



Connected Health

The Path to Better, More Integrated Care and Health Outcomes

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Connected Health is helping to define the future of care through the convergence of technology, healthcare, research and public policy—and the time to get in on it is now.

Imagine a world where...

...People spend less time traveling to medical appointments because they can get many checkups and consultations at home

... Every patient has a single 360-degree medical record continuously updated by care teams, devices, and self-reporting—not sporadic office visits and one-off lab reports

...Highly visual, personalized dashboards streamline physician workflow and help analyze patient data in real time

...Intelligent hospitals track assets as they move through self-regulating buildings to improve quality of care, safety, comfort, and efficiency

...The costs and complications of chronic disease begin to drop as remote patient monitoring and virtual coaching become routine practice

...Vast quantities of aggregated health data inform medical professionals, population health, and public policy—without compromising individual privacy

The Power of Connected Health

Welcome to the world of Connected Health, where smarter, faster, more accurate interactions between people, devices, data, analytics, and applications are transforming the way healthcare is delivered.

A convergence of challenges and enabling technologies are bringing change across the care spectrum—and the pace of change is accelerating.

Here today are network-enabled medical devices, such as stethoscopes that can transmit cardiac data directly into the patient's electronic health record (EHR) for fast, accurate, data-rich capture.¹ Wearable devices and wireless pill bottles monitor vital signs as well as adherence and issue alerts, permitting more people to stay in their homes. High school football players get possible concussions evaluated in real time right on the game field by remote clinical experts.² Real-time location system (RTLS) badges, mobile apps, and digital displays guide and inform patients and visitors throughout hospital facilities, improving quality of experience.

These examples represent just a small fraction of changes being fueled by the digital era, and by the migration to a Connected Health ecosystem.

What Is Connected Health?

While definitions vary, Connected Health is more than just wearable devices or one-on-one telehealth consults over distance. It is a web of intelligent communication and actionable information sharing with the intention of improving patient outcomes. It is enabled by a fabric of technology, in which people, processes, and devices are all capable of working together.

According to IDC, "Smart connected health encompasses a broad range of technologies that use telecommunications to facilitate the exchange of health information and the delivery of healthcare services, typically across a geographic distance, as well as manage chronic conditions and promote health and wellness. Real-time or near-real-time access to health information and clinical care alerts, along with evidence-based guidelines and clinical decision support tools that create actionable information, enables better decision making and more timely delivery of care."

– Source: IDC TechScape: U.S. ConnectedHealth Technologies, 2016. April 2016, IDC #CA40503716¹



More simply, we define Connected Health as connecting doctors to data, connecting patients to healthcare providers, and connecting practices to networks—all with the objective of delivering better, more integrated care and health outcomes.

Enter in the Internet of Things in Healthcare

While Connected Health builds on decades of healthcare-specific experience with mobile health (mHealth) and telehealth solutions, it is propelled by a rapidly evolving Internet of Things (IoT) that connects intelligent sensors, devices, software, and networks across the Internet.

Companies across industries are scrambling to put ecosystems of IoT to work to deliver new kinds of applications, products, and services for tracking, analysis, and coordinated action.

In the health industry, terms such as the Internet of Things in Healthcare and Internet of Medical Things (IoMT) are used to describe the IoT fabric that makes Connected Health possible.

What Is the Potential Impact?

According to a report from MarketResearch.com, the Internet of Things in Healthcare is expected to reach \$117 billion by 2020,³ while the mobile health segment continues to reshape care delivery, with an estimated growth of \$59.15 billion by 2020.⁴

Skeptics might doubt that the healthcare industry, noted for its slow adoption of information technology, will undergo dramatic change quickly. However, powerful drivers and enablers are converging in ways that signal that a tipping point is indeed on the horizon.

Connected Health



The Connected Health ecosystem leverages innovation in sensors, devices, connectivity, and apps for a new level of data-driven patient-centered and patient-empowered care. It enables continuous 360-degree medical record data collection over time, not just point-in-time office visits, and it benefits patients, caregivers, hospitals, populations, and policy makers.



Growing Urgency

There is an increasing consensus about the urgency of moving the needle on seemingly intractable healthcare challenges of access, quality, and cost.

Aging populations, chronic disease

Two compelling drivers are aging populations and the high incidence of chronic disease, which consume a disproportionate amount of health resources. In the United States, an estimated 75 percent of healthcare dollars are spent on chronic disease care, and two out of every three Medicare patients suffer from at least two chronic diseases.⁵ Rehospitalizations for preventable health issues are estimated to cost \$17 billion a year.⁶ The pressure for relief will grow as the population ages with approximately 10,000 new patients estimated to enroll into Medicare every day for the next 15 years.⁷

Connected Health shows great promise in helping to improve the health of patients with chronic conditions. For example, combinations of remote monitoring and TeleHealth solutions have repeatedly been shown to cut readmissions of high-risk patients with congestive heart failure (CHF) by more than half.⁸ Patients with chronic conditions who engage in frequent video chats with their doctor find it helps them keep lifestyle changes on track.¹³ Ever-more affordable and easier-to-use devices, such as wireless scales and heart rate and blood pressure monitors will extend these benefits to more of the chronically ill.

Data-Driven Decision Making

Providers, patients, and policy makers are all demanding more evidence-based insight. To be successful, Connected Health must be capable of analyzing more data from more sources and offering up the right data at the right time. When it does, it has great potential for improving outcomes while reducing costs. Examples include:

- Identifying trends and patterns through analysis of richer and continuous streams of patient data
- Improving workflow through analysis of real-time location and performance data, which can help pinpoint bottlenecks and gaps and inform decisions about restructuring roles, training, and staffing schedules, integrating the right technology in the right way, and creating meaningful incentives
- Cutting cost and risk through real-time tracking of medicines and other inventory to reduce error, waste, and theft

Patient Engagement

Many patients and their families are demanding the kind of convenience, choice, simplicity, and price transparency they experience when shopping online for other products and services.

While the medical community is waiting on evidence-based insights, the popularity of motivational wearable devices such as FitBit®, and the doubling in the use of mobile fitness apps⁹ are significant for other reasons. Their adoption reflects a growing pursuit of optimized “wellness” that tracks with other trends toward more personalized medicine. It also reflects comfort with physically attached devices collecting personal health data.

Many health systems are responding to consumer demands and looking to improve the patient experience by opening access to the patient’s EHR and clinical notes through patient information portals. Others are beginning to offer texting, email, live chat, and video consults with care providers, as well as opening online access to physicians’ calendars so patients can make their own appointments.

Enabling Technology

At the same time the demand for Connected Health is being driven by diverse forces, it is being enabled by technological innovation and maturation. Including:

- **Digital health data:** HITECH, ARRA, and ACA regulations have pushed providers to digitize their health data and adopt EHR.
- **Device innovation:** Including sensors, devices, mobile and embedded systems such as radio-frequency identification (RFID) chips, wearables, personal emergency response systems (PERS), and real-time location services (RTLS). Global market opportunities, competition, and economies of scale are driving down cost, complexity, and size—and driving up innovation in reliability, battery life, and connectivity.
- **Connectivity:** The ubiquity of network access, bandwidth, and coverage (RFID, WiFi, Bluetooth, M2M wireless services) combined with device connectivity make it possible to connect billions of physical objects to the Internet for anywhere, anytime data acquisition, transmission, and sharing.
- **Cloud:** Cloud computing brings advantages of lower cost and seamless incremental scalability. With hybrid cloud and managed hosting, providers have the flexibility and security required to augment private on-premises computing as data and devices grow.





- **Big data / analytics:** Real-time analytics of structured and unstructured data from multiple sources enable new kinds of applications by helping to make sense of data—from simple binary algorithms at the device level, to more sophisticated, multilayer, predictive analytics and machine learning—for example, smart medical imagers that can “learn” and help highlight abnormalities or changes from previous scans for further review. Still further, the aggregation of data across populations enable data-driven policy and disease management.

Turning Promise into Reality

In essence, the promise of Connected Health is improved, simpler, more efficient communication and collaboration and the ability to make more-informed decisions, based on better information, presented at the right time and in the right context.

Familiar and New Challenges

A mix of new and familiar challenges stand in the way of full realization of the Connected Health vision.

Legal, regulatory, and reimbursement hurdles

Strict mandates are often cited as the reason for the slow IT adoption in healthcare, and it makes sense that these safeguards be in place where decisions and actions mean the difference between life and death.

For instance, physicians and other caregivers are not allowed to deliver telemedicine services across state

lines. Lagging reimbursement policies have also slowed telehealth adoption and innovation. Recently, Centers for Medicare and Medicaid Services (CMS) started reimbursing for live face-to-face telehealth services between patient and provider for those with multiple chronic conditions. In most states, CMS will not pay for store-and-forward applications, for example, the transmission and remote evaluation of images of skin lesions. Different states have various standards by which their Medicaid programs will reimburse for telehealth expenses.¹⁰ There is also no single widely accepted standard for private payers and patients, who often need to seek prior approval. Still further, the U.S. Food and Drug Administration (FDA) is struggling to keep pace with the volume of 510(k) submissions to translate consumer-grade devices to medical-grade status.

New kinds of security and liability issues

The healthcare industry has long struggled to protect patient privacy and meet stringent HIPAA requirements. With Connected Health, the threat of security breaches grows. Indeed, the very connectedness that delivers value also expands risk beyond the disclosure or theft of private health information to manipulation of devices and programs located within and outside of healthcare facilities. The vulnerability of wearable and implanted devices connected to the Internet is especially concerning, because hackers could gain control of a device and alter commands. For this reason, some heart patients decline remote monitoring of their pacemakers by their doctors. In 2015, the FDA issued its first alert about the cybersecurity risk of a specific medical device.¹¹ In addition to expanding regulatory attention on networked clinical devices, the alert signaled that the responsibility and liability for addressing cybersecurity vulnerabilities encompass both the device manufacturer and the healthcare facility’s computer network.

Too much data, too little insight

In theory, the more data and data sources that can be combined, the better the insight and conclusions that can be drawn. However, with growing volumes of longitudinal data from connected devices, the challenge becomes making timely sense of all that data, especially for physicians and other clinicians, who are already overwhelmed by information and demands on their time.

Lack of integration and interoperability

HIMSS defines interoperability as “the extent to which systems and devices can exchange data, and interpret that shared data. For two systems to be interoperable, they must be able to exchange data and subsequently present that data such that it can be understood by a user.”¹²



With Connected Health, longstanding issues of healthcare IT interoperability and integration are exacerbated. Hospitals, already juggling technology from different suppliers, now face the prospect of more sensors, devices, gateways, controllers, routers and databases—all with their own protocols.

How Are Challenges Being Addressed?

Government, policy, and industry leaders are partnering to overcome the barriers to Connected Health through a combination of policy reform and technology initiatives to reduce complexity and security risks.

Policy and Process Reform

A mix of new and familiar challenges stand in the way of the full realization of the Connected Health vision.

Reforms include value-based reimbursement and new regulatory guidance on medical devices.

Realigned reimbursement and incentives

Connected Health, with its ability to aggregate and analyze large data sets, will itself play a role in helping to objectively determine the “value” a service delivers, helping to inform “value-based” reimbursement and incentive policies.

Even with limited reimbursement, Medicare patient telemedicine visits have increased more than 25 percent year over year for the past decade.¹³ In early 2016, CMS added the first two Current Procedural Terminology (CPT) codes for telehealth services.¹⁴ Also in early 2016, Congress introduced legislation, endorsed by 40+ medical associations, including the American Medical Association (AMA), which would expand the use of telehealth and remote patient monitoring services in Medicare.¹⁵ In addition, insurance companies are increasingly recognizing the value and reimbursing a wider variety of telemedicine services. As a result, the global telemedicine market is expected to hit \$66 billion by 2021.¹⁶

With the end of the Meaningful Use (MU) incentive program, CMS is moving away from a focus on specific technology to a focus on outcomes. The agency promises greater flexibility for providers to customize goals and a level playing field for new entrants. It is requiring “open APIs to allow apps, analytic tools, and connected technologies to get data in and out of an EHR securely” and is “deadly serious about interoperability.”¹⁷

Regulatory guidance

The FDA has taken an increasingly active role in the regulation of Connected Health technologies and now requires a unique device identification (UDI) for every medical device and model, which is listed in a public database. The FDA also provides a website for patient feedback on medical devices, released draft guidance on securing medical devices, and recently clarified and expanded its definition of UDI compliance.¹⁸

Reducing Technical Complexity and Risk

A range of technical approaches and initiatives seek to reduce the complexity and risk associated with Connected Health.

Architecture and services

Open standards and service-oriented architectures (SOAs) are making it easier for devices, data, and applications from multiple sources to work together, by plugging into existing frameworks. Efforts include:

- **EHR APIs:** EHR vendors have begun opening their products by releasing application programming interfaces (APIs) for import and export of data.
- **Health Information Exchange (HIE):** HIEs are architectural frameworks that set standards for exchange, integration, sharing, and retrieval of health information. The Chesapeake Regional Information System for our Patients (CRISP), for example, is a regional HIE developed to make it easier for healthcare providers in Maryland and the District of Columbia to build systems that will work together.
- **Fast Healthcare Interoperability Resources (FHIR):** FHIR is a vendor-neutral HIE framework being developed by Health Level Seven International (HL7).¹⁹ It is setting a global standard that providers and their vendors can use to develop and deploy solutions that can exchange usable data.
- **Integration Platform as a Service (iPaaS):** iPaaS takes integration a step further by delivering it as a cloud service, and it eases interoperability complexity by helping organizations develop, execute, and govern integration flows to integrate any combination of cloud and on-premises applications without software, appliances, or coding. Healthcare organizations can greatly reduce the cost and effort associated with traditional systems integration projects, middleware licenses, Master Data Management (MDM), and API management solutions.

Patient-centric data repository

Patient-centric repositories make it easier for data from multiple diverse sources to work together and provide each with a longitudinal view of a patient's medical history. A master patient index pulls a patient's data together from multiple encounters in different clinical facilities, even if those facilities do not connect to each other, and back-end integration of structured and unstructured data, images, and forms presents a 360-degree picture.

Data analytics and decision support

A number of entrepreneurs are working on bridging the gap between device data streams and EHR. Some are focusing on developing new user interfaces and dashboard applications that integrate, analyze, and present data collected from devices and EHR. Others use layered data integration and analytical platforms to display meaningful results within the existing EHR application. Virtual digital assistants that work with physicians to find information in EHR systems is another approach.

Developers inside and outside of health organizations are also leveraging techniques and technologies developed in business decision support to develop clinical decision-support tools. These tools leverage high-performance computing, intuitive interface design, the proper security layers, and advanced data modeling and predictive analytics to filter and present relevant data and identify patterns and trends.

New approaches to security and data governance

Protecting patients, devices, systems and data will always

require new techniques and tools to stay one step ahead of risks.

Innovations, such as new access layer security approaches, proactive security analytics, and 360-degree security dashboards that tie security intelligence across endpoints, network, user, and application are supplementing proven practices, such as identity and access management, data encryption, next-gen firewalls, and application vulnerability management.

Biometrics, identification, proximity, and smart cards, combined with single sign-on technologies, simplify secure access by authorized users. In addition, strengthening security by eliminating multiple complex passwords that invite workarounds, combined with secure "follow-me" workspaces, accessible on different devices and in different locations, greatly boost workflow productivity.

Another innovation that helps strengthen and simplify security is an intelligent gateway at the network edge. An edge gateway acts as a smart security bridge between traditional systems, sensors, and devices for all types of connections. Gateways can apply encryption, provide hardware-level security, and perform analytics and edge complex events processing. They can also validate data (ensure data has not been corrupted or compromised and is coming from the device from which it is supposed to be coming) and aggregate data from multiple sources. Once the gateway has analyzed and validated information at the edge, the data is further screened at back-end firewalls for viruses and other anomalies before being stored in the data center or the cloud.



Secure by Design

- 1. Harden devices:** Asset management, configuration management, performance, advanced malware protection on endpoints, device-level authentication
- 2. Protect data:** Data protection in transit and at rest, encryption
- 3. Ensure right access:** Content aware authentication and role-based authorization that do not get in the way of access for people and things
- 4. Provide the deepest level of protection:** Next-generation firewalls and continuous threat intelligence
- 5. Move to intelligent, proactive security:** Move from passive to proactive security with big data / analytics that help predict and prevent as well as help improve response

Secure by Design—Health organizations get intelligent, proactive security by the numbers.

How Can Organizations Get Ready for Connected Health?

In a world of Connected Health, the role of technology is more critical than ever. CIOs and their teams must play an active role, collaborating with clinical, operations, and financial experts to identify opportunities and forge solutions. Although the scope of Connected Health can be daunting, there are ways organizations can start now to be part of it.

Start small and focus on ROI

Organizations can move forward to gain experience and success by starting small, often with what is already in place, looking for use cases that have a clear ROI centered around the patient. For example, many may already be using digital devices in the ER or for TeleICU or TeleStroke, but data may not yet be connected, collected, or analyzed. Brainstorming by cross-functional teams can help identify where a small investment will yield measurable payback in terms of better care, improved outcomes, and lower costs. Once a value for a Connected Health solution has been established, you can then look to expand to other areas.

Architect for analytics

In designing solutions, teams should begin where insight or intelligence is missing—and map the required data flow to fill the gap. What data is needed? What are the data sources? Who will use the information and how? What protocols and tools will make it easy to bring in additional data and analytics later?

Secure by design

Health organizations must think security first, last, and always. What are the data-governance and security requirements? What users, applications, and devices will have access, and how will authentication and validation be managed? Security experts can help, first with a review of existing security practices, then by assessing the impact of new solutions. They can guide health organizations in designing and deploying a multifaceted security approach with identity management, access management, encryption, proactive security analytics, and network security.

Select the right partners

Healthcare organizations should seek out the right partners to create a Connected Health ecosystem, rather than trying to do it all. In addition to leveraging open standards-based, technology and device-agnostic architectural frameworks to connect with best-in-class healthcare solutions, organizations should look for technology partners with firsthand experience in converging healthcare information technology and IoT, security, networking, and information management. Partners with relevant experience in other industries can save time, effort, and money—for example, how data repositories in manufacturing might serve as a model for a patient-centric data repository, or how retailers keep transactions secure in wireless environments.



Next Steps to Connected Health

With 25+ years of experience in delivering healthcare information technology solutions to global health and life sciences organizations, Dell is well positioned to help you obtain a Connected Health ecosystem. Dell is a recognized leader in IoT, mobility, cybersecurity, and cloud computing. Our portfolio of healthcare solutions and services enable you to consolidate existing infrastructure to drive better care coordination, implement care anywhere, create anytime delivery models, adopt a data driven approach to improve health outcomes, and maintain security and privacy of patient and organization data. Talk to us today about how we can help you achieve better, more integrated care and health outcomes.

For more information, visit Dell.com/healthcare or contact your Dell Healthcare Strategist.



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