Now is the time for healthcare providers to get into IoT

Opportunities and path forward

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Executive summary

For quite some time, healthcare has been heralded as the next big opportunity for the Internet of Things (IoT). More than ever, today's IoT solutions have tremendous potential to enhance healthcare operations and generate overall improvements to care outcomes, cost and efficiency alike. But that great opportunity has, to a large extent, failed to materialize; thus, the adoption of IoT within healthcare settings has been much slower than anticipated.

This is all changing dramatically, however, as healthcare providers increasingly adopt telehealth solutions as a means to improve patient safety in today's COVID-19 "new normal." Most of the technical challenges that inhibited early healthcare IoT solutions have been overcome. New IoT solutions for healthcare are smarter and, more importantly, tailored to the needs and requirements of healthcare organizations. With 5G being rolled out, now is the time for healthcare providers to set their IoT roadmaps.

1. Current state of IoT in healthcare: what is changing now?

A big reason for the initially slow adoption of Internet of Things (IoT) in healthcare is that vendors underestimated the unique needs of the healthcare industry, an industry often seen as conservative, or slow moving. The reality, though, is that IoT is a logical by-product of care providers' primary focus on patient safety and risk minimization; an error might, in the worst-case scenario, mean that somebody dies. Just like with new drugs and medtech equipment, healthcare provider processes need to be tested and validated intensively to ensure that patient safety is not put at risk, something that vendors of new solutions often fail to fully comprehend. Therefore, new technologies need to either fit within existing processes or generate significant improvement to patient outcomes and/or care standards in order to motivate changed ways of working.

The first push towards healthcare IoT happened well before healthcare organizations and the technology were ready. But this is now changing, and the factors that will enable healthcare providers to successfully implement IoT solutions are falling into place.

Healthcare organizations are now rethinking their ICT architecture, moving away from legacy "homebrew" solutions to more enterprise-based implementations, enabling ecosystems and service-based design. Moreover, the global spread of COVID-19 has forced healthcare providers to accelerate adoption of telemedicine, eHealth and other remote technical solutions in order to secure patient safety by reducing the risk of infection. This will increase familiarity with digital tools and fast-track the development of new processes, leading to accelerated adoption of IoT solutions more broadly.

In addition, payers and insurance companies are driving healthcare organizations to rethink data management, through greater information-sharing demands. Payers are investing in data analytics and new technical solutions and are increasingly ready to pay for preventative measures as well as shifting focus of reimbursement models from procedures performed to outcomes. This requires not only accurate and timely information to continuously flow from healthcare providers to payer but also data that is several orders-of-magnitude better and common informatic adherence between organizations.

Moreover, device manufacturers are increasingly digitizing their products and assessing app developers and software companies to understand how to generate valuable data insights and easy-to-use interfaces. Device manufacturers already understand data safety and privacy requirements and are closer to care providers' needs and processes; thus, they can guide development partners and healthcare partners alike in the right direction.

So attitudes towards using technology as an enabler to provide better care are changing. Healthcare organizations are rethinking their ICT infrastructure, while payers and insurance companies are expecting better data. But what about the connectivity required to fully leverage IoT solutions?

There are solid connectivity options available

The most common connectivity solution in most hospitals is a combination of cable (e.g., for computers, critical medtech equipment) and Wi-Fi (e.g., personal devices, non-critical equipment). Most IoT use cases that have been widely adopted in healthcare settings have been low-power track-and-trace solutions (e.g., RFID tracking of carts, trays and handheld devices), generating efficiency improvements but without significant impact on costs or improvement of patient outcomes. Moreover, the mobile devices are very often separated from the data-generating and gathering systems by stringent firewalls, meaning communication between them is severely limited. This setup restricts the number of medical "things" that can be connected. Indeed, if all the equipment that would be connected were to be connected by cable, there would be room for little else. And anyone who has used Wi-Fi in a crowded space knows the challenges involved. In a recent study on network coverage in hospitals, 47 percent of hospital staff reported poor Wi-Fi coverage, and 39 percent reported poor cellular network coverage.

Use case: available in the field, on demand

The ambulance is often the first step in emergency care; the better care that can be provided early on, the better the outcome. Hence, ambulances today are equipped with advanced diagnostic and treatment tools (e.g., ECG monitors, automatic ventilators, nebulizer and ultrasound).

But actual care specialists (e.g., stroke specialists) are generally not physically available within the ambulance setting. Implementation of telehealth solutions therefore have begun to further improve delivery of timely care. These solutions include videoconferencing as well as connected medical devices that transfer measurements in near real time to a remotely connected specialist who, in turn, can provide on-site assistance or better prepare hospital reception. AR/virtual reality (VR) solutions are also increasingly used in this context (e.g., ambulance staff can wear AR glasses that transmit images in real time to doctors).

The technical abilities required to enable the process are to a large extent shared with other telehealth use cases, which emphasizes the need to have a cluster-based or more holistic approach when looking at use cases and their required architecture in order to place them into a common roadmap.

Technical development also needs to be considered, where, although the abilities mentioned above can be established as of today, the technology of tomorrow enables even further possibilities (see Figure 1). For instance, higher-resolution data, both in volume and time, is enabled by 5G connections. In another example, remotely controlled drones are being piloted using 5G technology, with high-resolution video being transferred from an accident site to a control center and then to a moving ambulance to better plan the best mode of action upon arrival.

Figure 1: Improving emergency response times

Step 1 – Connected hospital

The ambulance takes the patient to the nearest hospital, where specialists are available remotely and treatment can start faster

Step 2 – Connected ambulance

High-resolution monitoring and video in ambulance are employed so that specialists can connect directly to on-site care personnel, allowing treatment to begin even earlier

Step 3 – Connected drones

A video-enabled drone, equipped with medical devices, is sent to the patient or accident area before the ambulance arrives to enable planning of on-site actions and possibly treatment

Source: Arthur D. Little analysis

But there are other technical solutions available that could meet the needs of healthcare providers better than the setup often employed today. While full 5G will enable a number of additional use cases in healthcare, it is not the silver bullet it has been made out to be, so there is no need for care providers to wait for 5G to become available before starting to build out their IoT roadmaps. Private 4G and LTE network solutions available in the market today cover the needs of a large set of use cases still not in broad use but that have the potential to reduce administrative burden and improve healthcare operations.

A private network is essentially the use of cellular connectivity over a specified space and for a specific set of users. That means that a certain capacity and speed can be guaranteed, as opposed to public networks (or Wi-Fi), which depend on the number of people using the network simultaneously. The ability to maintain a stable connection for moving objects will vastly increase the usability of IoT. For example, the Memorial Health System Clinic in Springfield, Illinois, USA, leveraged an OnGo private LTE network to provide reliable connectivity for COVID-19 triage tents, and Kaiser Permanente is reviewing an investment in private LTE networks for hospitals within its plan and starting to work with device vendors to ensure device compatibility.

An LTE private network built today can be designed to be easily upgradeable to 5G when it is available. In fact, to be ready for a full 5G launch, organizations that want to reap the benefits should start planning today. For further details on private networks and 5G, see our Prism article "Realizing the potential of the Internet of Things with 5G."

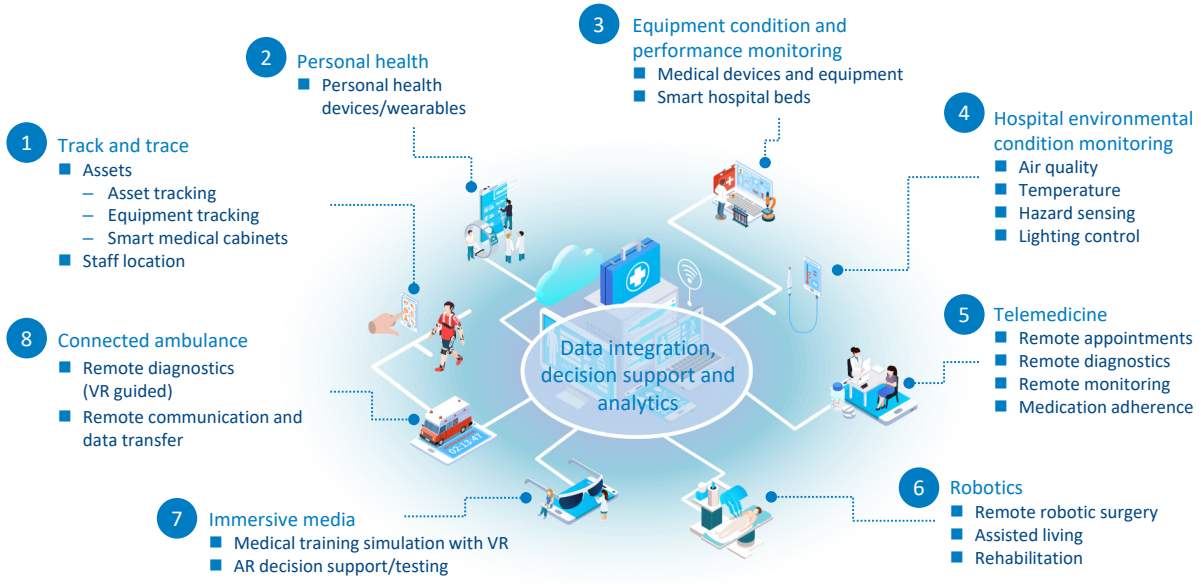
What are the IoT options for healthcare providers?

While the world of IoT can seem complex and contain a myriad of solutions, most IoT use cases are built up around a number of core functionalities ranging from simple track-and-trace solutions all the way to complex automation. These functionalities can, in turn, be leveraged to enable the key pillars of a smart hospital: clinical excellence, patient-centric care and operational efficiency. Figure 2 provides an overview of the different types of IoT solutions relevant for care providers.

But where should healthcare organizations begin? Once patient data comes into play, the level of complexity increases. Therefore, many organizations choose solutions that connect equipment but not patient data directly. To better track admissions or patient movement, for example, care facilities can use smart hospital beds rather than patient-tracking devices. The smart bed reacts to the weight of the patient and transmits a signal that the bed is occupied, providing an easy way to monitor occupancy in real time. When combined with information about the patient occupying the bed (in a safe system), care staff can track how often the patient gets out of bed, if the patient is in the room, and so on.

While starting with a few use cases as test beds, it's vital to keep the bigger picture in mind. This allows organizations to build up the appropriate infrastructure, while also planning for future requirements to ensure that infrastructure can scale up. The big gains from IoT will not come from connecting a few pieces of equipment, but rather when more "things" are connected, more data is generated and more advanced use cases and bigger gains are enabled.

Figure 2: Different types of IoT solutions relevant for care providers



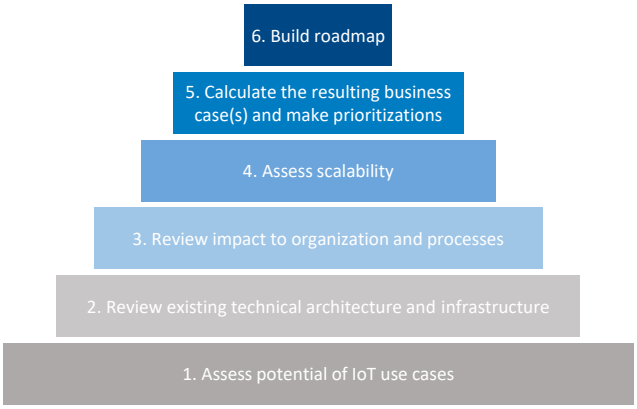
Source: Arthur D. Little analysis

2. What are the next steps for healthcare providers?

What should healthcare providers do to start building up IoT capabilities? The starting point should be to look at what options are available today, how technology is developing and most importantly, what needs can IoT solve for your organization? What are your IoT goals? What are you looking to gain? How do you get there? What will it take?

Arthur D. Little believes it is imperative to approach the possibilities with a broad, long-term perspective. Since healthcare adopts new solutions cautiously and slowly, establishing a longer game plan is the only way to ensure sustainability. Thus, it is key to plan around a portfolio of use cases to ensure that the infrastructure and processes being built up will be suitable for all planned use cases as well as capable of being scaled up for future applications.

Figure 3: Six-step roadmap for healthcare IoT solutions



Source: Arthur D. Little analysis

As Figure 3 illustrates, we propose a six-step approach to build a cohesive roadmap instead of procuring IoT solutions to solve single problems:

1) Assess potential of IoT use cases

What are the needs and pain points that you hope to solve? This may range from practitioners spending too much time on admin tasks instead of patient care, to equipment getting lost, to varying air quality issues in the clinic or hospital setting. Which processes are seen as burdensome? Where do you need to reduce risk? The greatest potential of IoT in healthcare is the ability to reduce time spent on menial tasks so that time can be freed up for value-adding activities.

What solutions could address the pain points? Identify different approaches and technologies and start looking at what is readily available on the market (e.g., either in modularized parts or as end-to-end solutions). Analyze how these could interact or be adapted to solve the different use cases.

What would solving the pain points enable? How would patient outcomes improve, costs be reduced or efficiency improved if you managed to address those needs? What is the value of those improvements (e.g., enabling preventative care, keeping patients out of the hospital, improving care outcomes for patients in hospital or reducing costs so that more patients can be treated for the same cost)?

2) Review existing technical architecture and infrastructure

What are the gaps between where you are today and what you would need to support the use cases? Some use cases will require new infrastructure investments, whereas others can be implemented easily on top of existing systems. What would it take for you to adopt the needed infrastructure (i.e., cost, time and resource requirements)? How will it fit into your existing architecture and roadmap? Depending on the organization's current technical abilities, a large upfront investment might be needed, or a different approach needs to be considered. If the solution requires a large investment, how can you future-proof it to ensure that your organization can leverage its investment for use cases further ahead in your roadmap as well as for immediate ones?

Use case: from smart beds to hospital cockpit

One example of how connected equipment can add value both in directly improving quality of care and indirectly contributing to improving operational efficiency is the use of smart hospital beds.

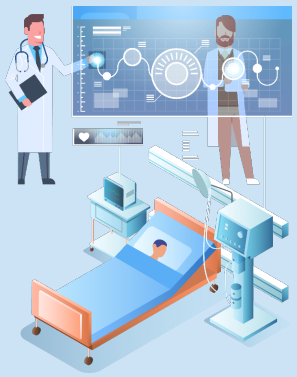
Smart beds use contact-free sensing and real-time analytics to monitor patients and thus improve care outcomes. Integrated bed sensors can monitor a variety of patient data and vitals (e.g., weight, body temperature and heartbeat) and detect blood, oxygen and pressure levels. The beds also record patient movement (e.g., if patients have left their bed and how often nurses have turned them); some can communicate with a patient verbally (e.g., remind a patient to refrain from getting up).

One such example is Multicare, an intensive care and therapy bed designed by LINET, which helps prevent pressure ulcer development through bed articulation, which increases envelopment capacity in the sacral area.1 This is critical for patients with medical conditions that prevent them from being turned manually. The vascular position capability optimizes venous return and reduces swelling (edema) and back pain.

Real-time alerts from the smart bed on sudden changes enable physicians to provide responsive care and intervene in time-sensitive scenarios, especially in the critical or intensive care environment. A Harvard Medical School study found that EarlySense, an under-the-mattress and bedside-monitoring system that tracks patient's vitals, reduced the rate of code blue events by 86 percent and reduced the average stay of ICU patients transferred from the medical-surgical unit by 45 percent.2

Smart beds also eliminate the need for manual bed usage tracking, freeing up time for hospital staff to focus on patient care. With the tracking of hospital beds, hospitals gain insight and control on location, usage and security and can streamline the flow of patients in and out of beds with minimized waiting time.

GE Healthcare has taken this one step further, centering the smart bed in a comprehensive, patient-conscious healthcare network. The company has developed a "command center" (similar to an airline cockpit) to form a larger network of data and oversight. A key feature is the "Wall of Analytics," an array of real-time visuals, analytics and alerts from multiple sources across the hospital. In 2017, Toronto's Humber River Hospital collaborated with GE to open Canada's first command center, improving overall efficiency by 40 percent. The system has enabled the hospital to deliver care to more patients with the same number of beds and avoids a projected shortfall of around 50 beds by 2021.3



1 Multicare. LINET, 2020
2 Monegain, Bernie. "Harvard study assesses EarlySense." Healthcare IT News, 20 March 2014
3 "Can NASA-inspired Command Centers help the hospital of the future? This hospital thinks so." GE Healthcare, 22 December 2017

A specific point worth highlighting here pertains to IT security and ensuring patient data safety. While a high level of IT security and GDPR compliance often is built into the solutions readily available on the market, they more seldomly adhere to the much stronger and commonly country-differentiated patient data and medical device regulations, such as HIPAA in the US. Thus, when looking at potential solutions, you need to assess the geographies for which the product is being developed. To make a product available to all geographic markets, several analyses and certifications are needed, which will most likely require additional product development.

3) Review impact to organization and processes

Would implementation of the use cases disrupt existing processes? To what degree? Implementing new technical solutions will naturally have an impact on an organization and its processes. For healthcare providers, it is even more important to minimize disruption and ensure that patient safety is not compromised. Indeed, a small change to a high-risk process can be more difficult to implement than a big change to a simple process, or a process with limited patient impact. If changes to the process risk impacting patient safety, training programs become vital and the time and complexity of change management will be increased.

Is the outcome worth it? What can be done to mitigate risks? It is obvious that it's not worth taking a major risk for a minor improvement, whereas it's a no-brainer to do so for a solution with a strong, positive impact and very low risk. But for anything not as clear-cut, how do you mitigate the risk and what is that cost?

4) Assess scalability

Are the use cases easy to scale? Can the use cases be combined in a logical way to enable better insights? Another crucial aspect to consider is how easy the use cases are to scale from a single pilot to covering multiple clinics, multiple sites or connecting different types of equipment. There is also scaling across multiple use cases to consider in order to ensure that data generated from one use case can be combined with data from one or multiple other use cases to enable actionable insights.

5) Calculate the resulting business case(s) and make prioritizations

What budget is available for the assessed time period? What use cases offer the best ROI relative to its business impact? In order to make an informed decision, business cases need to cover all costs related to the implementation and management of the new solution, as well as the gains to be made – including both direct financial improvement and, more importantly, quality of care and patient outcomes.

Which use cases should you prioritize? Given budgetary restrictions, costs and impact of the use cases, decide which ones to prioritize.

6) Build roadmap

When can and should you start implementing each use case? Build out a roadmap of the prioritized use cases – taking into account when technology will be ready and when budgets are expected to be available, as well as what rate of change the organization can reasonably manage.

What impact are you expecting, what are key milestones and how do you measure success? To best keep track of progress against the roadmap and measure the impact of implemented solutions, organizations should be clear about their IoT program goals as well as what KPIs to use to measure whether the goals have been achieved. These should relate back to the pain points that the solutions were expected to solve, along with the expected operational and final outcomes identified in the business case.

Conclusions

While the expected near-term growth of IoT in healthcare has often been inflated, its potential has not. Healthcare organizations that succeed with IoT will have the potential to provide expanded and better care at the same cost through improved patient outcomes, reduced cost and improved efficiency.

While healthcare IoT adoption has historically been slow, technical developments, increased usage of eHealth solutions resulting from COVID-19, along with a push from medical device providers, now enable the right type of solutions. But to achieve successful implementation, several hurdles must be overcome. And most importantly, the solutions must be adapted to the specific needs of healthcare organizations.

Successful IoT implementation is about more than just the technical solutions – more than anything, it depends on optimal upfront planning ahead of implementation as well as apt change management throughout and after implementation.

Arthur D. Little has experience with IoT and technology providers as well as with hospital processes, operations and infrastructure. We use this experience to help healthcare organizations develop and implement actionable and impactful IoT roadmaps.

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Opportunities and path forward

Arthur D. Little

Arthur D. Little has been at the forefront of innovation since 1886. We are an acknowledged thought leader in linking strategy, innovation and transformation in technology-intensive and converging industries. We navigate our clients through changing business ecosystems to uncover new growth opportunities. We enable our clients to build innovation capabilities and transform their organizations.

Our consultants have strong practical industry experience combined with excellent knowledge of key trends and dynamics. ADL is present in the most important business centers around the world. We are proud to serve most of the Fortune 1000 companies, in addition to other leading firms and public sector organizations.

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