**Diabetes Nanosensors:**

Living in the 21st century, you're most likely familiar with someone who suffers from Diabetes - a group of metabolic diseases, in which one's blood sugar levels are high over an extended period. It occurs either when the pancreas doesn't produce enough insulin, or when the body can't use the insulin it produces. Hyperglycemia (raised blood sugar) is a common effect of uncontrolled diabetes, which over time leads to severe damages – especially to the heart, blood vessels, eyes, kidneys and nerves.

According to the World Health Organization, the number of diabetics has risen from 108 million in 1980 to 422 million in 2014. Treatments costs all over the world reach trillions of dollars annually. Moreover, in 2012 diabetes directly caused 1.5 million deaths [1].

Though there's still no cure for diabetes, patients can reduce its complications (and treatments costs) by tightly controlling their blood glucose levels. But nowadays, the only way to do it is extracting blood samples every few hours, usually by finger-pricking. The samples are then placed on a sensor-tester and being analyzed by an electronic reader - which reports blood's glucose concentration. One problem of this method is it's unpleasant and painful, both scary for younger diabetics. More disadvantages include the need of constantly carrying around the electronic reader, the inability of performing it during sleep and the possibility of missing fluctuations in glucose level between samples.

Hence, the use of nanotechnology can improve the life of many people, avoiding this everyday intrusive procedure. Glucose targeting nanosensors "implanted" in the body of diabetics can maintain continuous glucose measurements day and night, with the ability of alerting the patient whether there are some anomalies (or chances for future complications, using Machine-Learning algorithms). Nanosensors have many other advantages – high surface-areas which yield larger currents and faster responses, improved catalytic activities and potentially avoidance of foreign body response of the immune system.
(for further sensor lifetime). Some innovations in this field are already in development.

One approach is the use of "Smart Tattoos"[2]–polymeric nanosensors which alter their fluorescence as the glucose's concentration changes. Implanting them on patients' skin (like tattoos) allows continuous monitoring of glucose levels.
For instance, nanosensors composed of a hydrophobic polymer containing lipophilic glucose recognition elements and fluorescent reporters.
At low glucose levels, boronic acid-based recognition element bounds to the reporter alizarin, forming a fluorescent complex.
When glucose concentration rises, the boronic acid binds to glucose, extracts it into the sensor's core, displacing the alizarin in the process to become non-fluorescent [3].

Another approach is the use of Quantum-Dot based glucose sensors [2], which are fabricated by attaching Glucose-Oxidase enzyme to a QD reporter - such as cadmium telluride (CdTe), manganese-doped zinc sulfide (ZnS) and silicon dioxide (SiO₂).
In the presence of glucose, the GOx generates hydrogen peroxide (H₂O₂), which quenches the QDs' fluorescence, providing an optical signal change proportional to glucose concentrations.

Many researches are yet to come before using Nanotechnologies to help diabetics, mainly clinical examinations, but current studies seem pretty promising.
References:

