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Improving Healthcare with Home-based Monitoring and Predictive Analytics

AccuHealth uses artificial intelligence (AI) powered by Intel® technology to manage remote, home-based care that improves patient satisfaction while reducing costly visits to emergency facilities or clinics.

AccuHealth

> "AccuHealth is shifting the balance away from reactive care delivered only in the hospital or doctor's office to continuous health and wellness. AI and other technologies are making it possible for the patient to be the 'point of care.'"
>
> — Jennifer Esposito, General Manager, Health and Life Sciences, Intel Corporation

> "Working with Intel means we have access not just to healthcare innovators, but broad technology innovators … to see the next thing coming and understand how we can do what we do, better."
>
> — Dr. Xavier Urtubey, Co-Founder and CEO, AccuHealth

Ricardo is a 78-year-old man with hypertension and diabetes who lives in a rural home in central Chile.[1] One year ago today, Ricardo was getting onto a bus for his weekly trip to the clinic for an exam. Today, he instead finishes his breakfast and spends the morning reading the daily newspaper. When an alarm rings, Ricardo picks up a tablet device "hub" along with several medical sensors, and then, one by one, checks his blood sugar level, blood pressure, and other vitals. Following that, he uses the tablet to answer personalized questions about his current symptoms.

All of Ricardo's medical information is collected by the hub and sent wirelessly to AccuHealth's virtual hospital, where analytics predictive algorithms are applied. Ricardo's virtual medical team receives notifications based on Ricardo's vital statistics whenever Ricardo needs attention. The medical staff can proactively reach out to Ricardo via the hub to help him make simple course corrections in his treatment and daily habits. They are able to identify potential problems that can be addressed by remote interaction, before the issues lead to deterioration in his health or an expensive visit to the emergency room.

This scenario isn't science fiction. AccuHealth is using revolutionary AI-based technologies to transform healthcare in Chile.

The Human and Dollar Costs of Chronic Illness

According to a 2017 paper by RAND Corporation, 60 percent of Americans in 2014 had at least one chronic condition, and 42 percent had multiple chronic conditions.[2] That's not only a quality-of-life concern, it's a financial one, too. As shown in Figure 1, when chronic conditions increase, so do healthcare costs, which makes chronic illness a major contributor to the overall rising costs of healthcare in the US and in many other countries.[2]

Many chronic issues develop slowly and can be managed if treated early and consistently, but patients frequently address health issues only after the problems have reached a critical stage. One reason for this lack of care is that it's nearly impossible to have direct, frequent contact between medical staff and patients. There aren't enough medical professionals to accommodate frequent visits, and patients typically can't afford the time or costs involved in getting to a clinic or hospital frequently for exams and follow-up visits.

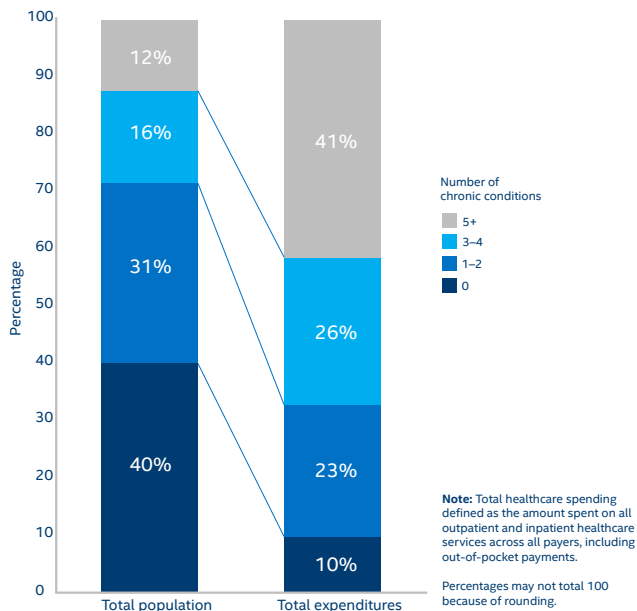**Prevalence and Spending by Number of Chronic Conditions (2014)**

Note: Total healthcare spending defined as the amount spent on all outpatient and inpatient healthcare services across all payers, including out-of-pocket payments.

Percentages may not total 100 because of rounding.

Figure 1. Healthcare costs rise with the number of chronic conditions[2]

Changing Healthcare from Reactionary to Preventive

AccuHealth is a chronic care management company founded in Chile. The organization has developed a proactive response to chronic care that uses advanced analytics and predictive algorithms to identify key events and trends in order to help prevent declining health in patients.

The end-to-end solution consists of patient sensors, hubs in patient homes, remote monitoring capabilities, and reliable back-end systems that are powered by Intel® Xeon® Scalable processors, which constantly collate, process, and triage information with alerts and tracking. The solution works by comparing current patient data to a massive database of anonymized medical survey data collected over a five-year time span. The data allowed AccuHealth to compile population statistics on cost, disease progression, comorbidities, age, gender, and other factors. AccuHealth was also able to compile data on health trends, psychological profiles, sociological profiles, and healthcare monitoring adherence across population segments. By combining data from this robust database with current patient vital health statistics, AccuHealth was able to develop an analytics and predictive algorithm platform that enables ongoing treatment for remote patients with chronic illnesses.

End-to-End Data Collection and Analysis

Figure 2 shows the complete platform process and architecture for AccuHealth's solution, from data collection to analysis and monitoring. Each step in the process is described below.

At the Patient's Location

Patients are provided with a customized kit that contains two key components: a set of biometric sensors and an

AccuMedic* telemonitor hub, which is an Intel® processor–powered tablet. The AccuMedic device has a 7-inch touch screen that is remotely configured with a monitoring plan that establishes a set of scheduled checkups adapted for each patient. The AccuMedic device guides patients to perform self-measurements of vital signs, such as blood pressure, blood sugar levels, weight, electrocardiogram (EKG), and other factors. The data is sent from each sensor to the AccuMedic device over a Bluetooth* wireless connection.

The patient also uses the AccuMedic device to answer multiple-choice questions on symptoms, medications, eating habits, and so on. The full set of collected data is called a "monitoring lot." This information is sent over a wireless mobile network from the AccuMedic device to the remote AccuCenter* platform at an AccuHealth* virtual hospital.

At the AccuCenter* Telemonitoring Platform

The monitoring lot reaches the AccuCenter telemonitoring platform, which also houses the patient's medical records, in addition to information on socioeconomic and psychological factors, outpatient visits, and the patient's use of hospital services. The AccuCenter platform runs on two HPE ProLiant DL360 Gen10* servers, powered by 10-core Intel® Xeon® Gold 5118 processors. These Intel Xeon Scalable processors are ideal for providing the processing power needed by the AccuCenter AccuBrain* software, which runs predictive models and machine learning algorithms. The AccuBrain software applies triage logic to categorize monitoring lots according to urgency level. The triage algorithms take into account quantitative and qualitative information included in the monitoring lots, in addition to data from previous monitoring lots, trend analyses, and comparison data from other patients.

The AccuCenter platform is also responsible for distributing each monitoring lot to the health staff of the AccuHealth virtual hospital, so the staff can examine and act on the information, as needed. The platform uses defection-predictive models to identify patients who are not participating regularly, so staff can take preventive action before a patient abandons the service.

Other predictive models identify patients with chronic diseases based on their outpatient visits and use of other hospital services. The AccuBrain system categorizes these patients into different levels of complexity, in order to build customized monitoring plans and determine checkup frequencies for each patient. The system also predicts future medical costs for each patient and measures the savings generated by the AccuHealth service.
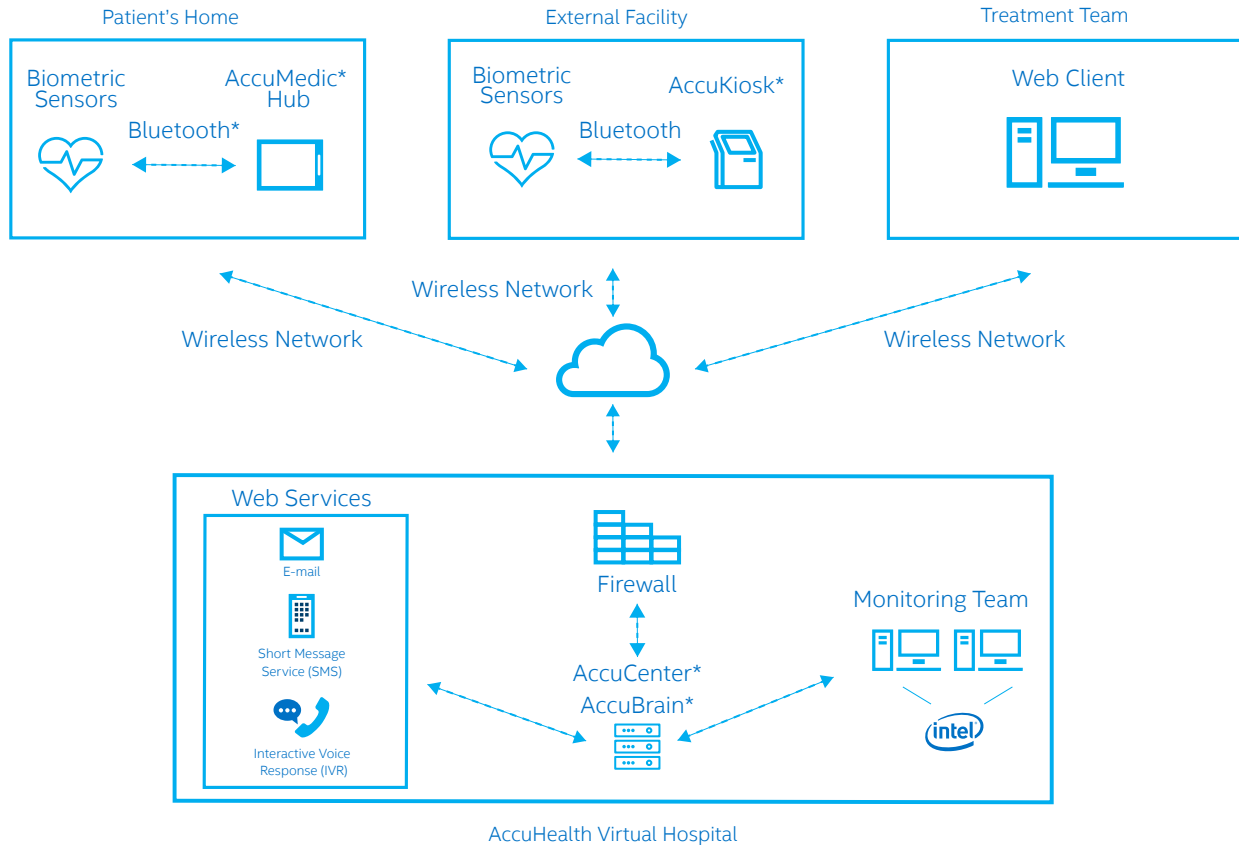
AccuHealth* Technology Architecture

Figure 2. The AccuHealth* telehealth solution uses sensors to collect and forward patient data from a remote hub to the AccuCenter* telemonitoring platform; sophisticated AI software analyzes current and historical patient data and cross-references it with survey data from millions of individuals in order to identify and predict health issues before they worsen

The Human Touch

AccuHealth provides a unique balance between high-tech and high-touch in its approach to modern healthcare. AccuHealth's medical professionals continuously monitor patient data and are in regular contact with patients regarding changes to their health status. In fact, the AccuCenter platform is explicitly designed to be a decision-support system, not a human replacement. The personal touch provided by AccuHealth medical staff is key to achieving patient engagement and, as a result, improvement in both patient health and economic impact.

Improving Healthcare, One Patient at a Time

The AccuHealth solution helps health professionals to proactively engage with patients who have chronic health issues. Thanks to regularly updated patient data and a large database of historical reference data, the AccuHealth solution can anticipate impending health issues so that medical staff can intervene preventively, before an emergency hospitalization is required.

The results speak for themselves. Since implementing the solution in Chile, AccuHealth has seen:

- A 42 percent decrease in emergency room visits[3]

- A 35 percent average savings on insurance costs[4]

- The highest possible customer satisfaction rating from 94 percent of patients surveyed[5]

Looking to the Future

AccuHealth is already expanding its presence internationally. The solution is a proven success in Chile, and it is currently being deployed in Colombia. And since March 2017, AccuHealth has formed a partnership with Rowan University in New Jersey, with the goal of testing and validating the AccuHealth solution for use in the United States.

There certainly is no shortage of countries looking for ways to improve healthcare outcomes and reduce the ever-growing costs related to chronic illnesses. The AccuHealth AI solution could be the prescription those countries are looking for.

Intel® Xeon® Scalable Processors Power AI

Intel Xeon Scalable processors make AI solutions happen with built-in reliability and greater flexibility for AI and combination workloads. Explore deep learning inference performance improvements of up to 14x with Intel software optimizations on Intel Xeon Scalable processors.[6] Check out the full range of Intel AI technologies and learn how other companies are using AI to help their businesses get more from their data.

About AccuHealth

AccuHealth is the first telehealth company in South America. The AccuHealth* solution provides remote care and monitoring of patients through a unique telemonitoring service, guided by a team of highly trained medical professionals who are available 24 hours a day. The AccuHealth business model is designed to complement doctors, insurers, and health providers by delivering an innovative service focused on patient needs.

Learn More

Learn more about AccuHealth technology at **accu.health/**.

Explore other ways companies are using Intel technologies to power AI and machine learning at **https://ai.intel.com**, and learn more about Intel Xeon Scalable processors at **intel.com/xeonscalable**.

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[1] Ricardo is a fictional composite and is intended for illustration purposes only.

[2] Bauman, M., Buttorff, C., and Ruder, T. "Multiple Chronic Conditions in the United States." RAND Corporation. 2017. rand.org/pubs/tools/TL221.html. Reprinted with permission.

[3] Instituto de Análisis de Políticas Públicas y Gestión. "Informe Final Evaluación del Programa de Telemonitoreo AccuHealth en el Servicio de Salud Sur Oriente." July 2016.

[4] Insurance provider CruzBlanca*, a Bupa* company, used the AccuHealth* solution to conduct an 11-month study from August 2014–June 2015. CruzBlanca wanted to compare the economic outcomes of 688 monitored patients with an equivalent control group (688 patients with similar diseases, comorbidity, and costs). The company analyzed the two groups' cost evolution during an 11-month period. Source: AccuHealth internal information.

[5] AccuHealth* patient satisfaction survey, March–December 2015. n = 1,179.

[6] Based on Intel testing in April 2018 on Amazon Elastic Compute Cloud* (Amazon EC2*) C5.18xlarge instance (two-socket Intel® Xeon® Platinum 8124M processor at 3.00 GHz), total memory 344 GB, Red Hat 7.2* (HVM) Amazon Elastic Network Adapter* (Amazon ENA*), Amazon Elastic Block Store* (Amazon EBS*) optimized, 200 GB provisioned input/output operations per second (IOPS) solid-state drive (SSD), deep learning framework: Apache MXNet* (https://github.com/apache/incubator-mxnet), topology: Google's Neural Machine Translation* (GNMT) (https://github.com/awslabs/sockeye/tree/master/tutorials/wmt) with Intel® Math Kernel Library for Deep Learning Networks (Intel® MKL-DNN) (https://github.com/intel/mkl-dnn), dataset: WMT 2017* (http://data.statmt.org/wmt17/translation-task/preprocessed/), batch size (1, 2, 8, 16, 32, 64, 128). For details, see: Intel. "Amazing Inference Performance with Intel® Xeon® Scalable Processors." May 2018. https://ai.intel.com/amazing-inference-performance-with-intel-xeon-scalable-processors/.