Blood sugar testing with no sharps

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Measuring blood sugar when you have diabetes usually involves pricking your finger and using a glucose monitor for the test. While this approach can give people with diabetes vital information about whether they need to take insulin or eat something sugary, it is nevertheless painful and inconvenient. Now, an international research team is one step closer to an entirely non-invasive blood sugar test. They report details in the *International Journal of Biomedical Engineering and Technology*.

Diabetes mellitus is the general name for several related metabolic disorders. Symptoms such as strong thirst and hunger and frequent urination are caused by high blood glucose levels, which arise either because the pancreas does not produce enough of the protein to control blood glucose, insulin, or because the cells that normally respond to the insulin to adjust blood glucose do not work properly. Type 1 diabetes, usually first appears in children and young adults and is caused by the pancreas not making sufficient insulin. Patients must test their blood glucose regularly and inject insulin as appropriate. Type 2 diabetes is due to insulin resistance where the insulin-receptor cells do not work properly, it might also be concomitant with insulin deficiency, it is associated with obesity and diet. Gestational diabetes can arise in pregnancy and lead to ongoing Type 2 diabetes.

Insulin is used to treat Type 1 and there are medications available too for the treatment of Type 2. If the condition is not treated it can lead to acute complications such as diabetic ketoacidosis and non-ketotic hyperosmolar coma. Serious long-term complications include heart disease, chronic kidney failure, and blindness. Estimates suggest that,

worldwide, 150 million people suffer from disturbances in metabolic regulation of blood glucose, diabetes. As obesity is closely correlated with the onset of Type 2 diabetes and overweight is on the increase in many parts of the world, there is likely to be an increase in the incidence of diabetes in the coming years. More worryingly, is that childhood obesity is also on the rise and this means that a formerly adult-onset disease (Type 2) is becoming more common in youngsters.

Shruti Narasimham, Biomedical Engineer at RWTH Aachen University, Aachen, Germany and Gaurav Kaila, Biomedical Engineer at Delft University of Technology, in The Netherlands and Sneh Anand of the Indian Institute of Technology Delhi, India, have turned to impedance spectroscopy to help them develop a system for the determination of blood glucose concentrations without having to obtain a blood sample from the person with diabetes.

The spectral lines obtained by impedance spectroscopy depend crucially on the concentration of glucose in a blood sample. So, the researchers first performed in-vitro with standard solution containing different concentrations of glucose. They then place electrodes on the forearm of a volunteer and record the impedance spectrum through the skin without having to pierce the skin. The reference then reveals the blood glucose concentration non-invasively.

However, there are several other factors that can affect such impedance spectra including patient-to-patient variation in skin type and skin moisture as well as related factors that would affect readings day to day for the same patient. The team is investigating these issues with a view to taking the prototype system to the next stage in research and development.

More information: "Non-invasive glucose monitoring using impedance spectroscopy," Shruti Narasimham; Gaurav Kaila; Sneh

Anand, *Int. J. of Biomedical Engineering and Technology*, 2014 Vol.14, No.3, pp.225 - 232, DOI: 10.1504/IJBET.2014.059672