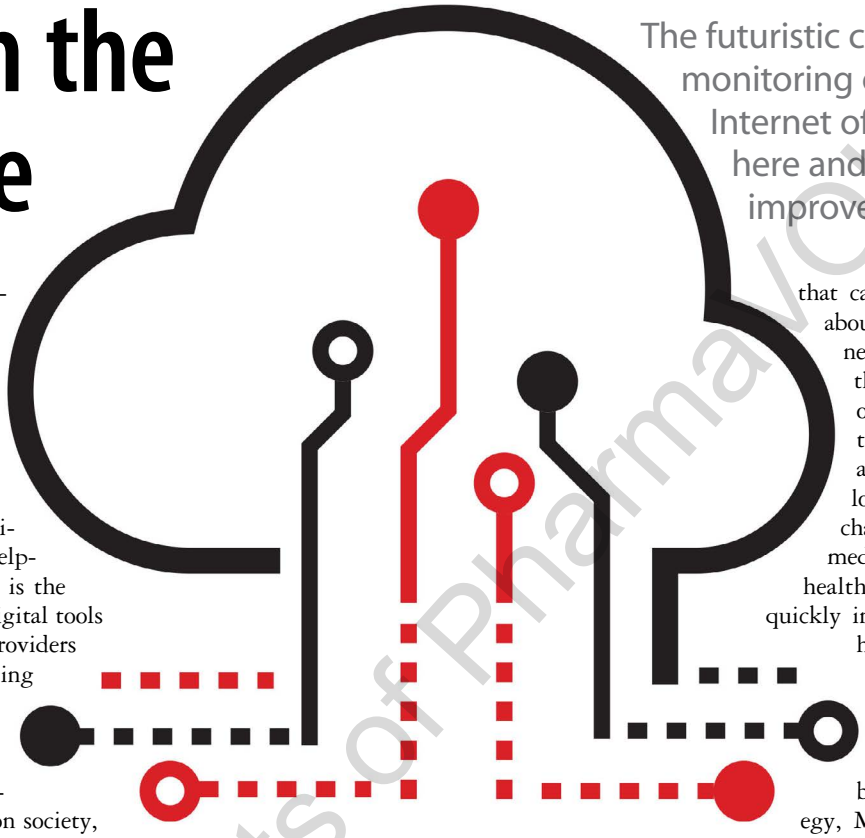
by Kim Ribbink

Putting Healthcare IoT in the Home

The futuristic concept of remote monitoring of patients using the Internet of Things is already here and being used to improve health outcomes.



Digitization has become a reality in healthcare, and it's helping to drive more patient choice, including the ability to manage patient health from the home. Wearable devices and telemedicine allow for remote patient monitoring. But perhaps key to helping care for patients at home is the Internet of Things (IoT) — digital tools that enable patients and providers to stay connected by exchanging data in a variety of ways.

The International Telecommunication Union (ITU) has defined IoT as a "global infrastructure for the information society, enabling advanced services by interconnecting (physical and virtual) things based on existing and evolving interoperable information and communication technologies."

In 2015 there were 15 billion connected devices and by 2020, Stanford predicts there will be 50 billion.

"Moore's Law on size, cost, and performance improvements means that we will soon be enveloped in non-invasive sensors that register our movements and biometric data," says David Ormesher, CEO of closerlook.

"While these tools may have felt futuristic a few years ago, today many of these devices are readily available, affordable, and being covered by payers," says Kathi Henson, chief operating officer, patient services, and chief patient officer, Eversana.

However, success at realizing widespread home healthcare powered by IoT requires a combination of advanced technologies and experienced resources.

"An IoT powered home has smart sensors that can be installed to collect data about the patient, a high speed network infrastructure to take the data from these sensors and other remote diagnostic devices to a central monitoring unit, AI algorithms that are constantly looking at the data to detect changes in patterns that will need medical interventions, and finally healthcare professionals who can quickly intervene to help diagnose and help the patient," says Nagaraja Srivatsan, chief digital officer, R&D Solutions at IQVIA.

According to Daniel Carchedi, senior director, business development and strategy, Microsoft, the intelligent edge — where analysis of data and development of solutions takes place at the site where data is generated — with the power of the intelligent cloud, will transform the way people interact with digital information and further blend the physical and digital worlds for greater societal benefit and innovation.

"The edge, powered by the cloud, enables us to evolve the notion that the 'world is a computer' such that we are beginning to interact with computers in a way that doesn't feel like computing at all," he says.

Home healthcare through IoT will absolutely reduce the cost associated with healthcare without compromising the quality of care, thus helping patients reduce their insurance premiums.

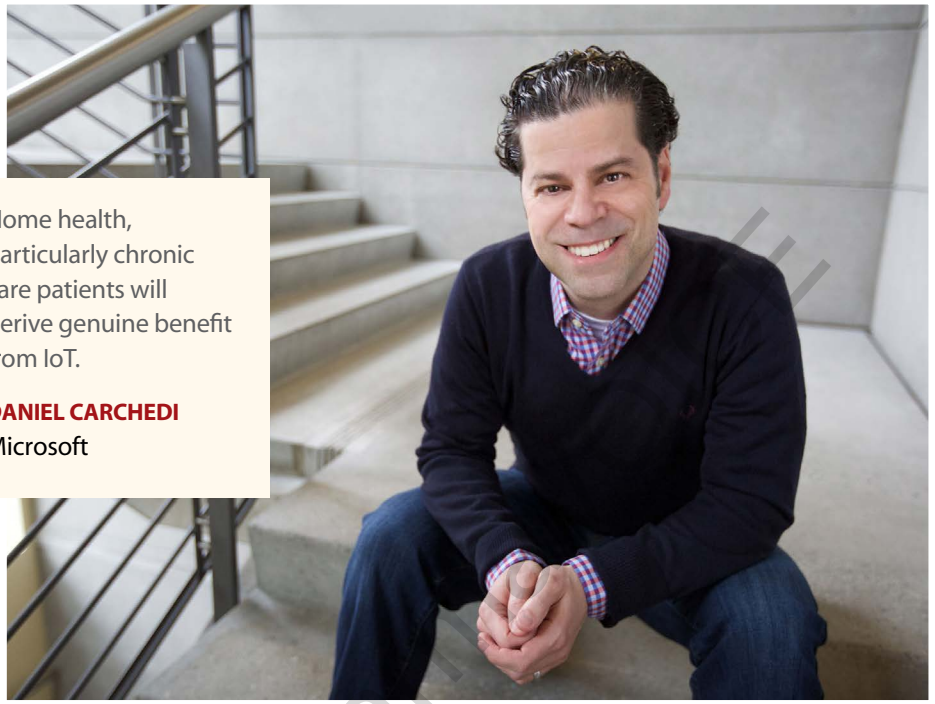
NAGARAJA SRIVATSAN
IQVIA

IoT could also be incredibly useful through the drug development and commercialization process.

LAURA WILSON
Fingerpaint

At some point there may be a place for the IoT, but it would seem we should first prove the value of IoT in areas other than healthcare.

DR. REBECCA KUSH
Elligo Health Research



Home health, particularly chronic care patients will derive genuine benefit from IoT.

DANIEL CARCHEDI
Microsoft

IoT can help solve a number of challenges for the healthcare industry and ultimately provide better care and lower costs and optimize ways to enhance patient engagement.

JOSH ROSE
IQVIA

The Benefits of IoT

The answer to spiraling healthcare costs is proactive disease management at home, says Thomas Dudnyk, president of VIVO Agency.

Ms. Henson says IoT tools not only allow healthcare providers to monitor patients from home in real time, but most crucially allow for early intervention.

"These tools give patients improved access to education about their health condition, including information to help them take earlier action to prevent progression of their conditions, while allowing them to remain independent in the home setting," she says.

Such oversight — in real time and around the clock — creates huge possibilities for patients with chronic disease as well as those trying to stay healthy, says Laura Wilson, patient strategy, Fingerpaint.

IoT also gives clinicians far more insight than they would gather during a visit, or as Dan Chichester, chief experience officer at Ogilvy Health, puts it "three data points at a visit become hundreds of bytes of data every day."

From progressive labs brought to patients' homes to connected therapies, such as sleep apnea devices, glucometers, insulin pens, weight scales, and non-invasive ventilators, that send information to remote teams alerting them when patients need intervention, IoT can change healthcare, Mr. Dudnyk believes.

"By identifying patients trending toward an exacerbation, we can help avoid costly and uncomfortable ED and hospital admissions," he says. "Wearables, online coaching, and telemedicine services can also drive healthier living and behavior modification. Many of these tools are here right now. In five years, they will form the foundation of outpatient care nationwide."

Mr. Carchedi highlights the technology breakthroughs that have the potential to improve quality of care: push button and speech enablement tools that send out emergency alerts, fitness bands or watches taking vital data from the body throughout the day and transmitting wirelessly in real time.

"These platforms will allow interoperability with a variety of medical devices and apps which are natively available and which generate enormous amounts of data that will help the healthcare industry and let patients live healthier lives," he says.

Deborah Lotterman, chief creative officer at precisioneffect, says IoT will be powering home healthcare, and people will be healthier for it. "From the moment we awake, the sensors that have been monitoring our sleep will offer recommendations for the day ahead," she says. "Feet will hit a bedside rug that will check skin for signs of a diabetic ulcer. Whether we choose green juice or coffee with 2% milk will be recorded by our smart appliances and the rest of the day's intake calculated. The fantasy just keeps going, as connected sensors record, calculate, and feed into algorithms that advise. But it's not a fantasy. The vision is tantalizingly close: those who are healthy will be able to stay that way longer, those who are ill will be monitored and ministered with changes in medication, diet, and motivation."

One huge advantage of IoT in home healthcare, Mr. Ormesher says, is it shortens the feedback loop through immediate biometric alerts to help people to make more rational choices.

"We learn early to avoid touching a hot stove through the simple but elegant feedback loop of pain," he says. "However, this breaks down when the action and reaction is asyn-

The IoT in Action

The following are examples of how IoT is being put into practice to enable patients to manage their care from home:

CYCORE is a smart monitoring system that helps cancer patients track their symptoms. It includes a Bluetooth-enabled weight scale, blood pressure cuff, and tablet with app for tracking symptoms. Information is sent to physicians, allowing them to make better treatment plans for their patients.

Several examples of continuous glucose monitors are now on the market, allowing diabetes patients to monitor their levels regularly. Examples of smart CGMs include Eversense and Freestyle Libre. The monitors, which are inserted under the skin, can sound an alarm if the glucose level is changing rapidly.

Smart inhalers work by modifying the patient's existing inhaler to register the number of puffs the patient has taken and then sends that information to an app. The app also lets the patient know about air quality and remembers the number of puffs a patient has taken on any day and the conditions on that day.

Ingestible sensors are designed to monitor adherence, enabling patients and their physicians to have more informed discussions. One example of a digital medicine system is Abilify Mycite, from Otsuka Pharmaceutical and Proteus Digital Health, which includes aripiprazole tablets with sensor for the treatment of adults with schizophrenia and bipolar disorder. The system includes the drug, a patch or wearable sensor, a smartphone app, and web-based portals for healthcare providers and caregivers. The system records medication ingestion, collects data on activity level and self-reported rest and mood. With patient consent, the information can be shared with a healthcare provider and care team.

The Kinect HoloLens Assisted Rehabilitation Experience platform lets practitioners create personalized physical therapy programs for patients wherever they are using real-time data feeds. By connecting to Microsoft's Azure IoT Suite, practitioners can see data from a physical therapy session.

chronous, often by years or decades, such as the impact of cigarette smoking."

There's a huge time-saving for patients and caregivers who don't have to spend time traveling to appointments, as well as overall cost-saving from home health IoT, Mr. Srivatsan says.

"Patients benefit by being comfortable in their homes while being cared for, and clinicians can optimize their teams to make sure that the right experts and caregivers are available to intervene," he says. "Home health enabled by IoT can also help increase participation by family members, enabling them to monitor their loved ones and drive better health outcomes."

IoT is still cluttered with latency issues, disconnected services, and a lack of any truly breakthrough players in healthcare.

BRENDAN GALLAGHER
Digitas Health & Publicis Health

According to Josh Rose, VP, R&D, global strategy and head of virtual trials solutions, IQVIA, smart device connectivity — powered by IoT — results in vast amounts of data, which, combined with predictive analytics, can provide much-needed insights on patients who might be at risk for disease.

"Access to data and the ability to properly analyze this data enhances decision-making capabilities for medical teams," Mr. Rose says.

Saving Lives, Treating Patients Faster

The potential for life-saving intervention, treatment of conditions before they become acute, and reduction in unnecessary doctor and emergency room visits are all benefits, Ms. Wilson says.

"Additionally, patients may be able to be released sooner from hospitals and short-term care facilities," she notes.

Bringing IoT into medicine can equal better, safer, simpler patient care, Mr. Chichester says.

"A nursing facility in Brooklyn tracked vital signs and movements via sensors in patient mattresses and pillows," he says. "The ROI on IoT has been a 45% reduction in pa-

THE GLOBAL IOT IN HEALTHCARE MARKET SIZE IS PROJECTED TO REACH $534.3 BILLION BY 2025

Source: Variant Market Research

tient falls, a 60% reduction in bedsores, and an 80% reduction in emergency events."

To deal with the terabytes of data gathered by IoT sensors, companies such as physIQ have developed and commercialized FDA-cleared AI products for ingesting, classifying, and analyzing this level of real-time, continuous data on an individual level.

"PhysIQ creates a personalized baseline of normal and alerts providers when a patient's condition is deteriorating," Mr. Ormesher says. "The platform is already being used for remote patient monitoring and clinical trials."

In clinical research, connected devices can improve studies beyond automating remote data collection, Mr. Rose says.

"For example, continuous temperature sensors can alert to the onset of flu, a study endpoint that is often elusive and that can increase the cost and length of a study if insufficiently identified," he says. "Smart phones equipped with AI-driven algorithms can continuously and passively monitor to detect cough, a critical endpoint in respiratory studies."

There is also potential to leverage IoT for adherence once a medication is prescribed.

"Patients and their care partners can receive reminders and dosing advice, check-ins by providers and pharmacists, and trackers can even let the care team know whether medication has been taken," Ms. Wilson says.

Despite the potential, Ms. Lotterman says IoT only lives up to its promise when the technology is available to all.

Risks Assessed

The potential to use IoT to achieve better, safer, simpler patient care aside, Mr. Chichester warns it can also be a data privacy code blue.

"IoT devices across categories have shipped with terrible security," he says. "As this technology enters more into medicine, the benefits must be weighed against significant questions about health confidentiality, even device hacking."

Many of the tools that will enable healthier living, lower the cost of care, and create greater access are here right now.

THOMAS DUDNYK
VIVO Agency

IoT will benefit patient care in two ways: it will reactivate the feedback loop and it will allow for safer home care.

DAVID ORMESHER
closerlook

IoT will absolutely be powering our home healthcare, and we'll be healthier for it.

DEBORAH LOTTERMAN
precisioneffect

Rebecca Kush, Ph.D., chief scientific officer at Elligo Health Research, warns of medical insurance-related concerns about turning home healthcare over to an IoT solution, especially if one were to try to use the IoT in clinical research.

"There are a number of potential home healthcare solutions that could and are being tested as initial opportunities, without yet placing trust in an entire interconnected set of services and tools," Dr. Kush says. "These opportunities include telehealth along with mobile devices, applications, and basic reminders; these could be done as options within decentralized clinical trials. At some point there may be a place for the IoT, but it would seem we should first prove the value of the IoT in areas other than healthcare."

Brendan Gallagher, chief connected health officer at Digitas Health & Publicis Health agrees that thought still hasn't really been given to the impact IoT in the home may have or the rules around who has access to that data and for what purpose.

Latency issues and disconnected services are other problems, Mr. Gallagher says.

"For the most part IoT hasn't turned our homes into Wellness Centers yet," Mr. Gallagher says. "But with 5G on the horizon, emerging voice technology, the system looking to cut costs dramatically, and some of the largest telecoms and tech companies in the world all investing in massive healthcare initiatives, we could see a rapid shift in the IoT home healthcare space."

Mr. Chichester believes the countermeasure to concerns over IoT would be a shift in intent: to treat human beings as things good at sensing, and not things there to be sensed.

"Each patient would benefit from being in charge of her or his data collected: not the device manufacturer seeking a free license on medical telemetry," he says. "In the words of future-thinker Cory Doctorow, 'treating humans as something more than a data-point, but as something with native intelligence, personal worth, and dignity, opens up world-changing possibilities." PV

Bringing IoT into medicine can equal better, safer, simpler patient care. It can also be a data privacy code blue.

DAN CHICHESTER
Ogilvy Health