

The Internet of Healthy Things: Considerations for Healthcare Professionals



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Executive Summary

In this whitepaper, we'll take a look at how the Internet of Things (IoT) has infiltrated the healthcare industry, creating a new phrase: the Internet of Healthy Things (IoHT). Specifically, we'll walk through the benefits – and more importantly – the challenges or considerations that providers, patients, and insurers are facing. All of this will help us discover: Is the Internet of Healthy Things ready for prime time?

Internet of Things: A World Connected

To many, the term “Internet of Things (IoT)” is a futuristic vision of society. A society where everyone and everything is connected via a massive network of devices that share information and services with the potential of making our lives better (and maybe even more exciting and productive). While this vision may seem to be a long way off, it has actually been more than 30 years since an industrious student at Carnegie Mellon University first connected a device, a remote Coke machine, to a network. The goal? To check if the machine was stocked and the soda was cold before walking across campus to purchase one. I am sure that this student would agree that this first “Internet connected appliance” made his life better, particularly when looking for a quick caffeine fix for late night studying. It's a simple example, but one that shows the early potential of how a connected device can enhance our everyday experiences.

Fast Forward to Today: Has IoT Made Progress?

Considering the Internet of Things has been around for 30 years, one would think that the IoT's reach would exceed what actually exists today. While progress is being made with new devices and new ways to connect them, the reality of a ubiquitous Internet of Things remains just outside of our reach, despite the constant buzz about its potential.

The fundamental challenge remains – IoT supersedes industries, organizations, and cultures. It requires a technological ecosystem independent of an organization's typical structure. The Internet of Things needs to grow into a complete ecosystem of inanimate sensors communicating, at a level not requiring human prompting, in order to truly become integral to people's lives. The lack of cohesiveness across organizations and industries makes it hard for IoT to evolve. Yet, with each new innovation, the eventual complete integration of connected devices comes a little bit closer and the technologies are finally coming into place that will allow the potential of the IoT to fully manifest.

What “Things” Actually Exist?

The primary requirement needed to drive the growth of the Internet of Things is, quite simply, “things.” Things that can be wirelessly connected to a network, whether that's a sensor embedded in a road to track traffic patterns and synchronize stop lights, a fitness band that counts your steps and tracks your heart rate, or even a refrigerator that knows when you are out of eggs and sends a message to your smartphone telling you to stop at the store.

Currently, there are more than [8.4 billion connected devices](#), representing an investment in the IoT of approximately [\\$737 billion](#). Companies like Target have created interactive environments for consumers to explore the potential of the IoT in a “home-like” setting. Wearable tech sales are [increasing](#), and [connected utilities](#) are likely to be the way of the future. The IoT solutions are also slowly beginning to emerge in healthcare, where new partnerships are forming, such as the [IBM and Pfizer collaboration](#) on a first-of-its-kind research facility that utilizes IoT sensors to remotely monitor Parkinson's patients. The “things” are coming into place, and the technologies that provide the foundation of IoT are slowly, but surely, coming together.

The state of IoT today



8.4
billion

connected devices



\$737
billion

approximate investment in IoT

Introducing the Internet of Healthy Things (IoHT)

In the healthcare industry, the benefits of a connected, constant monitoring, automated, and machine-learning world are evident and quite significant. We could see wearables that call an ambulance if a patient's vital signs drop, automated prescription refills to minimize medication noncompliance, and a frictionless, inexpensive, error-free supply chain from supplier to patient, even a living hospital room that adapts itself to the changing conditions of a patient.

There is no shortage of ideas when considering how the IoT can transform healthcare delivery and how it can achieve the “Triple Aim” – improve health outcomes, lower the cost of care, and enhance the quality of life for patients. While healthcare “things” are available today, their comprehensive implementation is challenged by organizational, social, safety, and emotional boundaries. We are able to collect healthcare data but are often challenged in analyzing it and creating meaning. And even when we do, it is difficult to communicate findings in an accessible and actionable way.

Without finding a way to accomplish the three components of collecting, analyzing, and communicating data, we won't be able to create an “[Internet of Healthy Things](#)” that enhances patient lives and we will be kept from enjoying the immense benefits promised by such a system. The good news is that these boundaries are becoming well understood, with much progress being made to transform the data captured through the IoT technology using analysis designed to inform and educate patients and provide them with the tools that they need to manage their health.

Listening: Changing the Healthcare Landscape

In considering the IoHT space, the data capture, or “listening” component of healthcare is fairly well established. Whether a parent listening to a child's cough or a physician using a stethoscope to listen to a patient's heartbeat, the ability to understand an individual's condition by “capturing” and interpreting information is fundamental to healthcare. For as long as healthcare has existed as a practice, we have been listening to what our bodies tell us and applying that information to our health. The foundation of medicine is built upon listening to what's wrong with our bodies and listening to what works when we try to fix them. The manner in which we have done this has changed over time, but the general idea has stayed the same.

As technology has advanced, listening has been made easier and more comprehensive. Within the IoHT, wearables have had an immense impact on the shift from episodic to continuous listening. With wearables, we don't need to be in the doctor's office to learn basic information about our health. In fact, [17.6% of US consumers already own a wearable](#) and are aggregating health data and “listening” to their own bodies. With wearable penetration increasing, consumers are realizing the value of the data that they are capturing.

Wearables have the game-changing ability to provide quantitative health information in a consumer-facing, affordable, and continuous manner – the benefits of which cannot be understated. And the technology is continuing to evolve and improve with many non-traditional companies entering the health space. For example, [Bodytrak](#) has introduced personal sensors that measure core body temperature, heart rate, rate of oxygen consumption, and motion. And [Qardio](#) monitors heart health, including blood pressure, heart rate variability, skin temperature, respiratory rate and activity tracking. Each company is pushing the boundaries of wearable technology and opening up doors to new ways of listening.

Data. Data Everywhere. Now what?

As previously stated, the loHT is driven by data captured by sensors, but how it is used or analyzed is critical to turning it into actionable information within real-world settings. While the practice of healthcare data analysis is fairly well established, as exemplified by comparative effectiveness and health outcomes studies, it is typically performed using clinical and/or claims datasets. These datasets are the foundation of most large scale studies and are well understood by analysts. loHT data, on the other hand, is not as well understood due to the large number of potential data sources, the type of data that is captured, and the frequency in which it is collected. In addition, the types of analysis conducted using clinical and claims data tend to be of a retrospective nature versus the real-time data capture enabled by loHT technology. The constant real-time data collection within IoT has resulted in the push for analytics, such as machine-learning, to be embedded within the loHT solutions themselves. While this is not yet the standard, there are promising case studies where the ability to analyze and draw conclusions from large amounts of sensor data have been possible, hold great promise, and can result in significant health impacts.

In addition to embedded analytics, cognitive computing offers much promise for advancing the impact of the loHT. Cognitive computing brings together technologies, such as artificial intelligence, machine-learning, and natural language processing to consume and analyze all types of structured, unstructured, and semi-structured data. This is a necessary component of the loHT, due to the variety of data captured by sensors, and the need to make meaning of it all. The most well-known of the cognitive computing platforms, IBM Watson, is doing just that – [piloting precision care and services technology](#) with senior residents and patients of Oregon’s Avamere Family of Companies, which includes independent living, assisted living, and skilled nursing settings, as well as Infinity Rehab. IBM’s technology integrates real-time data from sensors with historical, de-identified patient data to capture information about residents’ and patients’ behaviors and health indicators. The analysis will provide personalized insights into patient needs and allow Avamere to become more effective, efficient, and directed in how they provide care. IBM and Avamere were able to capture data, make meaning out of it, and turn that meaning into real, tangible health impacts.



Comparing loHT data with historical data creates personalized insights that allow healthcare providers to become “more effective, efficient, and directed” in how they provide care.

What Does it Mean for Me?

The Power of Healthcare Personalization

In order to successfully transform healthcare, or as many are starting to say, “health,” we need contextual data generated in real-time by patients and consumers as they interact with the world around them. We then need to turn this data into meaningful information so that we can understand what it means and apply it to our lives. Personalized, contextual data aggregated on this scale has immense potential – from identifying when we need to see a healthcare professional to determining how much sleep we need, and from encouraging exercise to recommending the best restaurants (and those to avoid!). It sounds easy, logical even, but analyzing the data in a way that is actionable is probably the most difficult aspect of mastering the loHT. The information needs to be personalized and created specifically for me based on my environment, my communication style, and in a way that motivates me to act; rising above the noise that takes up so much of our daily interactions. To have the maximum impact, the loHT needs to become independent of direct human interaction, moving from connected sensors that gather data into machine-learning and cognitive computing programs that turn the data into meaningful, bite-sized recommendations that we can apply to our own lives. All of this done in real-time, all of the time. The more it is used, the smarter it will get, aggregating information learned over time to provide the most accurate results based on an individual’s specific traits and behaviors.

It’s All About Me

One example of how personalization can enhance interactions with the loHT and have a significant impact on an individual’s wellbeing is the [Lark app](#). Lark utilizes your phone’s sensors and manual input to track your weight loss journey, analyzing your health data and providing you with personalized recommendations based on that data. It listens, analyzes, advises, and coaches. Lark incorporates a wealth of different factors – from sleep habits to daily activity – and can connect to your Apple Watch for even more information. It brings in existing tech and software combined in novel ways to return valuable health recommendations to its users, whenever and wherever they need a little coaching. Contextual and constant data analysis allows hyper-personalization and the results are big. Applications such as Lark can successfully engage users in ways that are quite impactful, while still remaining relatively unobtrusive to everyday life.

The Internet of Things has the potential to make our lives better, more exciting, and more productive. It holds great promise in addressing the challenges of population health – improving health outcomes, lowering the cost of care, and enhancing the quality of care for patients. The ability to use the loHT to capture data, analyze it, and personalize it, turning it into accessible, consumer-facing health recommendations is all within reach. The technology is available, the case studies are showing positive results, and yet there are still some hurdles holding us back.



It Sounds Good, But...

Obstacles Need to be Considered

While the benefits of IoT in healthcare are continuing to be explored, there are obstacles that need to be addressed if these things will transform how we live our lives. Some of the challenges that are frequently raised include loss of patient privacy or Protected Health Information (PHI), technical hurdles caused by a lack of interoperability standards and decentralization of data, concern over data accuracy and potential impact to patient safety, and finally, the ability to consume data captured and make it relevant to patient care. Individually, all of these challenges are solvable, but when combined they require a carefully planned approach that takes into consideration not only the technology that enables the Internet of Things, but also the people and processes that are critical to its successful use in transforming patient lives.

Privacy and PHI

Patient privacy and data security continue to be one of the major issues to using devices as components in the Internet of Healthy Things. Whether patient, clinician, or health IT professional, few would argue this, particularly when considering how often the terms “cybersecurity” and “hacking” have been splashed across the media over the past several years. While traditional environments where healthcare is delivered – such as hospitals and clinics – tend to have well designed, secure networks and staffing, IoT introduces less protected environments into the mix, such as a patient’s home, school, or office, as well as any public locations that a patient frequents. The cost of “free” WiFi can be profound if a patient’s healthcare data, and potentially identity, is compromised or stolen. It is important that these risks are well understood and that security is taken seriously not only by patients, but also by those providing the technology and systems that enable the Internet of Things. As the IoT becomes a ubiquitous part of our lives, security and privacy need to be something that we, as consumers, healthcare professionals, data scientists, and engineers, need to keep top of mind.

Device Interoperability

Interoperability, or common communication protocols, is a major issue that limits the potential of the Internet of Things in healthcare. It is not unusual to find a connected environment with many devices that have been developed by multiple manufacturers. In general, this should not be a problem; however, it is also not unusual for each of these devices to have been implemented using their own proprietary standards and systems, which makes it very difficult to share information across platforms. In addition, even when data can be captured, integration of the data is very challenging – especially when it needs to be done quickly and accurately. This is caused by the fact that, in addition to the difficulty of interoperability from a technical standpoint, there may be data integration challenges due to a lack of patient identification standards. Each device may track patients using its own unique identifier which may not correlate with any other recognized identifier. One device may use a patient’s driver’s license, passport number, or social security number, and thus may recognize the same patient in different ways. Since there is a lack of a national standard identification number, methods need to be employed that can ensure the data captured from a device can be accurately matched to the right patient and integrated accordingly.

Data Accuracy to Ensure Safety

Assuming data can be captured, integrated, and associated with the correct patient, there remain concerns over the accuracy and completeness of what has been captured. For example, if the device malfunctions or fails to capture a key metric, the clinician will be forced to try to interpret incomplete data without the ability to go back to the source device to better understand what was actually captured. This could be particularly critical if the device was a part of an integrated drug delivery system and failure to accurately capture data could result in the under or overdosing of the patient receiving the drug. Obviously, a device that operates in this capacity must first go through a rigorous FDA testing and approval process, but it is still worth noting. What is more likely to occur is when a device is monitoring a patient's condition and it is not being deployed correctly or the specific sensor capturing data is malfunctioning. In this case, vital signs that are provided to a clinician may result in an inaccurate diagnosis or treatment protocol for that patient. For the Internet of Things to be effective in the delivery of patient care, it needs to accurately capture a patient's condition at a specific moment in time and relay that information correctly to the clinician or caregiver.

Does IoT Really Produce Meaningful Data?

The final hurdle, and potentially the most challenging, is how to create meaning from the vast amounts of data generated by connected devices. It is not enough to simply capture, protect, integrate, and ensure data accuracy. Sophisticated analytical techniques and algorithms, as well as people, are required to design and implement them to truly make data actionable and realize the promise of the Internet of Things. There are many reasons why finding meaning in the data is difficult and it starts with the data or, more accurately, the concept of "Big Data." Data captured by IoT devices definitely meets all of the criteria for Big Data, as defined by the four V's: Volume, Velocity, Variability, and Veracity. These factors often challenge traditional IT infrastructures, requiring significant investment in new technologies to support the storage, processing, and management of IoT captured data. This can include Cloud Computing infrastructure, NoSQL databases, Open Source software frameworks and even the implementation of machine learning and other Artificial Intelligence-based techniques that can be used to organize and create meaning from this data which ultimately have the power to improve lives.

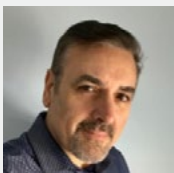
Another contributing factor to the challenge of finding meaning in IoT data is the scarcity of data scientists well-versed in healthcare as well as innovative techniques in analyzing it. A recent New England Journal of Medicine article stated that healthcare needs at least 10 to 20 times more data scientists than those who exist today, which has resulted in many jobs remaining unfilled. Having the ability to analyze this data needs to become a core competency for healthcare providers, such as physicians, hospitals and health systems, payers, device manufacturers, pharma, and biotech companies, among other participants in the healthcare ecosystem. Being able to capture insights from this data and integrate them into clinical workflows and care protocols, as well as deliver easy to understand and actionable formats directly to the patient, will become essential in achieving the transformation of healthcare.

Internet of Healthy Things: The Future is Here – Adapt or Get Left Behind

This concept of an Internet of Healthy Things (IoHT) world where we are continuously capturing patient data and using it to improve health is a very real possibility in the near future. Sensors can operate in real-time, all the time, to gather the raw data that is necessary for analysis. The more data collected, the greater the precision in analysis, and the deeper our understanding of a patient's health. Eventually, with enough data, we will be able to predict health issues before they manifest themselves, on a population level, and all with minimal human interaction or analysis. While costs today continue to be a factor that limit the pervasiveness of this capability, increased competition is driving them lower and encouraging innovation.

Healthcare organizations that excel in the three components of IoT (data capture, analysis, and translation) are quickly establishing themselves as leaders in the emerging IoHT space and showcasing what's possible with today's technology. By including apps and sensors, along with traditional disease management techniques, these organizations will approach population health challenges in unique and innovative ways. And most importantly they will improve health outcomes, lower the cost of care, and enhance the quality of life for their patients.

Connect with the Author



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Steve LoSardo is a dynamic leader and visionary with more than 25 years of experience providing high value information technology solutions to consumer, life science, and healthcare companies. A proven innovator, he is adept at solving complex business problems using advanced, technology-driven approaches based on best practices and industry standards. At Mobiquity, Steve is focused on delivering innovative digital solutions using web, mobile, voice and IoT technologies to pharma, biotech, medical device, provider, and payer organizations. He is passionate about collaborating with clients as they explore new ways to transform people's lives with technology.

Steve has previously held leadership roles at IMSHealth (IQVIA), PricewaterhouseCoopers, SDIHealth and Verispan (Quintiles). He holds an M.B.A, specializing in Computer Information Systems, as well as a B.B.A. in Management from Hofstra University in New York. He is a member of Montclair State University's School of Business, Information Management & Business Analytics Advisory Board.

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About Mobiquity

Mobiquity is a digital consultancy that partners with the world's leading brands to design and deliver compelling digital products and services for their customers. Its approach balances human needs with usefully applied technology, unbound creativity with research and analytics, and agile development with strict engineering and security standards.

Mobiquity's end-to-end services consider every dimension of a digital business from marketing to IT, providing strategy, experience design, product engineering, cloud services, and analytics. Mobiquity is an AWS Partner Network (APN) Premier Consulting Partner and has worked with AWS since 2011 to deliver 100% cloud-based innovation to its clients.

Ready to talk about the IoT in your business?
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