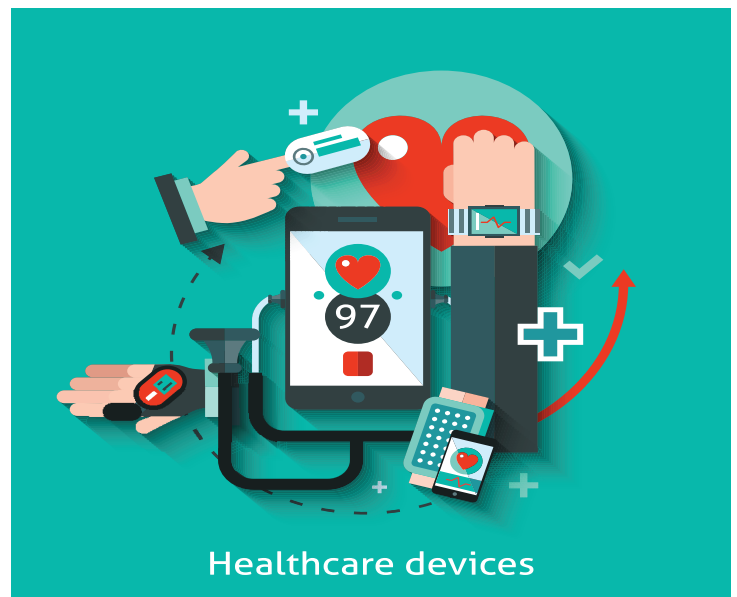


# NEXT EVOLUTION OF HEALTH IoT: MOVING TOWARDS THE EDGE



Telemedicine



Healthcare devices



Health monitoring



Mobile health

# Next Evolution of Health IoT: Moving Towards the Edge

Evolutions in computing and connectivity are driving new developments in the health IoT space.

Connectivity is necessary in order to gather data from devices both in patients' homes and in healthcare settings. However, it is not enough to simply receive the data – the value of data lies in its interpretation and use.

**This whitepaper discusses how companies can unlock the value of their health device data via the use of edge computing, machine learning, and health flexible IoT platforms.**

## The Changing Healthcare Landscape

**2020 has brought about rapid changes in the healthcare landscape.** Use of health technology has become normalized among care providers and among consumers, and changes in regulation and reimbursement point to permanent shifts in the way healthcare is conducted going forward.

### COVID-19 Accelerates Connected Health Adoption

- The advent of COVID-19 caused a massive increase in telehealth and health tech adoption among both consumers and care professionals. In some cases, the industry was judged to have undergone five to ten years of changes within the span of just several months.
- These changes have had a permanent impact on the preferences and demands all players in the ecosystem: consumers, medical practitioners, administrators, health IT professionals, employers, insurers, and many more.
- Players that do not adapt to this new reality – **increased demand for health technology that serves the needs of clients and is well-integrated into physician workflows** – will face a competitive disadvantage going forwards.

### Consumer Use of Health Technology on the Rise

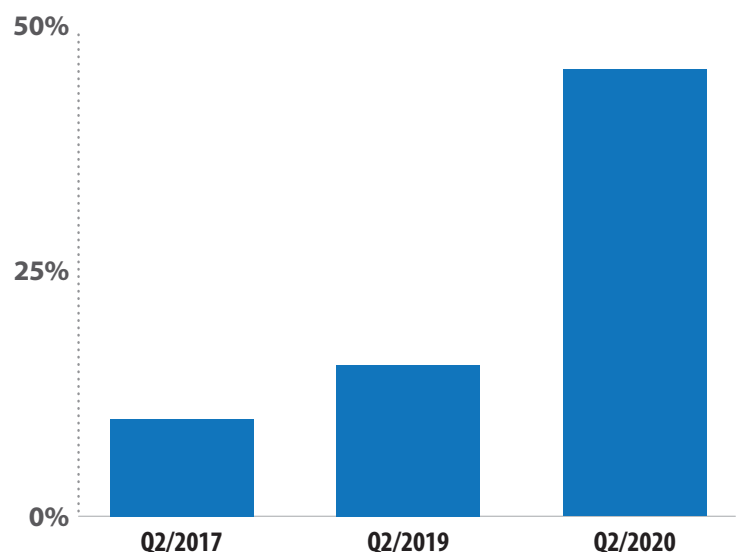
A Parks Associates May 2020 consumer survey captured a nearly three-fold increase in remote visits with a healthcare practitioner.

They reported positive experiences and high levels of satisfaction, and consumers aged 65 and older had higher satisfaction than younger people.

Between 2019 and 2020, the percentage of consumer who had a remote visit in the previous twelve months rose from **15%** of US broadband households to **41%**.

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### Telehealth Service Use by US Broadband Households



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Many connected health device owners are particularly interested in sharing data from their connected health devices with telehealth services.

64% of connected health device owners report that services that allow them to share device data are “appealing” (rating 5-7 on a 7pt scale), vs. 43% of non-owners.

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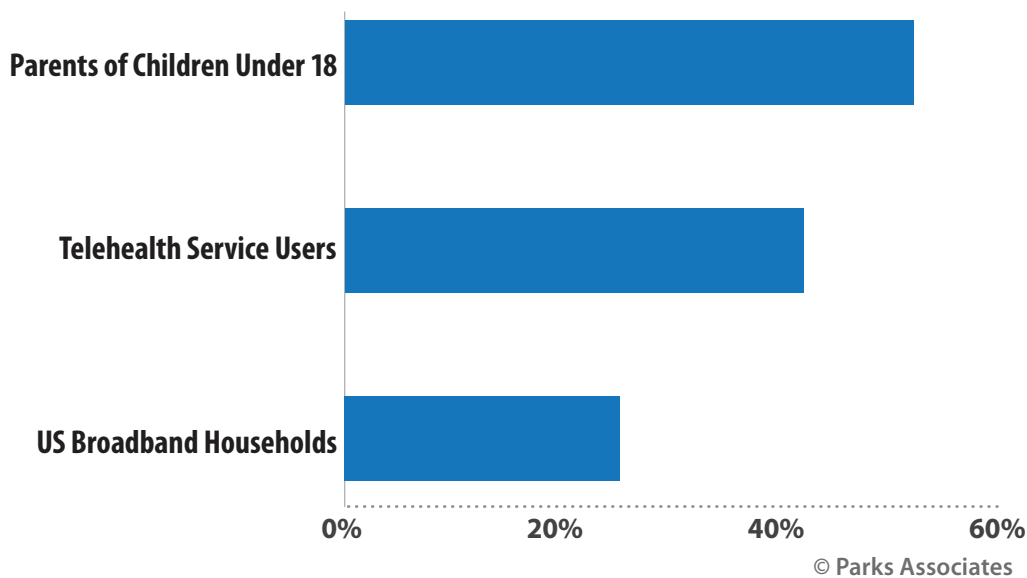


Consumers report high intentions to purchase connected health products. As of May 2020, 29% of heads of US broadband households were very likely to purchase at least one type of connected health product in the next 12 months, with 25% interested in medical devices and 17% interested in wearables. Intention to purchase is particularly high among parents of school-aged children, as well as telehealth service users.

Roughly a third of those ages 65+ report that, when they can no longer live safely in their own homes, they are considering setting up a sensor-based system in their home that monitors their safety and calls for help when they need it.

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## High Intent to Purchase Connected Medical Products



Next Evolution of Health IoT: Moving Towards the Edge

## Increasing Use of Health Technology by Care Professionals

- Beginning in early 2020, a high percentage of care professionals either rapidly scaled – or deployed for the first time – telehealth solutions in order to connect with their patients. This occurred in reaction to restrictions placed on in-person healthcare visits; many policy makers and health system administrators made the decision to cease delivering elective care in person, making remote care solutions the only way for many patients to access the care they needed.
- Many in the health space expect demand for remote health platforms to be permanently increased compared to 2019, among both consumers and care professionals. On the consumer side, widespread exposure to virtual care and its benefits, as well as high levels of reported satisfaction among users, will mean that consumers will be reluctant to exchange the convenience of virtual visits for in-person services. On the professional side, many platforms offer greater operational efficiencies than in-person visits and in certain circumstances result in improved patient outcomes.

### **Telehealth vendors and telehealth specialists saw huge utilization boosts during this time.**

Amwell, a leading telehealth platform, reported a 1,000% increase in virtual visits due to COVID-19, with even higher increases in certain locations.<sup>1</sup>

Northwell Health, a NYC-based hospital system, reported a 900% increase in its ambulatory telehealth visits within just the first six weeks of the COVID-19 crisis in New York.<sup>2</sup>

**Consumers are also likely to increasingly demand that their care providers offer remote consultation services – and may take their business elsewhere if this is not the case.**

## Weaknesses in Current Virtual Care Solutions

- At present, many virtual care solutions have a weakness: they are remote visit only and lack the means to gather important vital sign and clinical testing data. This significantly limits the use cases of telehealth – limiting use of virtual solutions in tracking chronic conditions, in monitoring those patients who are at an elevated risk of complications due to a disease state, those who are pre- or post-surgery, and others who may benefit from tracking data. While remote patient monitoring platforms exist and are highly in demand by care professionals, many of these programs have not yet been scaled to the same extent as remote visit solutions. A number suffer from user experience flaws, causing user error and frustration with regards to pairing devices and taking measurements.
- On the consumer side, data from connected health devices would help to augment remote visit services as well as remote patient monitoring platforms by providing valuable access to patient health metrics and trending information. However, these devices are commonly siloed from the rest of the healthcare system. Consumers who want to share data with clinicians oftentimes need to either do so manually, or by generating in-app reports and emailing them to their care providers.
- At present, a number of innovative players in this space are rolling out well-designed and user intuitive health IoT solutions, pulling in data from devices in consumers' homes, and building intelligent, integrated platforms that best position companies to take advantage of the telehealth boom and better serve their clients and patient populations. Changes in reimbursements have also helped accelerate the adoption of new approaches to monitoring that, in lieu of sending data straight to medical records and putting the burden of viewing and interpreting data on clinicians, call on third party monitoring services to interpret the data and escalate to clinicians if appropriate.

<sup>1</sup> Christina Farr, Ari Levy, CNBC.com, "Amwell confidentially files for IPO amid surging demand for remote health care", June 4, 2020: <https://www.cnbc.com/2020/06/04/amwell-files-for-ipo-confidentially.html>

<sup>2</sup> Parks Associates analyst briefing with NorthWell Health, July 31st 2020.

# Next-Gen Approaches in Health IoT Solutions

There is a need for health IoT in both in-patient and outpatient settings, and among consumers. Next-gen approaches to health IoT collect health data, integrate with robust platforms and services, and provide intelligent feedback and interpretation. Many promise to deliver a superior patient experience than would be provided via in-person visits, offering patients care where and when they need it and educating them along the way.

## Need for Data Collection

- **Many patients are no longer physically visiting their care providers due to COVID-19 concerns.** These patients are either using remote care platforms or are skipping care altogether. This is creating a coming hazard, as without patient's health data and measurements, care providers will face difficulty in monitoring the trajectory of at-risk patients and also in diagnosing patients with dangerous diseases.
- **Remote patient monitoring and other health IoT platforms collect many types of health data,** and offer many advantages over asking patients to take their own measurements via unconnected solutions and share that data with their providers. The data is subject to less reporting bias, and there is less friction and higher adherence in patients' taking their own measurements.
- **Use of health IoT and collection of health data also offer a number of benefits in in-patient clinical settings.** By automatically gathering data, they reduce workload among clinicians. Algorithms are also capable of using the collected data to proactively identify health issues and advert emergencies.

In May 2020, as a result of COVID-19, **29%** of US broadband households were unable to visit the doctor for a consultation or check-up, while 13% were unable to undergo a previously scheduled medical procedure.

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## Need for Data Integration

- **Many in-home health IoT solutions are not integrated with clinical systems.** While many on the technology side are familiar with solutions offering this type of functionality, many clinicians share a perspective that this is very difficult to impossible – if not impossible – to achieve. This is largely due to historical reasons, including the rollout of electronic medical records systems and early health tech solutions. Many of these systems are still in use today, and clinicians and administrators are unaware that modern solutions have solved many of the pain points they experience daily.
- **In-patient clinical IoT solutions have traditionally used inflexible firmware that is difficult to update.** Many older deployments require outdated operating systems in order to manage and support devices. This produces risk to hospital IT – risk of needing to dedicate unnecessary resources to manage difficult to update systems, as well as security risks associated with out-of-date operating systems such as encryption of IT systems by ransomware or theft of patient and/or billing records.
- **There is a need for solutions to integrate with other solutions in intelligent ways.** For example, a health IoT solution integrating with a remote visit solution, or in the in-patient setting multiple sensors feeding each other data in order to make intelligent decisions as to when to alert clinicians that there may be an issue. However, many solutions in the market today are point solutions offering a single type of functionality and few integrations – this causes fatigue on the part of clinicians and others trying to make use of multiple solutions.

## Need for Intelligence in Data Interpretation

- **Just retrieving measurements is only scratching the surface of what health IoT can do.** Artificial intelligence and machine learning, as well as highly tested and clinically proven algorithms, vastly increase the value proposition of health IoT. They enable a wide variety of new use cases, provide decision support tools for clinicians, and reduce administrative burden.
- **In the consumer space, AI and algorithms help to empower consumers to interpret their own health data and take action to improve their health outcomes.** These tools empower seniors and family caregivers, providing valuable peace of mind as well as safety, security, and health options.
- **Examples of use cases powered by AI and algorithms include** the ability to algorithmically compare patient trajectories, proactively identify and avoid health crises, triage at-risk patients, diagnose unidentified and undiagnosed medical conditions, and predict falls or mobility declines in the elderly, among many others.

## Edge Computing: Bringing Intelligence Out of the Cloud

### Three Main Models of Computing

With Regards to AI, Machine Learning, and Advanced Algorithms

<b>On-premise</b>	devices on site connect to computers on site.
<b>Cloud</b>	devices on site or offsite connect to servers in far-off places.
<b>Edge</b>	a hybrid of on-premise and cloud where much of the computing is done close to the device and other computing is done far away.

On-premise computing is generally considered the most secure, while cloud computing offers greater computational power and a more widespread range of functionality. Edge, meanwhile, offers a best-of-both-worlds approach.

### Value of Edge Computing vs. Cloud-Only Solutions

**Edge computing offers a number of advantages over cloud-only systems.** Because edge computing uses a hybrid model with some computing happening locally, it offers greater speed, greater accuracy, and greater reliability as solutions do not need to talk to the cloud in order to function. This helps protect solutions from broadband slowdowns and outages, as well as offer additional privacy and security protections.

**Edge computing also supports what has been called a “software-defined” approach.** IoT devices, once deployed, are able to be updated over time with new features and functionality. Devices can also be more easily kept up to date with security enhancements, helping to prevent data theft and malware. This makes it easier for IT teams to manage devices once they are deployed. Many devices will be able to do computing activities on their own, such as offer real-time analytics and work intelligently with other devices.





# Use Cases for Edge Computing, Machine Learning, and AI in Health IoT

The following three examples illustrate the use cases for edge computing, machine learning, and artificial intelligence in health IoT.

## Smart Alarm/Dashboards for Monitoring

Edge computing is capable of combining and interpreting data from multiple devices locally, leading to greater speed and intelligence. One use case example is that of smart alarms for in-patient monitoring. Using edge computing, a smarter alarm system can be created, combining data from different monitors – for example, verifying patient heart rate across both monitors before sounding an alarm. This allows the system to avoid the false alarms that fatigue healthcare workers.

## Comparing Trajectory of COVID-19 Patient to Others in At-Home Setting

Artificial intelligence can be used to help monitor COVID-19 patients in the comfort and safety of their own homes. Devices in the home send data to remote monitoring platforms, allowing physicians to track the health of their patients. Artificial intelligence, paired with a rich dataset, allows physicians to identify patient trajectories and compare a patient's trends to others with similar trajectories. This has been used to save the lives of patients with COVID-19, identifying when patients – who may otherwise feel well enough to not realize they need help – are at risk of death and require hospitalization. This type of functionality may also be applied to the field of chronic disease monitoring as well as post-surgical recovery, among others.

## Virtual Assistants for In-Home Health Care

By combining edge computing and AI, intelligent whole-home solutions may be enabled for remote patient monitoring or even eldercare. Sensor suites monitoring daily activities such as taking medication, or health metrics such as blood sugar, temperature, weight, pulse oxygen, lung capacity, and blood pressure may be combined with smart displays featuring virtual assistants. The virtual assistant may encourage patients or seniors to follow through on medications, monitor their vital signs, perform rehabilitation exercises or mental health routines, or conduct video consultations with their care providers. The addition of depth cameras allow the solution to postural stability and gait, evaluating if seniors are at risk of falls.



# Implications for the Future of Connected Health

COVID-19 and the resulting increases in virtual care adoption and changes in regulation have permanently altered the healthcare landscape in the US. There is a great need for virtual care solutions, particularly those integrating data from devices in meaningful ways. Organizations that do not do this operate at a competitive disadvantage to those who do.

Heightened awareness of virtual care among providers has also brought about new demand for off the shelf end-to-end virtual care and telehealth solutions. However, each health system or clinical office has its own unique IT infrastructure, particularly with regards to integration with EMRs/EHRs and clinical and billing systems. What is needed are agile, experienced software and systems integrators who can engage directly with providers on their needs and tailor a solution for their unique situation.



At the same time, high levels of consumer demand for connected health devices point to a growing demand for health data and actionable insights among consumers. **Consumers want to be able to access this data and share it with their care providers.** Providers – and virtual care services – would do well to consider integrating with existing consumer health platforms.

Edge computing allows healthcare organizations to improve their internal operations and better diagnose and support their patients. These solutions support various types of in-home monitoring and diagnostic devices, applications, and platforms, across a single common platform that solves many of the headaches of earlier technology.

**Agile edge computing brings the power of cloud-native development home, enabled by advances in computing and connectivity, building scalable platforms that can both extend and augment provider capabilities now and in the future.**





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## About The Author



### Kristen Hanich, *Senior Analyst, Parks Associates*

Kristen heads Parks Associates' consumer electronics and mobility research, with expertise in other verticals including connected cars, mobile networking, healthcare, wellness, and independent living. She leads a mix of custom and syndicated research projects throughout the year, with a focus on major players and emerging trends. Kristen specializes in bridging the gap between data-driven and narrative approaches to understanding the consumer markets via a mix of qualitative and quantitative research approaches.

Kristen has dual master's degrees in applied anthropology and public health from the Universities of North Texas in Denton and Fort Worth. She earned her BSc in health at the University of Texas at San Antonio and has a graduate certificate in Geographic Information Systems.

**INDUSTRY EXPERTISE:** Consumer electronics, mobility services and devices, connected health and wellness

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