

CRJ R&D: The potential of

Millions of people's lives have already been changed thanks to the ingenuity of Apple's HealthKit and ResearchKit. There is no telling how many lives will be saved in the future with the ever-evolving world of technology

Technology dominates our daily lives and modern living is predicated on the types of gadgets and software available. Constantly evolving technology influences innumerable industries – healthcare, entertainment, science, warfare and emergency response systems – to name a few.

Apple, one of the major corporations at the forefront of the technological world, pioneers cutting edge technology and creates innovative software that transcends all sectors. The company has opened its framework to thousands of developers, who have created more than two million applications, with an infinite number of uses.

Corporations like this have been vital to the progression of technology. They integrate countless new ideas and innovations into their consumers' lives, not only to aid and supplement lifestyles, but also to inspire them. Many industries have been revolutionised by this technology, which will continue to develop rapidly to meet the demands of the public.

In recent years, the tech giant has taken an interest in healthcare by releasing software that simplifies users' ability to track and manage their personal health goals. In 2014, Apple released a ground-breaking health tracker called HealthKit. Previously, many iPhone applications allowed users to record and track data such as calories burned, distance travelled, flights of stairs climbed, weight trending and glucose monitoring. However, none were as comprehensive as HealthKit, which provides a framework that supports communication with various health apps, activity trackers and accessories, allowing for retrieval, storage and merging of data and generating a complete health report card viewable in one location. Before this, it was not possible to capture a user's complete health profile because data in other health apps was stored in different locations and there was no capability to synchronise or merge this data.

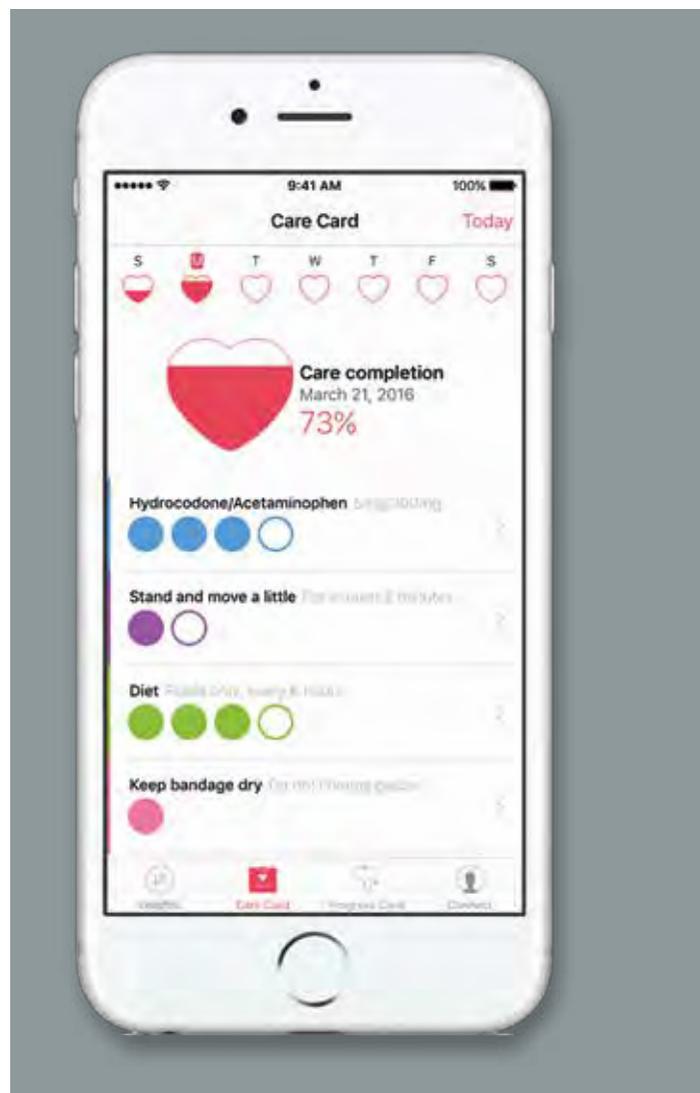
The Apple Watch, released in 2015, is not the first of its kind; devices like this, such as the FitBit, have been around for a while.

The true innovation lay in making it compatible with HealthKit, which incorporates a new interface that records workouts on the watch. This helps to set goals for burning calories, exercising, and standing; it also tracks achievements and personal bests, promoting a healthier lifestyle through goal setting and competition.

Using Bluetooth, all of the data is stored across devices in the same Health App. This universality, shared across applications, allows for more accurate and convenient data collection. Apple has since launched updates that now include

A new update will be made to HealthKit in September, allowing medical records to be shared directly to the Health App within a person's iPhone. The implications of this technology are enormous, providing healthcare providers with direct, easy access to the patient's detailed history

Apple



skin type, UV exposure, water intake, and reproductive health data for females. All of this contributes to a better, more complete picture of a user's health status and history.

Another healthcare focus where Apple has had a significant impact is that of medical research, the core of modern healthcare, diagnosis and treatment, which is guided by evidence-based medicine. Medical research is integral to the advancement of medicine through developing new drugs, treatments, and procedures. However, most (if not all) research studies require subjects to take part, and doctors have long struggled with recruiting patients to their studies. In a video released by Apple, Kathryn Schmitz of the University of Pennsylvania recalls some data from her 2009 study that focused on women with breast cancer: "We had sent out over 60,000 letters, and those letters netted only 305 women." Her comments highlight exactly how difficult patient recruitment is and, without patients, there is no study. Apple changed this with its release of ResearchKit in 2015.

This provides a framework similar to that of HealthKit, in which teams of developers and healthcare providers can create applications to collect and analyse data for their respective studies. It has revolutionised the way that medical research can be carried

apps to save lives



out; instead of patients having to travel to a clinic or office for an appointment, they can participate from the comfort of their own homes. Since its launch with ResearchKit in 2015, the mPower app for Parkinson's disease, created by the University of Rochester and Sage Bionetworks, has enrolled more than 10,000 participants, making it the largest Parkinson's study in history. Using interactive tests, data analysis and surveys, the app is helping researchers to improve understanding of the symptoms associated with the debilitating disease, and how to treat them more effectively.

Further applications

Applications like these have been growing both in popularity and in diversity, with many organisations tapping into ResearchKit capabilities. An app from Mt Sinai Hospital and Weill Cornell Medical College, both in New York City, helps participants to manage their asthma by identifying areas with bad air conditions. The goal is to use the study to develop treatments individually for asthma patients. Autism & Beyond, an app developed by Duke University and the University of Cape Town, screens for early signs of autism using facial recognition algorithms and the cameras in an iPhone to analyse

emotional reactions in children. It eliminates the need for children to see a doctor and helps cut down on late or misdiagnosis of autism.

The GlucoSuccess app from Massachusetts General Hospital has used the gyroscope on the iPhone, along with user inputted information about food and medication, to support the belief that there are multiple types of Type 2 Diabetes. The goal is to define the subtypes and create better methods for treatment or even to cure the disease.

Apple announced a new adjustment to its network of healthcare technology at its World Wide Developers Conference (WWDC) in June 2016. A new update will be made to HealthKit when iOS 10 becomes available in September, allowing medical records to be shared directly to the Health app within a person's iPhone. Using the *Health Level 7 Continuity of Care Document (HL7 CCD)*, a healthcare provider can share documents to HealthKit, so patients can share them with other healthcare providers, leading to improved continuity of care. This eliminates the need for a user to keep track of cumbersome medical documents and it makes it easy for healthcare providers to view information about their patient quickly.

The implications of this technology are enormous. For ►

► example, if a patient is injured or experiences symptoms of a chronic or acute condition while travelling, healthcare providers now have direct, easy access to the patient's detailed history, rather than wasting valuable time searching for this information. Ideally, the documents will be translatable into other languages, so that even doctors in foreign countries can access them.

There are other types of technology created by Apple that are not necessarily used for medicine or healthcare. For example, the iBeacon is currently used in airports and shopping centres. When enabled in an airport, a Bluetooth beacon activates the app and brings up the user's boarding pass and plane ticket. In shopping centres, the beacon will activate the app and display promotions or coupons from associated stores. The SOS feature announced at the WWDC in June allows a user to contact emergency services with the touch of a button. After the user is finished with the dispatchers, the device displays their important medical information until the first responders arrive.

The advancements in technology made by Apple and other companies have great potential to bring about influential changes in the world of disaster response and global wellness. While applications like the mPower and

Autism & Beyond track diseases from a phone, it is also possible to create an app that uses similar technology to screen for pathologic signs and symptoms that plague third world countries. Inhabitants of such

countries who cannot receive medical attention or screenings, could potentially be diagnosed by smartphone, cutting down the time to diagnosis and treatment.

In some cases, a clinician is simply not necessary to collect data or diagnose a condition. Patients can be independent in their healthcare, screening themselves first, looking for a treatment, and then seeking medical care if necessary. In addition to advancing the accessibility of healthcare across the globe, technology like this would increase confidence and inspire a feeling of self-progression.

In the world of disaster control and trauma medicine, minutes to even seconds can prove invaluable hence the term 'The Golden Hour' – patients' lives depend on it. Imagine what first responders could do with technology like the iBeacon. Upon arriving at the scene of a disaster, whether natural or human-caused, such as a terror attack, responders could use the Bluetooth signal at the scene to pull up victims' important health information. They could review all of the user's information from HealthKit, thus helping to make sure they receive effective, personalised care. Even better, the beacon could make victims' medical documents accessible so that upon arriving at a hospital or clinic, doctors could immediately view their documents.

In the event of a disaster, the beacon signal can display a victim's heart rate and blood pressure, helping first responders to triage patients by acuity of illness and speeding up the process.

What if the new SOS feature was combined with existing technologies? When pressing the button to contact the emergency services, the device could send out the location that a person was calling from, helping the responders locate them faster. This could prove useful in situations such as locating a person lost hiking or even in locating patients in the rubble after an earthquake or tornado.

The role of technology in the world of emergency and disaster medicine is quickly gaining ground, as the ultimate goal is to

connect, inform and provide life-saving care to victims and their families affected by catastrophic events. Technology plays a multifaceted role that includes re-establishing lost lines of communication, facilitating co-ordination of emergency response missions and providing immediate, life-saving, goal focused care.

As noted above, mobile applications such as the iBeacon can be used to improve the accuracy of trauma and disaster triage or even as a method for locating those who are missing. The American Red Cross has created an application called 'The Emergency App', which has multiple preparedness features for all types of disasters; it also has a feature called 'Family Safe' that allows people to connect to their loved ones to let them know their status in a crisis.

Other potential uses for smartphones and mobile applications in disaster trauma medicine lie in utilising the vital sign features of HealthKit to guide rescue efforts in combination with an application that can provide basic and advanced life support guidance.

Imagine the potential of combining an app that will guide patient resuscitation, based on input from Healthkit, which may facilitate recognition of when a patient is in need of life-saving treatment.

Linking current technology such as live streaming patient information

The SOS feature announced by Apple allows a user to contact emergency services with the touch of a button

to a resuscitative algorithmic application will, essentially, guide first responders or even bystanders to start performing care. The combination of algorithmic treatment based on live patient data streamed from Healthkit could provide advanced trauma care access in remote areas by people who may have minimal to no healthcare knowledge, bridging the time gap from the point of injury to the arrival of advanced healthcare providers. This could mean the difference between life and death for a patient.

The disaster response community stands to gain much from such advancements, and those that are yet to come. Even by simply utilising what is already available today, lives can be saved by reducing time to diagnosis, decreasing time to treatment and improving overall patient outcomes.

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