Future of Implantable Wireless Medical Telemetry

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National Academy of Engineering lists two of the 14 engineering grand challenges of the 21st century as "Engineering Better Medicines" and "Advance Health Informatics". Both of these challenges rely on personalized healthcare management and the seamless transmission of the medical data from the patient to the healthcare provider. Transformation of healthcare from reactive and hospital-centered to preventive and person-centered mandates development of new technologies that would enable "*long-term continuous monitoring*" of all physiological parameters. As a result, early diagnostics capabilities will also be enhanced tremendously and active management of own health by improving the lifestyle will become a reality. Among the critical physiological parameters requiring continuous monitoring are blood levels of glucose, cholesterol, uric acid, lactic acid, and calcium, iron, magnesium, and potassium ions, and disease markers such as cancer and others. The most effective way to monitor these parameters is through subcutaneous sensors, which can provide high sensitivity and accuracy owing to their direct access to the interstitial fluid, unlike noninvasive technologies such as bioimpedance, infrared, Raman, optical coherence, etc. However, current state-of-the-art implantable sensors, *e.g*. for glucose monitoring, have limited functional longevity (≤ 1 week) due to degradation and fouling from fibrosis and inflammation. It is thus imperative to develop biocompatible biosensors that can remain functional in the body for an extended period (>1 year). Such long-term and "miniature" biosensors combined with control electronics and wireless telemetry would help realize preventive and person-centered healthcare, replacing the need for frequent lab-based blood tests and superfluous dependence on medications.

In this talk, I discuss several emerging technologies based on biocompatible ZnO nano sensors to overcome the limitations of long-term implantable continuous monitoring.