



Healthcare 4.0: How big data and IoT can bring big gains to our wellbeing

The Fourth Industrial Revolution, otherwise known as Industry 4.0, is upon us, and with this, infinite possibilities.

Through the automation of certain tasks using smart digital technology, the incorporation of Internet of Things devices and technologies like cloud and fog computing, machine learning and big data, the possibilities to improve efficiency, accuracy and safety in multiple sectors is infinite.

In the current global context, nowhere has there been greater urgency to rapidly digitally transform than in the healthcare sector. What trends can we expect from healthcare 4.0 in the future and how will they lead to improved care?

Telemedicine: the new normal

Among the most obvious trends in tele-medicine, we have been witnessing an acceleration in the use of remote medical appointments, via video conferencing software, to avoid physically going to a hospital.

IoT devices have been used for many years in the medical context in areas such as neuromonitoring, blood glucose monitoring, cardiac monitoring, fetal & neonatal care monitoring and respiratory care. In addition, with the increasing popularity of consumer IoT devices like fitness trackers, there is enormous scope for analyzing patient-generated data. This means more remote patient monitoring and preventative medical care.

The [Patient Monitoring Devices Global market study](#) by Research and Markets has predicted that the global market for portable and remote patient monitoring devices will grow steadily to reach US\$43bn in 2027.

According to the [American Hospital Association](#), 53% of US hospitals already have a remote patient monitoring system and at least 76% of North American patients connect with doctors via videoconferencing.

The devices themselves just collect the data. The next step is to transfer that data securely to data centers or remote servers where it can be processed by analytics tools and decisions can be made.

The benefits of IoT

The use of the internet of things devices (IoT) can bring multiple benefits for patients, doctors, hospitals and even insurance companies.

Patients

For patients the use of remote monitoring devices means more personalized, timely and effective treatment and doctors can take more accurate, evidence-based decisions. Continuous monitoring from home leads to faster diagnosis. Patients can also take a more proactive role in preventative treatment.

This can result in cost savings with more infrequent doctor's visits, shorter hospital stays and fewer readmissions.

Wireless devices can monitor vital measurements such as blood pressure, heart rates and glucose levels but also provide useful alerts for taking medication, doing exercise and attending medical appointments.

They are particularly useful for the elderly or people living alone or in remote locations.

An example of an IoT device for complementing treatment of asthmatics is the Respiro smart inhaler made by Amiko. ARM-based Cortex-M processors allow the capture of air flow and inhalation volume on inhalers and can alert doctors to potential problems.

But this is just the tip of the iceberg. Disposable skin patches, contact lenses, implantable devices and even tiny cameras and nanobots that can be swallowed as pills are all on the horizon.

Doctors

Physicians can use the data collected from IoT devices to identify the best course of treatment and predict their outcomes.

Real-time remote monitoring of a patient's vital signs on the way to a hospital can also provide emergency staff with essential information to be better prepared for when the patient arrives.

Hospitals

Hospitals also benefit from IoT. Sensor tagging can be used for real-time tracking of medical equipment such as defibrillators, oxygen pumps or even wheelchairs. They can also analyze staff performance data and strategically deploy staff at different locations where they are most needed.

Monitoring devices can be used to help prevent infections and for controlling pharmaceutical inventory. Smart fridges can check temperature for the correct storage of critical vaccines. Other devices can monitor potential power outages and system failures.

Robotic-assisted surgeries are also becoming more commonplace and can improve precision in the operating theater as well as be used for carrying out life-saving surgery remotely.

All of this can improve the efficient use of resources and save costs.

Insurance companies

There can also be benefits in health monitoring for insurance companies. Data capture can add transparency between insurers and customers in underwriting, pricing, claims handling, and risk assessment processing.

Insurers could also offer incentives of lower premiums to customers that agree to use IoT-enabled devices.

Fog Computing

But how do we connect these devices and take advantage of the data?

To provide real-time analytics of patient-generated data, healthcare organizations often use cloud solutions as the storage layer between the device and the analytics engine that provides the insight.

Uploading data to the cloud can take seconds or even minutes depending on the connection and distance from the source. But some critical patients can't wait that long.

For that reason, there is fog, or edge, computing, which adds an additional layer of computing power between the device and cloud. Individual devices become processing nodes that can handle smaller, time-sensitive tasks without having to send all their data up to the cloud.

The benefits include maximizing big data analytics resources by keeping some tasks out of the main cloud data storage queue and allowing them to be completed more quickly. Not every piece of data is critical and needs to be moved to the cloud, and other data can wait to be moved and stored later.

Fog computing enables devices to perform tasks where there is low, or unreliable, bandwidth, for example patient monitoring in rural areas.

Additionally, it could connect through LoRa (Long Range Radio) networks that are mainly targeted for M2M and IoT devices.

Fog computing is not a replacement but a complement to the cloud, designed to allow patients to stay connected with their doctors.

Smartphones are increasingly becoming useful as fog computing devices. They may not store any of the patient data itself, but can allow a user to modify information held at a central location.

IoT interface devices that allow permissions-based access to electronic medical records could connect pharmacies, payers, hospitals and specialists without the need to transmit a new iteration of the health record every time one entity wishes to make a change.

The collaborative edge ecosystem could take advantage of the security and data integrity of blockchain technology to ensure that users are accessing the same up-to-date information.

This could improve accountability and make it easier to share data and connect stakeholders in a cost-effective manner.

To trust or not to trust

Of course, there are challenges for digital health.

Smartphones aside, most IoT devices are still expensive, which is a current limit to their widespread use. However, as adoption increases, costs will come down.

There are also issues such as trusting in technology and automating potentially critical decision-making. Machines are only as good as the data they receive and don't take into account human variables.

That said, there may be pressure from the commercial side of the business to automate more routine checks, meaning that healthcare centers could multiply many times the number of patients they attend to.

With advances in machine learning, computers will be able to learn to compensate for, or detect, missing data and adjust accordingly. In the long-term it is probably inevitable that many routine tasks will be replaced by machines.

Security

To fully leverage the potential of tele-medicine will require greater data sharing amongst physicians and hospitals. If a patient with a heart problem has a problem when on vacation in another state, rapid access to their clinical history could mean the difference between life and death. The same goes for collaboration to find vaccines and cures for complex medical conditions.

But as more data is shared online, the more potential there is for cyber-attacks, hacking and the misuse of that data. Many people still feel uncomfortable with their data being shared.

Hacking of medical data can also be quite low-tech. There have also been cases of Covid-19 vaccine deniers signing up for a vaccination and then not showing up, just to disrupt and slow down the vaccination effort. Social networks are also being used to disseminate fake news about vaccines, the use of masks etc.

There are other obstacles such as bureaucracy or regulation that prevent the sharing of data amongst doctors or clinics, and standardized formats for sharing digital data, but those issues exceed the scope of this article.

The future

What is certain is that big changes are coming for healthcare.

Covid-19 has left its mark in a number of ways regarding our health. Over the last year, people have become accustomed to communicating with their doctors via video conferencing and are realizing the time they can save by not having to visit a clinic as well as the benefits of keeping in regular contact with their doctors.

During lockdown, people became more aware of best practices in hygiene to avoid infections and of the importance of doing regular exercise and using fitness trackers.

Smart devices are only going to get smarter, incorporating technologies like AI, machine learning, and analytics. This will improve the accuracy of treatment and encourage people to be more proactive in taking care of themselves. In summary, technology can help us improve healthcare. But most importantly, what is changing is our acceptance of that technology and willingness to adapt.

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