By Robin Robinson

THE INTERNET of THINGS:
BEYOND HYPE
AND INTO REALITY

IoT discussions often focus on futuristic gizmos, but pharma partnerships with technology companies indicate adoption is getting real.

Still high from the excitement of the hundreds of innovative and extreme IoT gadgets featured at the International Consumer Electronic show held in Las Vegas every year, healthcare thought leaders are buzzing with the plethora of healthcare opportunities presented by biosensing technology and remote monitoring. Under that current of consumer wearable, patchable, digestible hoop-la however, there is a very serious movement in the life-sciences industry as it tries to determine the role of IoT. The Internet of Things is seen as a way to connect everyday objects and networks, allowing them to send and receive data.

To that end, in just the past year, there has been a dramatic lift in partnerships between life-science and technology companies, such as Google X, Calico, MC10, and Qualcomm. Six of the more recent joint ventures seeking to connect with IoT include AbbVie, Biogen Idec, Novartis, Roche, and UCB.

Technology company MC10 and UCB are partnering to develop MC10's Biostamp platform for patient-focused disease management solutions. The collaboration will integrate MC10's sensing platform with UCB's pharmaceutical products.

AbbVie and Calico Life Sciences (a Google-founded research and development company focused on aging) are collaborating to discover, develop, and bring to market new

FAST FACT

EXPERTS ESTIMATE THERE ARE 25 BILLION CONNECTED DEVICES IN USE THIS YEAR, AND BY 2020, THERE WILL BE 50 BILLION.

therapies for patients with age-related diseases, including neurodegeneration and cancer.

Roche and Qualcomm are teaming up to develop a next-generation remote patient monitoring system using Qualcomm's 2net platform to collect data from patient medical devices and wirelessly send the information back to cloud-based back-end services.

Novartis has also teamed up with Qualcomm on a joint investment of $100 million to fund early-stage companies that offer technologies, products, or services to benefit physicians and patients.

Also, Novartis' eye care division Alcon is partnering with Google X (Google's innovation lab) to in-license its smart lens technology for all ocular medical uses. Alcon will develop and commercialize Google's smart lens technology.

Biogen Idec and Google X have joined efforts to see why MS progresses differently from patient to patient. Using sensors, software, and data analysis tools, the companies will collect and sift through data from people with MS.

These partnerships and investments demonstrate that the industry is tapping into the capabilities and opportunities of IoT, particularly to enhance patient care.

"Seeing relationships like Google and Novartis and MC10 and UCB arising is a sign that the industry is developing new ways of looking at health, medicine, and wellness," says John Nosta, president, NostaLab. "It will be the nature of these relationships that begin to tease out some of the newer advances we will see in the future."

Pharma's growing interest in IoT is being driven by consumer demand and innovative companies outside the industry that are creating a marketplace that pharma needs to follow. Consumers are increasingly using smartphone-connected mobile sensing systems, such as wearable vital sign monitors and activity trackers, and innovative technology organizations are investing in sensors.

According to ON World, of all the verticals in the IoT market, the multi-trillion dollar healthcare market has the largest total potential payoff.

Start-up companies with wearable sensor innovations have raised more than $1 billion

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in venture funding and the majority of these companies are targeting healthcare.

According to PwC, the increase in investment of sensors indicates that the IoT movement is under way, as sensors are crucial to facilitating IoT. Healthcare is one of the 10 markets that is investing in sensors, the PwC 6th Annual Digital IQ report says. Therefore, pharma appears to be following its consumers and the faster-paced technology companies and partners to the table.

While there has been a lot of attention placed on consumer and patient wearables (for more information on wearables, please see The Wearables Craze also in this issue) IoT also will dramatically change the industry supply chain and manufacturing by enabling machines and devices to communicate to one another and share and track information, which will help address the daunting challenges of manufacturing and distribution of medical products. Solutions will include systems that facilitate data collection and analysis, remote access, and track and trace.

According to a report by Tata Consultancy Services, the increasing use of sensors on the manufacturing floor will bring radical changes in operations to pharma manufacturing plants across the world. Called IoT-PM (pharma manufacturing), these tools will drastically change the maintenance and monitoring process of manufacturing plants. Cost savings are predicted in the trillions of dollars annually. Recent advances in sensor, Internet, cloud, mobility, and big data technologies have led to affordable sensors and connectivity devices, vastly increasing the potential of IoT-PM to influence further changes, the report says.

As the FDA approves more wearable devices for use in clinical trials, and as uptake of consumer-facing wearables to monitor activity increases, use of IoT in clinical trials is also expected to increase. Technology promises to deliver more value to clinical trials as it enables a real-time view of the patient experience and collects data that had previously gone uncaptured.

"Clinical trials is one of the first places we've seen meaningful usage of IoT," says Faruk Capan, CEO, Intouch Solutions. "For example, the Novartis and Qualcomm partnership is using Qualcomm's mobile platform in clinical trials."

Mr. Capan is referring to the Trials of The Future program, designed to leverage healthcare technology to improve the experience of clinical trial participants and patients using Novartis products and provide connectivity with future products marketed by Novartis. According to Qualcomm, Novartis is using its 2net Platform in a clinical study, evaluating the use of mobile devices with lung disease patients. The study leverages 2net Mobile-enabled smartphones and 2net Hubs to seamlessly collect and aggregate biometric data from medical devices and transmits this data to the cloud-based 2net Platform, which securely sends the data to the study coordinator.

"Patient recruitment and online market research are great opportunities that come from IoT," says Malcolm Bohm, CEO of Liquid Grids.

"IoT is the pathway to create and measure actions taken by patients," he says. "Recruiting patients for clinical trials can become more mainstream and leveraging actual patient feedback can inform how we should reach and connect with them in the true context of their lives."

The many IoT technologies that focus on improving patient care represent a huge opportunity for pharma to provide services beyond the pill. The joint venture between Novartis and Qualcomm is driven by the need to develop technologies, products, or services that go beyond the pill to benefit physicians and patients. Mr. Capan says this is right on point for today's IoT integration.

"The industry has been talking about beyond-the-pill models for years, and IoT is going to lead to that goal," Mr. Capan says. "To bring value beyond the pill to all stakeholders, a pharma company will have to put its own system in place or partner with someone that can."

Either way, he says, the companies that explore and invest in this area first will emerge with the competitive advantage.

What IoT Means to Pharma

The future of the healthcare IoT is a world in which even a toilet can become a repository

IoT isn't about gadgets; it's about the way the technologies talk to each other and create a connected experience.

KURT MUELLER
PulseCX
@PulseCX

for health data. Tiny wearable, embeddable, and digestible sensors are creating a health and medical world of connectedness that is loaded with invaluable patient data. From a weight scale to a mirror, to a shirt, to an adhesive skin patch, to an embeddable or digestible chip — all of these technologies have the capacity to collect and communicate information that will enhance processes and the ability to make informed decisions in real time.

In the short term, these quantified-self devices can help improve patient compliance and adherence.

"Even before we get to the advantages of massive sharing and interoperability of IoT, we are seeing devices that are capturing data about drug performance," says Nelson Figueiredo, VP, associate director of technology, at Ogilvy CommonHealth, part of Ogilvy CommonHealth Worldwide. "If something

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FARUK CAPAN
Intouch Solutions

The most potential with IoT is the impact connected devices and sensors will have on care delivered by HCPs.

NELSON FIGUEIREDO
Ogilvy CommonHealth, part of Ogilvy CommonHealth Worldwide @OCHWW

IoT is the pathway to create and measure actions taken by patients.

MALCOLM BOHM
Liquid Grids
@liquidgrids

is going wrong with a new prescription, these devices can be the first alert to healthcare professionals."

Doctors can receive information about patient vitals that may be asymptomatic to the patient, so it might ordinarily go unreported. These data can help healthcare professionals to quickly respond to negative side effects, rather than waiting until a catastrophic event.

"These data in aggregate can have benefits for healthcare professionals, manufacturers, and, of course, patients," Mr. Figueiredo says.

The most important element of the IoT however, is not the tools; it's the seamless and secure communications that deliver the experience across the entire patient journey.

"The Internet of Things isn't about the gadgets, it's about the way they talk to each other and create a connected experience," says Kurt Mueller, chief innovation officer at PulseCX. "The big opportunity of IoT is that it allows manufacturers, marketers, providers, payers, and even retailers to integrate data to help optimize patient outcomes. This is also the greatest challenge."

This integration will eventually change the way that medicine is practiced and the way patients receive care. The industry will need to embrace this change to be an effectual stakeholder in the patient journey.

According to Mr. Nosta, the industry needs to get ready for a fast-paced future that will require a more nimble business plan.

"The future is both promising and fearful for pharma companies because the advent of IoT represents a fundamental change," he says. "We are seeing changes on so many levels, with digital native doctors and new revolutionary technology in diagnosis and treatment in genomics, in all sorts of aspects of care. Everything is changing so rapidly. The future is coming at us so quickly that it demands pharma companies to become agile, and to embrace change as the new normal."

Mr. Nosta suggests three steps for the industry to prepare for the IoT age. First is settling into the mindset that the future is no longer 10 years out, but much closer at hand. Second is to source solutions from nontraditional partners, and third, have the ability to actually accommodate the nature of those changes.

"Retrofitting innovation to an older system that is largely set in stone is difficult," he says. "Drug development processes to the way we sell products will be turned on their head."

Mr. Nosta says innovation and partnerships may come from some unlikely places, such as Lowe's home improvement business, which has embraced IoT with its own smart home app and sells other brands of connected devices for the home like Google's Nest. At-home devices monitor daily activities that can contribute to the collection of data that can enhance health.

For example, Mr. Nosta says at CES discussions included the potential of developing a carpet embedded with sensors that could tell how someone was walking, if someone had fallen, or had not moved in a normal manner. While this may seem pie in the sky, Mr. Nosta is convinced that this is where IoT is taking healthcare.

"IoT represents a totally connected life, and all the data we can obtain from all the things we do today will be a rich source of information for science and medicine, so our kitchens and our bathrooms will become human labs that provide all types of data that help inform," he says. "Sensors will be able to monitor the way we eat, the type of cavities we have, or the bacterial contamination we have in our mouth, for example. Another place that may be used to supply a vast array of physiologic samples is the toilet. This emergence of connectivity will actually help reinvent aspects of care, such as reinventing the house call through telemedicine and the ability to measure physiologic perimeters over the smartphone or the Internet. IoT will in part be responsible for restoring some of the fundamental basic sweet spots of medicine of the past, only now from a technological perspective."

Connected devices will allow patients to build their own library of data to help access their health and behavior and the data, passively collected through wearables and sensors. This self-reported patient data will paint a holistic picture of patient behavior and drive improved outcomes through partnership with patients' healthcare team, Mr. Figueirido says.

"Where I see the most potential with IoT

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Congressional Caucus Called on the Internet of Things

Congresswoman Suzan DelBene (D-WA) and Congressman Darrell Issa (R-CA), Chairman of the Subcommittee on Intellectual Property, Courts and the Internet, have launched the Congressional Caucus on the Internet of Things (IoT). The IoT Caucus will focus on educating members on the development of innovative technology and public policy in the Internet of Things space. The caucus will inform members about new opportunities and challenges in health, transportation, home, workplace, and more as everyday devices take advantage of network connectivity to create new value. As user engagement increases, there will likely be a policy debate about data sharing and privacy implications and the future of a thriving IoT marketplace will be affected by a spectrum of policies and other federal management systems, according to a press release from Congresswoman DelBene's office.

is in the impact connected devices and sensors will have on care delivered by HCPs," he says. "While attending CES, I saw a new wave of wearables and connected appliances targeting a multitude of audiences; fitness, health, and performance were all covered."

Wearables are the new technology darlings, but in order to work, they need to integrate seamlessly within a consumer's life, Mr. Mueller says.

"To truly take advantage of and capitalize on IoT, applications and technologies need to have the ability to pass data seamlessly, so individuals, whether patients, physicians, or payers, can take action on the information or feedback they receive over time, throughout the treatment journey," he says. "And, there has to be a benefit — the what's in it for me factor — for people to want to be connected."

For example, the iPhone's new thumbprint security access is extremely easy to set up, and therefore there is a tremendous amount of benefit derived from something that is simple to do. Tap your finger on the button to input your fingerprint – and say goodbye to needing your PIN. Just touch the button with your phone and it unlocks (and only for you). How-

ever, Apple's HealthKit, on the other hand, makes the process of inputting information and connecting to other devices to share data more labor intensive, Mr. Mueller says.

"HealthKit is available on all the new iPhones," he says. "But it takes a certain amount of effort to enter your data and get it set up, and then you have to enable your other devices to pass data to it; it's not difficult but what's the motivation to want to do it?"

Besides being seamlessly integrated into the treatment journey, tools should also offer a significant increase in value at every stage in the treatment journey and work as both an enabler and an enhancement to the patient/physician dialogue as opposed to an intrusion or barrier, Mr. Mueller says.

"Savvy marketers will take advantage of these connections across the treatment journey and have the ability to communicate key messages and offers at each milestone and key moment of impact," Mr. Mueller says. (For more information, see sidebar IoT's Impact on the Patient Experience.)

Security and Privacy Challenges

Ever since digital health emerged, the risks of privacy and security have been in question. The nature of health data does present more challenges than other industries might face, however, the risks are no more prevalent than in the financial industry. Banks have figured it out, and so will pharma, Mr. Nosta says.

"At CES, cyber security emerged as a very important issue, and I believe that necessity is the mother of all invention," he says. "The banking and finance industries addressed this years ago by drafting solutions to security that would work within their systems. I would say that healthcare offers tremendous opportunity for innovators and entrepreneurs to find new levels of encryption and technology that make digital health secure."

The opportunities may be two-fold, as the life-sciences industry has two privacy challenges it has to face.

"The first is the challenge of data gathering and tracking information, and the second is the security and encryption of personal health information, think HIPAA," Mr. Mueller says. "Our industry will not only need to comply with FDA regulations, but also be incredibly responsible and align to the FTC framework for consumer privacy, data gathering, and sharing."

In January, the Federal Trade Commission recommended a series of concrete steps for businesses to enhance and protect consumers'

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privacy and security "as Americans start to reap the benefits from a growing world of Internet-connected devices." The FTC report also notes that connected devices raise numerous privacy and security concerns that could undermine consumer confidence. According to the report, the FTC believes its best practices for companies will provide guidelines that will allow the benefits of the Internet of Things to be fully realized.

As consumers become more comfortable with IoT capabilities and begin to experience the benefits, their concerns about data security will eventually turn to confidence in the system, Mr. Nosta says.
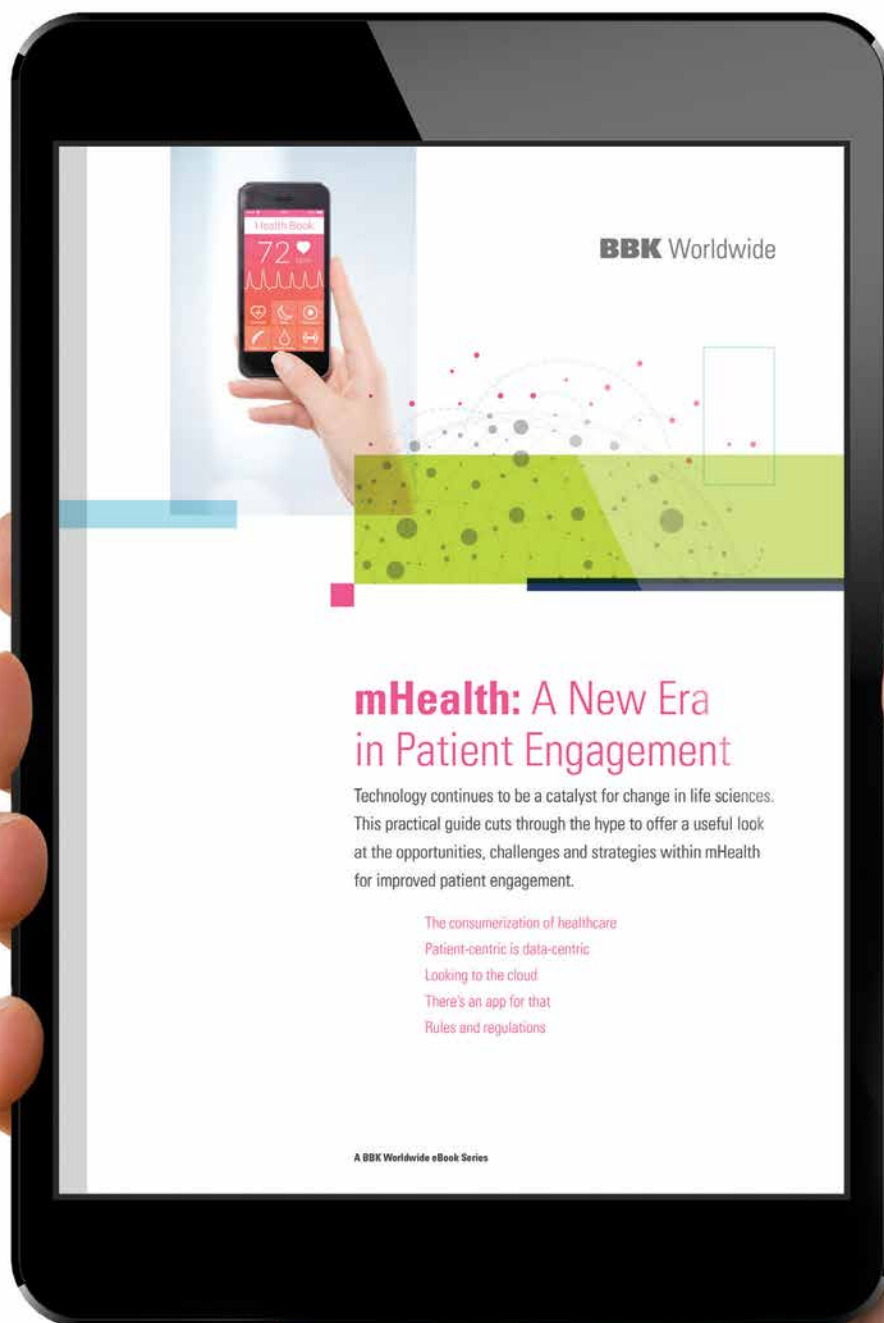
"In today's environment, privacy is being replaced by trust," he says. "For example, 100 years ago no one would know where I lived; today everyone can know where I live, yet I

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don't look at that knowledge as an intrusive part of technology. I don't lose sleep over it."

Lack of Standards

Standards that would facilitate open application program interfaces (API) enabling different brands of devices and solutions to communicate to each other will be critical to IoT success in digital healthcare. Paul Sonnier, publisher of The Digital Health Post, has compiled a list of open digital health APIs on his storyofdigitalhealth.com website and described them as a powerful mechanism for integrating data across digital health solutions of all types.

But until firm standards are set, the market will remain fragmented and adoption will lag, says Mr. Figueiredo.

"The biggest challenge facing the industry is the lack of standards among developers and manufacturers building devices," he says. "Right now there is an influx in the number of connected devices and sensors in market and in development. Many are not interoperable and require third-party intervention to connect all of the devices/sensors and parse the data being collected. Some device makers completely lock data into their own ecosystem, not allowing the user access to the data in any other apps or to sync other devices with its software. This lack of standards is particularly difficult for us in the pharma and healthcare space because we are an industry that requires standards for sharing health information."

Mr. Figueirido suggests the major players should set up a task force to create standards that work across all systems and devices. There is no value in being able to collect data if they cannot be shared easily across platforms and devices.

Samsung has started the ball rolling with its Digital Health Initiative that leverages an array of hardware and software technologies designed to bring developers, healthcare professionals, academics, and health enthusiasts together to create a healthier world. The key component is a new health open reference design platform tailored to take advantage of the latest sensors, behavioral algorithms, battery technologies, and displays. This is an open data platform and open sensor platform with the goal to accelerate innovation. Out of this comes the Simband design, and Samsung Architecture Multimodal Interactions (S.A.M.I.), the first truly secure, open, diverse data platform. Its open APIs enable it to collect data from any type of device or online source and deliver it to any other device or application in real time.

These APIs are simple, which allows sensor developers to record data in the way they want.

IoT's Impact on the Patient Experience

Kurt Mueller, chief innovation officer at PulseCX, presents a step-by-step example of how IoT can deliver a positive customer experience during a simple office visit.

1. Woman goes for her wellness visit to her OB/GYN.
2. Sitting in her doctor's waiting room, she is listening to Pandora.
   a. Tomorrow Networks' geo-location combines with supplied data profile while she's sitting in the doctor's office
   b. Based on her profile, she receives brand and condition message on Pandora
3. She uses Phreesia to check in.
   a. Based on algorithm of her profile
   b. Brand and condition message served up
   c. She opts-in to receive more information about a condition she believes she may have and immediately receives:
   ... i. Doctor discussion guide served to her phone before her consult
   .... ii. Adherence program enrollment if she's put on therapy
4. She and the NP/PA talk and the NP/PA passes information to the doctor as he/she enters the room.
5. While in the exam room, the patient explores educational videos on a Samsung tablet from Context Media in the exam room, which provides additional education about the condition she may have.
6. She and her physician talk about the condition, the doctor examines her and agrees it might be what she thought and:
   a. Sends an electronic Rx to her pharmacy
   b. Hands her a starter kit with a co-pay card to help pay for therapy
7. From her mobile phone, she goes online, activates her co-pay card, and automatically enrolls in the brand adherence program to help her stay on therapy and achieve the best possible long-term outcome.
8. She goes to Walgreens to pick up her prescription and while in the store, her Walgreens app offers additional discounts on products she may be interested in as she walks up and down the aisles, as she had other shopping to do while at the pharmacy.
9. Her prescription is packaged using a SmartPackaging blister pack that transmits data when the blister is broken. When she breaks the seal of the first dose the following morning, a signal is sent to her doctor's office, as well as her insurance company, and she receives a motivational text on her phone to let her know she's begun her treatment journey.
10. Each time she breaks the seal on the next dose, she receives a message on how well she's doing, or if she's non-compliant, motivational messaging is sent on the need to be compliant, as well as offers of tools and information to help her get back on track; it also sends a message to her insurance company and physician's office.

At the end of the day, the patient has an engaging, rich experience from the time she began her health-seeking journey, right through to being prescribed the therapy — with technology integrating the brand, tools, and resources into her long-term journey. And all parties win. The insurance company benefits with lower healthcare costs because she's compliant and her condition is being managed, her doctor benefits by receiving the best possible reimbursement because he/she delivered the best possible outcome, she's having a better experience along her journey by the IoT connecting everything together on her terms.

Positioning itself as a data broker that will enable wearable devices to upload information to the cloud, S.A.M.I. enables developers to access the data and leverage it to create entirely new applications.

Issues around interoperability and open APIs may delay some adoption of IoT, but it will not stop it, says Mr. Nosta. IoT is here, and consumers are driving the trend. So it's just a matter of time before a standard emerges.

"The marketplace will force a solution here, because it will be a necessity for companies to work out," he says. **PV**

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