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Connected Health

Sector Innovation Series

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Connected Health Overview

Healthcare systems around the world were significantly challenged by the fast-moving SARS-CoV-2 pandemic in 2020. The speed with which the coronavirus, or COVID-19 spread caused hospital systems to become overwhelmed and the ability for many people to get urgent care was impacted severely. Healthcare professionals responded valiantly in the face of rising casualties to care for those afflicted with the aggressive symptoms of the virus. COVID-19 strained not only the healthcare providers and emergency responders but also the supply chain providing personal protective equipment (PPE), ventilators and other medical devices needed to treat those infected.[1]

Another major challenge was the containment of the COVID-19 spread. Health monitors in municipalities all over the globe were trying to keep track of how and where the virus was spreading in order to take appropriate measures to slow the infection rates. This was particularly difficult due to the highly contagious nature of COVID-19 and the airborne transmission from infected individuals. One person could infect a large number of people they came into proximity thus compounding the problem. Testing and diagnosis had to be developed at unprecedented speeds to keep containment from disintegrating. Lab infrastructure had to be adapted rapidly to support the new testing for COVID-19.

Vaccine development also had to be accelerated by the global research efforts through the intensive sharing of genetic sequencing information and application of machine learning to determine candidate mRNA treatments. A process for producing a vaccine that typically take years had to be done in a matter of months.

COVID-19 accelerated the disruption already taking place in the healthcare sector dramatically. From diagnosis, intake, care and recovery to testing, vaccine development and distribution, the pandemic has transformed the global health sector in many ways that would have otherwise taken a longer time to evolve. The rapid evolution involves not just the novel use of advanced technologies such as machine learning and AI but also how healthcare knowledge workers collaborated to respond to the crisis. In this report, the accelerated transformation of the connected health sector will be presented in order to provide insights on where the opportunities for more innovation exists.

Health Sector Business

Before going further into the challenges of the health sector, it is instructive to understand the major entities or stakeholders in this diverse business environment. These stakeholders are the basis from which personas can be identified and developed in order to better approach designing for innovation. It is also to helpful to know what role each plays in the collaborative sector workflows and processes involved for providing patient care.

A major guiding principle in health sector innovation is to identify novel ways to improve the healthcare experiences for patients while managing costs and reducing inefficiencies. The quality of care is a key aspect of design that drives a lot of innovation to address the challenges in the health sector.

Healthcare Challenges

The challenges faced by the healthcare sector are multi-faceted, ranging from limitations imposed by archaic and siloed information systems to fragmented and non-coordinated business processes. The innovation opportunities in this sector can be approached effectively by designing for the right problems instead of searching for immediate solutions that only serve to propagate the current status quo. The challenges can be assessed with a designer's mindset so that the underlying needs can be met more efficiently. This report will describe innovative ways these sector challenges can be addressed with support from new technologies.

- **Costs** – How may healthcare costs be reduced through greater efficiencies in integration, sharing of information, and streamlined processes? How can these cost objectives be achieved without degrading the quality of care?
- **Accessibility –** How may health care be made more accessible through enhanced discovery and intake mechanisms?
- **Readmission** – How might patient care support be improved so that the probability for readmission is reduced dramatically?
- **Personalization** – How might healthcare providers deliver more personalized care for patients to provide better services and experiences?
- **Crisis Management** – What are the opportunities to provide better support mechanisms to healthcare providers in crisis scenarios? The COVID-19 pandemic provided a context to develop many insights that can be leveraged for innovation.
- **Supply Chain Fragility** – How might innovation solve the current limitations in the supply chain to enable a more responsive health sector, particularly in times of crisis?

Electronic Health Records Management

Electronic health records (EHR) represented an improvement in managing patient data over paper-based storage to start the evolution of the health sector into the digital age. EHR was focused on the sharing of information so that a patient's health and medical data (EMR) was more accessible by the different entities involved over the patient's care lifetime. EHR and EMR served to eliminate inefficiencies and increased responsiveness but implementations were not without risks and issues. Adoption by healthcare systems faced barriers due to costs of implementation, uncertainty in ROI, and the usability of the formats.[2] Another major concern was security of the patient data using EHR systems which led to legislation such as the Health Insurance Portability and Accountability Act (HIPAA) to project health sector consumers.

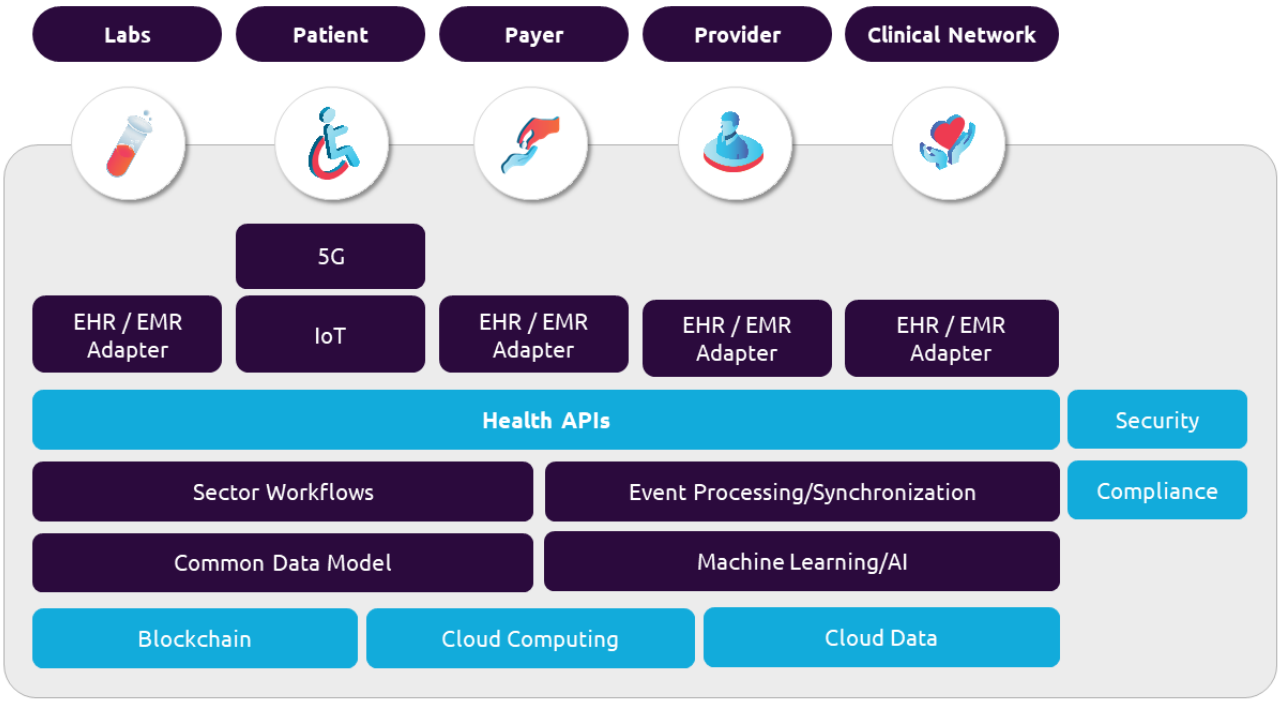
While EHR was a significant advancement in the health sector to address its challenges, new technologies provide many opportunities to make even better progress by leveraging the digital data more effectively, efficiently and securely. Many healthcare systems and practitioners have been using mobile technology to begin this evolution to build on EHR.

Another major aspect of the innovation opportunity in the health sector is to apply the lessons learned from EHR implementations to produce better outcomes for investments in digital technology. One major factor is the facilitation of customization of data interfaces to better suite a health sector entity's workflows and processes. A one-size fits all approach is not feasible in the sector so an approach to integration where costs are contained, and maintenance is managed efficiently is an imperative.[3] In any innovation consideration, security and compliance with existing health sector regulations must be at the forefront of design, development and deployment.

COVID-19 accelerated the disruption already taking place in the **healthcare sector** dramatically.

Connected Health Ecosystem

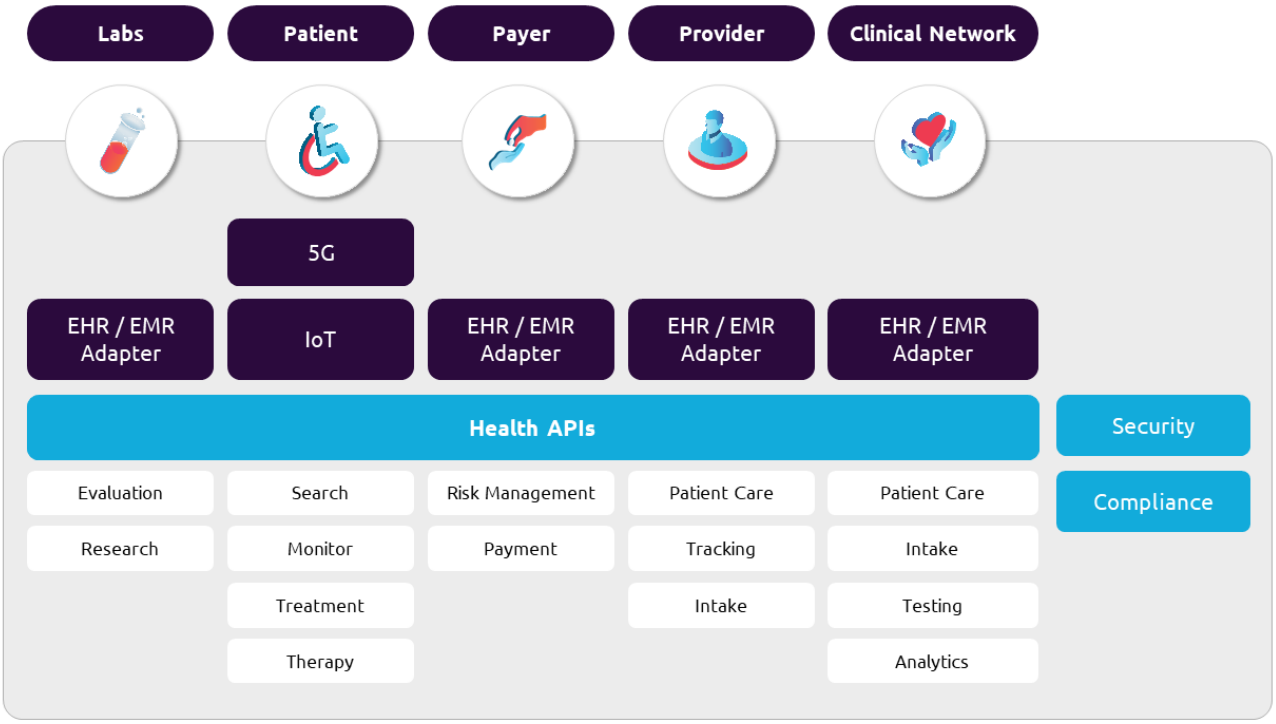
A connected health ecosystem consists of enabling technology layers that improve integration, enhance accessibility to timely patient care, improve tracking and monitoring patient health, and reduce overall risk in care delivery. Velocity is one aspect of the ecosystem that can be improved dramatically by leveraging cloud computing and data storage. Cloud technologies can also serve to mitigate risks by being able to better anticipate complications via predictive analytics and also be more responsive to emergency scenarios. In this section a holistic connected health architecture is presented to serve as a foundation for innovative solutions that can be leveraged throughout the patient care lifetime.



Connected Health Ecosystem

The design of the architecture recognizes the need to utilize cloud technologies to facilitate integration, collaboration, computation while mitigating risk and management costs. The cloud can also serve as a shared environment that provides secure access to services and data while meeting compliance requirements. A common backbone for these critical responsibilities reduces implementation costs as well as increases agility in the ecosystem.

A set of health APIs can be implemented on this architecture to provide services for different entities in the ecosystem. The APIs are endpoints by which the entities can integrate to collaborate and communicate more seamlessly. These endpoints can invoke workflows between parties or communicate events to better respond to patients needs. Synchronization services also keep data up to date as events are being processed.



Connected Health Workflows

A common data model is the canonical language in the ecosystem that enables easier integration to support the health APIs. The model provides an ontology for the data entities in the health sector domain. EHR/MHR adapters using the FHIR standard can be incorporated so that health care entities can achieve customization of data feeds according to the specifications of their particular workflows. An adapter framework would ease implementation thereby lowering costs for deployment and maintenance.

Machine learning capabilities in the cloud can enable more responsiveness to risk management and patient care trends. The data used to deliver these machine learning services is shared across health care entities and thus represents an agreement to use the analytics to better deliver patient care collaboratively. Mutual governance and oversight will be needed when leveraging cloud technologies in this architecture.

Preventative Wellbeing Wearables

Wearable devices with IoT capabilities are proving to be an effective means to provide preventative wellbeing services to consumers and patients. Wearables are connected products that are worn by the consumer such as a watch or bracelet. Fitbit and Apple Watch are two examples of wearables that are commonly used to keep healthy habits in place, from workout regiments to reminders to take medication. These devices interact with cloud APIs to ingest data and process events to take any actions needed based on the context. For example, an Apple Watch health application can be developed to provide specific, personalized care for diabetes patients. The app can even integrate with healthcare provider APIs to incorporate services that would deliver additional care value to help the patient receive higher quality, customized care.

Healthcare APIs, AI, machine learning and IoT technologies all play key roles in modernizing healthcare sector infrastructure for more **innovation.**

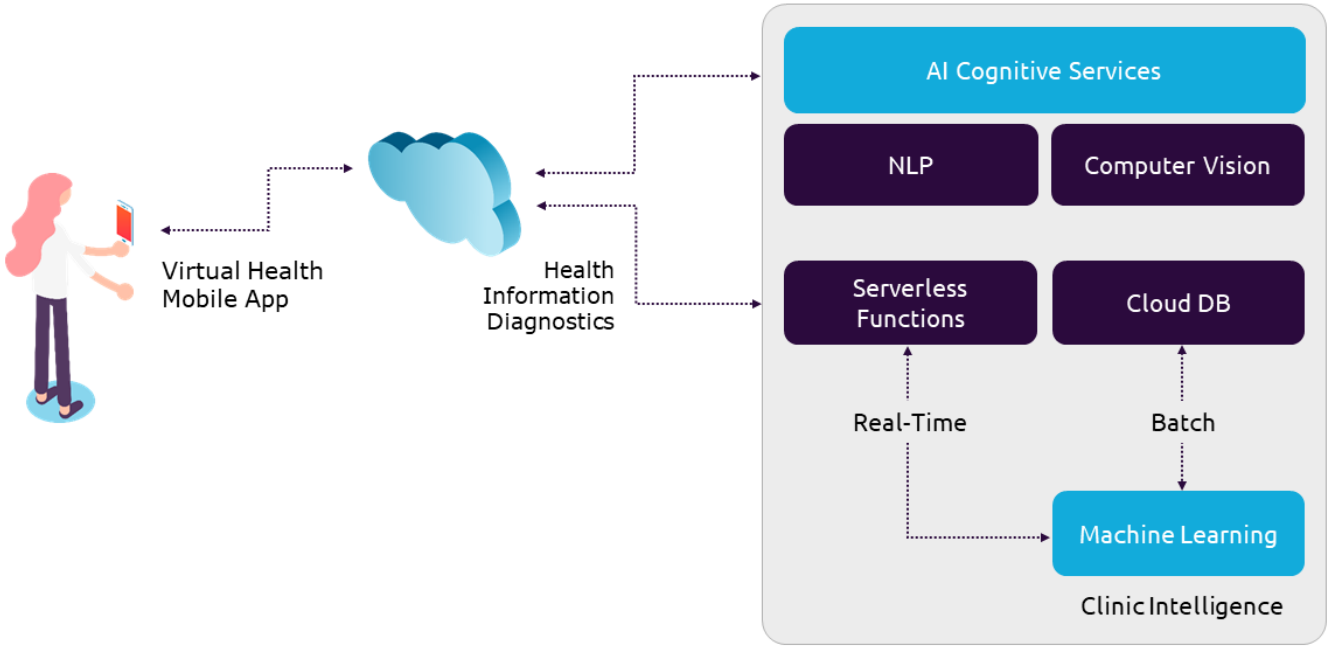
Apple Watch and Fitbit Wearables

Sogeti developed an Apple Watch health app that connected to an open healthcare API to enable a patient to find the nearest clinic. The patient receives a list of nearby clinics thereby accelerating time-to-care.[4]

Sogeti also created a Fitbit tracking application where data is transmitted to cloud services and then used by analytical processes to determine health metrics that could be used by payers to offer discounts or special offers on their insurance products.

Virtual Health

Telehealth interfaces and chatbots are also being increasingly utilized to provide virtual health services for patients. In the socially distant requirements during the COVID-19 pandemic, these types of virtual services accelerated in adoption by the health sector. The patient could interact with a health care professional via a video consultation without the need to go into a clinic or doctor's office. As 5G technology also increases in adoption, these virtual health applications can leverage that infrastructure to provide more interactivity and engagement for patients that need a greater level of accessibility to their healthcare needs. 5G enables richer, media-based applications at greater speeds and responsiveness and reduced latencies. The broader coverage for 5G also makes access to these types of applications more accessible, particularly for those in areas with limited Internet access.

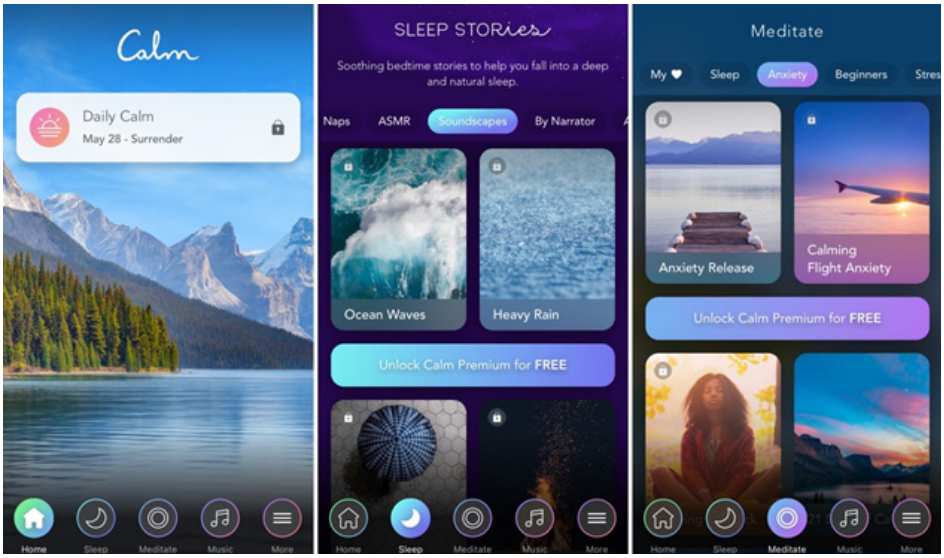


Virtual Health Architecture

Chatbots are another effective means to deliver virtual health advice to patients. Using a chatbot can provide answers to frequently asked questions in an interactive online conversation. Chatbots can leverage machine learning to be able to better respond to inquiries and deliver more accurate answers so that patients can develop a trust with the service. The chatbot may also have intelligence related to the specific patient so that more personalized virtual care can be delivered in a secure manner. This type of interaction can be an opt-in experience for the patient subscribed to the chatbot service.

Mental Wellness

Mental wellness applications are growing in popularity because of their effectiveness in helping consumers. Mobile applications present mental wellness features such as meditation and stress management in an easy-to-use interface. Given that stress is a major factor in causing many types of sickness, these applications provide an effective preventative self-care option for consumers that is convenient to incorporate into daily lifestyle. Calm and Headspace are two examples of these types of apps.



Intake, Care and Recovery Healthcare Experience Design

Healthcare experiences can be reimagined using design thinking to enhance patient engagement and ease the stress of the intake process for new patients. Digital touchpoints provide a way to interact with new patients to help them develop a perspective that will make admission easier to manage. Mobile applications can be developed to provide new patients with the ability to become more familiar with the admission process as well as get a better sense of the treatment or procedure they will undergo.

Healthcare APIs

Healthcare APIs can be leveraged to make it easier to find the right care provider. Simplifying accessibility through a discovery API helps the patient evaluate options for health care and also provide a channel for providers to make referrals. By unbundling health services and publishing them as consumable APIs, health care providers can reduce interaction costs in the ecosystem and encourage innovation. With APIs published, application developers can incorporate the capabilities into innovative healthcare products and services. The overall effect of open healthcare APIs is accelerating higher quality time-to-care.

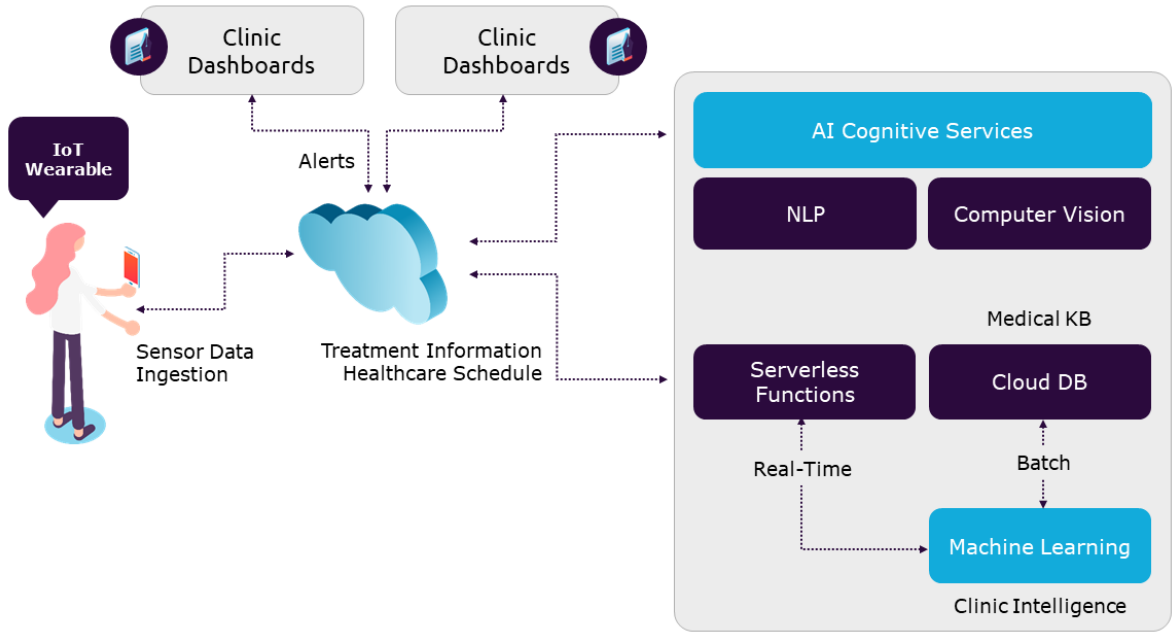
Healthcare experiences can be reimagined using **design thinking** to enhance **patient intake, care and recovery.**

As availability and diversity of healthcare APIs increases, software developers can create composite applications and services that bundle these capabilities to deliver greater value to patients and other entities in the ecosystem.

Clinical Systems Intelligence

Clinical systems can get better, more real-time intelligence by leveraging IoT data as well as machine learning for monitoring and tracking patient care. Data collected from IoT devices such as wearables can be aggregated and analyzed using machine learning algorithms to better prevent readmission and also improve the quality of care over time. Clinic practitioners can use a dashboard interface to get visualizations of key information to better track patient care. The machine learning can be applied to also deliver more personalized care depending on patient data profiles.

Another important aspect of clinical decision support systems is the ability to detect and respond to events in a timely basis. For example, streaming analytics evaluating real-time IoT sensor data using a machine learning algorithm determines that an event threshold has been detected for a given patient. The process triggers an event which is then surfaced to the decision support system dashboard so that clinical staff can respond rapidly to the alert.



Clinical Systems Intelligence Architecture

Gamification

In her book, SuperBetter: A Revolutionary Approach to Getting Stronger, Happier and Braver, award winning game designer Jane McGonigal presents the point-of-view that gamification can be applied to recovery from health-related illnesses and injuries. Her research developed an approach that has been applied to many patients going through a recovery process. Part of the research involved applications that incorporated the Live Gamefully method.[5]

McGonigal describes her own experience successfully using the approach after a traumatic head injury. Gamification leverages the positive effects of gaming to deliver innovative approaches to recovery for patients. Connected health applications can consider this approach as a novel way to engage patients to enhance quality of therapy and accelerate their recovery.

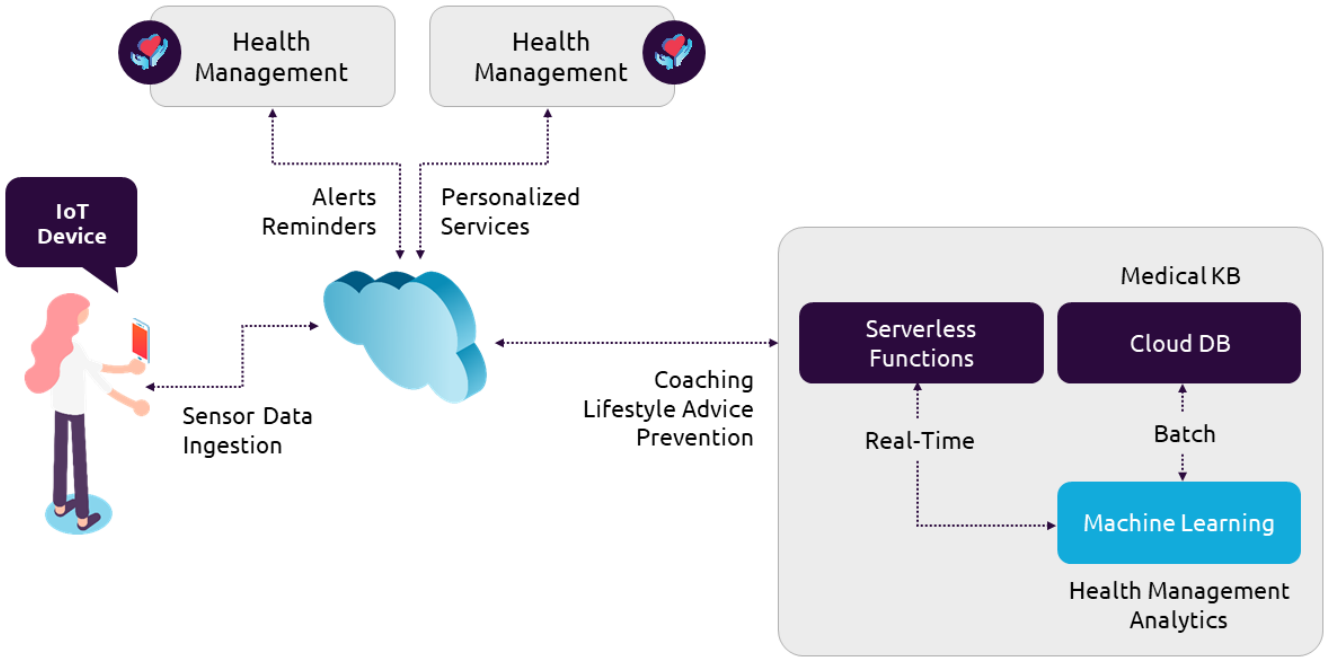
Chronic Treatment IoT Sensors

Chronic ailments represent a major category of use cases in the healthcare sector costing around $500 billion dollars annually.[6] These types of ailments require constant monitoring and tracking by healthcare providers to improve the quality of life for the patient and also prevent readmission. IoT sensors and wearables are two mechanisms that can be used to provide monitoring capabilities on a patient's health condition. As data is transmitted in real-time, the healthcare provider can view the patient's status and detect any reoccurring patterns that may require further attention or advising with the patient.

Health Management Platforms

Data from IoT sensors can be the basis for developing health management platforms that deliver value-added services for patients with chronic diseases. The platform can be leveraged for treating other types of health conditions that would benefit from continuous care such as behavioral monitoring. The platform services are personalized to the specific needs of the patient so that they receive the best care possible to help them overcome the challenges of living with a chronic condition.

Machine learning can be applied in analyzing IoT sensor data to enable intelligent health management services for chronic conditions. The intelligent services enable identifying or anticipating patterns that may require special attention or coaching for the patient. Developing these types of deeper insights into a patient's care over time increases the benefits the platforms can deliver.

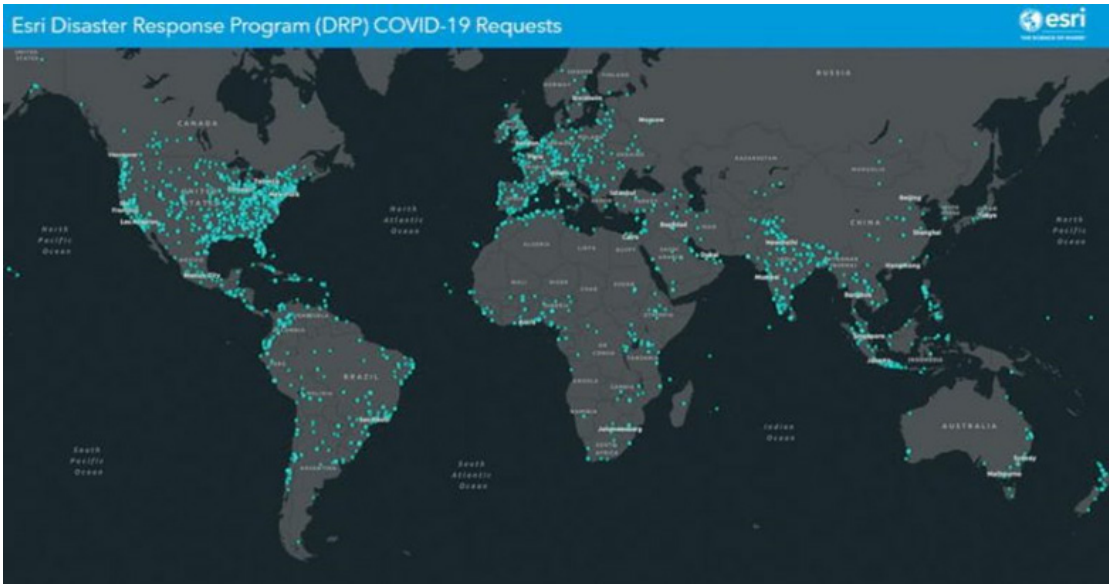


Health & Lifestyle Management Platform Architecture

Crisis Management Mappers

One of the important lessons from the COVID-19 crisis is the utility of mapping software to track virus spread. Mapping software is used in times of natural disasters to indicate danger zones or health risk levels for those responding to the crisis. However, these mapping tools can also provide additional insights to improve ability of the health sector to develop an awareness of patterns that may be affecting the health of a community. Visualizations presented by mappers provide graphical representation of trends so preventative care information may be shared with the community. This type of intelligence is a way to achieve cost avoidance when an environmental condition may be affecting a large segment of a population.

Air quality mappers are another example of this type of preventative health information. Sensors may be distributed throughout a geographical area to detect and measure air quality. The IoT sensors feed the data to a central monitoring station where the data can be analyzed, and alerts issued if the air quality falls below a certain threshold. Trends of air quality can be measured over time to determine the overall impact to the community. The alert information can be distributed to prevent hospital or clinic admissions, particularly in the event air quality has dropped due to a crisis situation.



Crisis Mapping Dashboard

Health Messaging Compact Language

In crisis situations, communications infrastructure is often impacted preventing critical health situational awareness from being shared by first responders. In these types of situations, a small amount of critical data may prove to be the difference in saving lives.

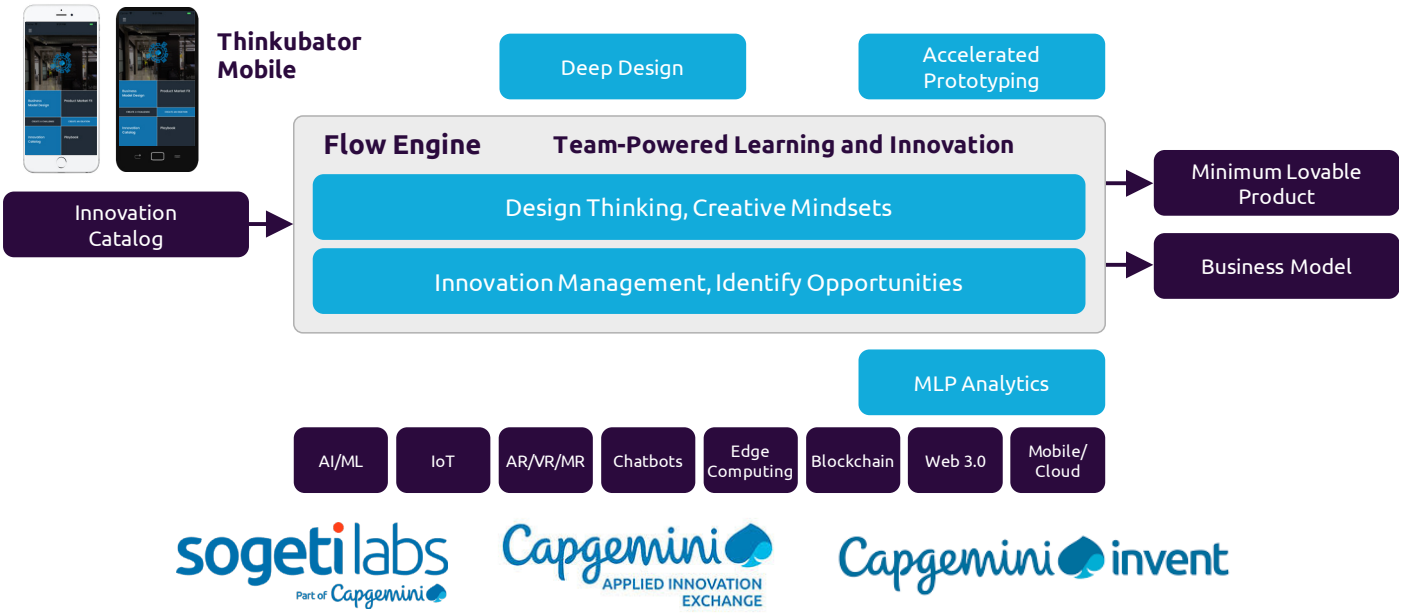
When communication needs to be efficient and precise in very dynamic environments, it is useful to consider a health messaging protocol where key information is communicated in a very compact language. The message schema format may be structured to contain elements required to indicate healthcare response and supplies needed to mitigate the crisis. The schema may also contain geolocation data to provide reference needed by mappers to plot the event to include in dashboard visualizations.

Thinkubator Business for Connected Health

Connected Health ventures require an assembly of the right talent, the right technologies and a repeatable, high-velocity approach to innovation. Whether it be to develop internal innovation capabilities, seeking to develop a partner ecosystem or launch entirely new brands, Connected Health ventures need to be supported by a robust enterprise innovation platform that enables radical market-centric collaboration. SogetiLabs developed the Thinkubator Business enterprise innovation platform and services to partner with innovative ventures seeking these capabilities. Ventures can leverage the Capgemini innovation ecosystem to accelerate time-to-value creation.

Thinkubator Business is a design-oriented corporate accelerator which applies a scalable and sustainable operating model for enterprise innovation that delivers rapid business value in the form of innovative Connected Health products, services and solutions. Thinkubator Business:

- Enables individuals with innovation techniques and mindsets.
- Empowers teams through a learning and innovation platform.
- Deploys innovation pipelines directly into the enterprise.



Thinkubator Business Platform and Ecosystem for Connected Health Innovation

Thinkubator Business is powered by a highly customizable team-based enterprise innovation platform with

- An artificial intelligence and machine learning toolkit for deep design,
- Software factory automation for accelerated prototyping,
- And an integrated innovation flow engine to deliver value fast.

Thinkubator Business combines design thinking with innovation management to align creative production with strategic growth opportunities to achieve real business impact. With innovation management, new Connected Health ventures can:

- Apply techniques for creating vision,
- Develop strategies to accelerate product/market fit,
- Incorporate proven methods for designing innovative business models,
- Implement innovation monitoring and tracking mechanisms.

Thinkubator Business can bring together the talent from the Capgemini innovation ecosystem to successfully meet the challenges and opportunities of the new Connected Health venture.

- **SogetiLabs** – Sogeti consulting and engineering think tank for applying innovation and leveraging disruptive technologies to deliver business value.
- **Capgemini Invent** – Capgemini strategy and business design firm with deep and broad sector-based experience.
- **Applied Innovation Exchange** – Capgemini innovation ecosystem that facilitates connections with startups, universities, sector experts and technology partners across a global network of locations.

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Footnote Index

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About SogetiLabs

SogetiLabs is a network of technology leaders from Sogeti worldwide. SogetiLabs covers a wide range of digital technology expertise: from embedded software, cybersecurity, AI, simulation, and cloud to business information management, mobile apps, analytics, testing, and the Internet of Things. The focus is always on leveraging technologies, systems and applications in actual business situations to maximize results. SogetiLabs also provides insight, research, and inspiration through reports, articles, presentations, and videos that can be accessed on the SogetiLabs website **www.labs.sogeti.com**

About Sogeti

Part of the Capgemini Group, Sogeti operates in more than 100 locations globally. Working closely with clients and partners to take full advantage of the opportunities of technology, Sogeti combines agility and speed of implementation to tailor innovative future-focused solutions in Digital Assurance and Testing, Cloud and Cybersecurity, all fueled by AI and automation. With its hands-on 'value in the making' approach and passion for technology, Sogeti helps organizations implement their digital journeys at speed. **www.sogeti.com**