Wearables and Glucose Monitoring: The New Frontier in Diabetes Management
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Wearable technology for continuous glucose monitoring (CGM) holds the promise to revolutionize the way millions of adults and children with diabetes manage the potentially deadly disease.

Growing global presence

Diabetes represents an emerging global epidemic that affects 347 million people worldwide, with the World Health Organization (WHO) predicting the disease will become the seventh leading cause of death in the world by 2030.

Type 1 diabetes occurs when the pancreas does not produce enough insulin, a hormone that regulates blood sugar (known as glucose) levels. About 95 percent of diabetics have Type 2 diabetes, which occurs when the body cannot effectively use the insulin it produces. A third type, known as gestational diabetes, can develop during pregnancy.

In its research, IHS found diabetes to be rapidly unfolding worldwide.

The Western Pacific region has the largest concentration of diabetics (138 million), including 96 million in China, reports the International Diabetes Federation. Southeast Asia has 75 million diabetics, including 67 million in India. Approximately 37 million people in the Middle East and North Africa have diabetes, and another 52 million in Europe have the disease. Africa, with an estimated 21 million diabetics, has the highest percentage of undiagnosed people.

In the United States, 29 million people have diabetes and one out of four don’t know they have the disease, according to the U.S. Centers for Disease Control and Prevention (CDC). Another 86 million have prediabetes, placing them at risk of developing diabetes due to high blood-glucose levels. From 15 to 30 percent of people with prediabetes will develop Type 2 diabetes within five years unless they lose weight and exercise.

Although genetics play a role in the onset of diabetes, IHS found that lifestyle issues such as obesity and physical inactivity are the main factors behind the increased prevalence of Type 2 diabetes. Reports of Type 2 diabetes in children, once a rare occurrence, also have increased worldwide. The cause of Type 1 diabetes is unknown.
Correlation between diseases

The risk of death for adults with diabetes is 50 percent higher than for healthy adults. According to WHO, diabetes caused 1.5 million deaths in 2012, and total deaths from diabetes are projected to rise by more than 50 percent in the next decade. About 80 percent of diabetes deaths occur in low- and middle-income countries.

Diabetes can lead to serious and costly complications, such as cardiovascular disease, hypertension, blindness, nerve damage, stroke, kidney failure and more.

Cardiovascular disease is responsible for 50 to 80 percent of deaths in diabetics, and 50 percent develop hypertension. Moreover, 1 percent of global blindness can be attributed to diabetic retinopathy, which occurs from accumulated damage to the small blood vessels in the retina. Diabetes is also a leading cause of amputations.

Many of the complications associated with Type 1 and Type 2 diabetes could be avoided with proper disease management and preventive care, such as regular eye checkups and foot exams to identify chronic, non-healing ulcers that can lead to amputations. Healthy eating and physical activity can also help with Type 2 disease management.

Treatment options for Type 1 and Type 2 diabetes

Diabetes treatment involves using oral medications and insulin to maintain safe blood-glucose levels and prevent complications. People with Type 1 diabetes must use insulin because their body does not produce the hormone. Some people with Type 2 diabetes can manage the disease with healthy eating and exercise, but they may also need oral medications and/or insulin to maintain target blood-glucose levels.

The key to successful diabetes management involves monitoring blood-glucose levels, typically with blood-glucose meters. Diabetics must conduct daily finger pricks to place a drop of blood on a test strip inserted into the meter. An enzyme converts the glucose into an electrical current that speeds through the strip and is read by a meter. Test results can help diabetics to adjust their diet, exercise regimen and treatment plan.

The sale of blood-glucose meters represented $439 million in revenue in 2014 worldwide, according to IHS estimates.

About 16 percent of diabetics require insulin. Most use a syringe to inject the insulin, although other delivery methods include insulin pens and wearable pumps. IHS estimates place insulin sales at $17 billion in 2011, up 13 percent over 2010.

Diabetes can take a financial toll on individuals and society. For example, the total costs of diabetes in the United States in 2012 was $245 billion ($176 billion for direct medical costs and $69 billion in reduced productivity). Medical costs for people with diabetes are twice as high compared to people who do not have the disease. Coverage by health insurance companies for diabetes care and products vary significantly.
Wearable technology for diabetes management

Wearable technology such as insulin pumps and continuous glucose monitoring devices can make it easier to track blood glucose levels in real time and deliver the appropriate insulin dose on every occasion. The devices are available as stand-alone products, although some manufacturers offer systems that integrate insulin pumps and CGM.

**Insulin pumps**

Insulin pumps are computerized devices that deliver precise, continuous amounts of insulin round-the-clock through a catheter placed under the skin. The pumps can help people achieve better control of blood-glucose levels and eliminates the need for multiple daily insulin injections. The devices are small enough to fit in a pocket.

People who use insulin pumps, however, must continue to monitor blood-glucose levels with finger sticks because the pumps are not an artificial pancreas.

IHS expects revenue from insulin pumps in 2016 to reach $1.1 billion and grow to $1.5 billion in 2019, equivalent to a compound annual growth rate of 8.7 percent starting from 2011.

**Global Revenue Forecast for Insulin Pumps**

![Revenue (US$ millions)](chart)

Examples of manufacturers in this market are Animas One Touch, Asante Snap, CeQur PaQ, Insulet Omnipod, Roche Diagnostics Accu-Chek, Smiths Medical CozMore and Tandem Diabetes Care. Each manufacturer boasts unique features.

The OneTouch Ping from Animas Corp. combines an insulin delivery system and wireless blood-glucose monitor, allowing users to test blood-glucose levels and dose their insulin from one remote device. The Asante Snap is the only pump using prefilled, seven-day insulin cartridges, eliminating the need to manually fill the reservoir.

The Accu-Chek Combo from Roche Diagnostics features a pump and a remote meter that communicate wirelessly to control functions. CeQur PaQ offers a three-day, wearable patch pump with no tubing, designed for people who may not need a full-featured pump.

Smiths Medical’s CozMore has an insulin pump and blood-glucose monitoring system that combines insulin pump therapy, blood-glucose monitoring and data management. Tandem Diabetes Care T:flex offers the largest-capacity insulin pump, designed for people who require more than 100 units of insulin a day. The Insulet Omnipod offers the market’s first completely tubeless insulin pump.
Continuous glucose monitoring

Continuous glucose monitoring technology measures glucose levels in real time round-the-clock, unlike blood-glucose meters and strips that capture one moment in time.

CGM consists of disposable sensors, transmitters and receivers (also called monitors). The sensor is inserted under the skin (typically on the abdomen) to measure glucose levels in tissue fluid every few minutes. The small sensors are connected to a transmitter that sends the data wirelessly to a handheld receiver, which displays the results and trends.

With CGM, people get constant feedback about their blood-glucose levels, so they can quickly and easily adjust insulin dosages based on their body’s immediate needs. The data can be downloaded to computers and mobile devices, including smartphones, to share with the individual’s healthcare team.

Revenue in 2016 from CGM receivers and transmitters in 2016 is expected to reach $175.4 million and rise to $196.9 million in 2019, equivalent to a compound annual growth rate of 4.1 percent starting from 2011, according to IHS projections.

Meanwhile, revenue from CGM sensors in 2016 is anticipated to hit $358.6 million and then rise to $400.7 million in 2019, equivalent to a compound annual growth rate of 3.9 percent starting from 2011.

Examples of companies in this market are Cellnovo, DexCom and Medtronic, with each offering technological advancements.

DexCom Inc. has the only FDA-approved flexible sensor that can be worn for up to seven days, and its DexCom G4 Platinum System with Share has Bluetooth technology built into the receiver. Medtronic’s Paradigm Real-Time Revel system integrates its insulin pump with CGM, although a stand-alone version without the pump is also available.

Worth noting is that Abbott Diabetes Care has pulled out of some CGM markets, and its FreeStyle Navigator System is only available in Europe or the U.K. And so far, the Libre patch has gone to market only in the U.K.

Despite the advantages, several factors may prevent people from using CGM. The transmitters, receivers and sensors are expensive, and not all insurers cover the costs. CGM systems can cost thousands of dollars, and a month’s worth of disposal sensors can cost up to $450. Also, daily finger sticks are still required to calibrate the device, and the FDA recommends using finger-stick results to confirm treatment decisions.

Glucose monitoring news

Glucose monitoring innovations are taking place on many fronts.

Non-invasive monitors

The GlucoTrack from Integrity is a non-invasive blood-glucose monitor that clips to the earlobe, eliminating the need for daily finger pricks. It’s the only device that simultaneously uses three technologies—ultrasound, electromagnetic and thermal—to obtain a reliable reading without drawing blood. Up to three users can share the main unit, although each individual requires a personal ear clip.

Glucose monitoring patch

Abbott has developed the Freestyle Libre Flash glucose monitoring system using a small, round sensor that can be worn on the arm for up to two weeks, eliminating the need for finger pricks and finger-prick calibrations. The patch—about the size of a $1 coin—measures glucose in interstitial fluid with a filament inserted under the skin. Users can pass a scanning device over the sensor to get a reading.
DexCom received FDA clearance to use a smartphone app with its DexCom G4 Platinum System with Share™. Bluetooth technology built into the receiver allows remote viewing of glucose levels, trends and data from an Apple iPhone or iPod touch. DexCom also has developed an app to report glucose levels on the Apple smartwatch, due out in April. The watch relies on a tiny monitor inserted under the skin to measure glucose levels every five minutes. The monitor sends data to a remote handheld device, which sends info to an iPhone app that communicates with the watch to display glucose data.

**Continuing long-term developments**

Several scientific efforts underway could dramatically alter diabetes management.

**Probiotic pill**

Researchers at Cornell University in Ithaca, New York, were able to reprogram the cells of diabetic rats to produce insulin using an engineered version of lactobacillus, a probiotic found in the human gut. The engineered probiotic secretes glucagon-like peptide, a hormone that releases insulin. After 90 days, rats that received the probiotic had up to 30 percent lower glucose levels than those that didn’t. The next step involves testing higher doses to see if the probiotic can reverse diabetes. Scientists are working with biopharmaceutical company BioPancreate to make the probiotic into a pill for humans.

**Contact lens**

Google has teamed up with Novartis to create a sensor-equipped contact lens that measures glucose levels through tears. The lens relays information in real time, eliminating the need for constant finger sticks. A pinhole-sized passage in the lens allows the tears to seep over into the glucose monitoring sensor unit, which uses radio frequency identification (RFID) technology to relay data to a handheld device.

**Artificial pancreas**

Scientists around the world are working on various versions of an artificial pancreas that would automatically keep blood-glucose levels within target. In healthy people, the beta cells in the pancreas detect blood glucose levels and deliver the appropriate amount of insulin to prevent glucose levels from becoming dangerously high or low. With an artificial pancreas, a computer program calculates how much insulin the pump delivers, based on readings from a CGM system.

Although advancements in wearable glucose monitoring devices are encouraging, IHS believes a formidable challenge remains in making this technology affordable and accessible to the millions of people worldwide who have diabetes.

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For more information on this white paper or on IHS research relevant to this topic, refer to the **Wearable Technology Intelligence Service** from the Industrial, Security and Medical research service of IHS Technology.

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