today, on a very complex patient. We did a CT scan and then we had three-dimensional printing of their entire heart. This is another powerful tool in digital health. Using a 3D printing device you can simulate whatever procedure you are planning to do on the patient before you actually work on the patient's heart. The 3D print exactly replicates the patient's problem, so that when you come to operate on the patient, everything has been tried. You can have all the digital data, and also a 3D print of the device which allows you to visualise the solution.

Digital health will help us to monitor the patient better before the procedure, help us prepare better during the procedure, and help us monitor the patient after the procedure.

Medicine will change significantly in the next 10 years as a result of all the changes in the digital world, and each one of us will give his own share and contribution. I think that we are in the midst of a very big revolution, and there are many, many questions that will need to be answered in the next few years in order really to change the entire way that medicine is practised today.

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DISCLOSURES: None.
