New and emerging non-invasive glucose monitoring technologies

Diabetes is a life-long condition where the levels of glucose in the body are too high because the body is unable to convert it to energy due to insufficient insulin or the insulin not working properly. There are two main types of diabetes, type 1 and type 2. Effective diabetes management reduces the risk of long-term complications associated with the disease, which include heart disease, blindness, stroke, kidney disease and amputations leading to disability and premature mortality. For most people with diabetes, managing the condition has an impact on their lifestyle and quality of life.

Blood glucose monitoring
Monitoring blood glucose levels helps people with diabetes and their carers make informed decisions about their diet, activity and medication requirements, such as insulin dose. It can also help patients, carers and their healthcare team alter treatments to help prevent long-term complications.

The conventional way for people with diabetes to test their blood glucose levels is through a portable device known as a blood glucose meter. First, the side of a finger is pricked using a lancet to draw a small drop of blood. The blood is then transferred to a test strip which is inserted into the blood glucose meter, which then provides a result. This method, however, is generally disliked due to the pain and inconvenience associated with finger pricking. The development of a non-invasive glucose monitoring (NIGM) technologies may provide patients with an alternative, painless method.

A variety of new technologies are being developed to non-invasively measure glucose levels in patient with diabetes. In this report, we provide an overview of emerging NIGM technologies and the potential benefits of these to people with diabetes. We also provide information about the individual technologies that we identified and the views of healthcare professionals and potential users on these technologies.

Technologies Identified

Our review identified 40 NIGM technologies. Thirty-nine were being tested in clinical research studies and one was available through the developers’ website but it is not routinely used in the NHS.
The technologies identified were at different stages of development and differed in the way they work. Of the 40 NIGM technologies identified, 24 were intermittent NIGMs and 16 were continuous NIGMs. The technologies used varying sites of testing including the skin, tear fluid, saliva and breath. Three general glucose monitoring technique categories were identified: optical, transdermal and electrochemical techniques.

Optical techniques utilised the different properties of light to interact with glucose in a concentration-dependent manner. Within this category were a number of techniques used in emerging NIGM technologies including multiple spectroscopy techniques, optical coherence tomography, fluorescence and surface plasmon resonance interferometry.

Transdermal techniques involved the measurement of glucose through the skin using chemicals, electricity or ultrasound. NIGM technologies identified in this category were further subdivided into technologies using reverse iontophoresis and impedance spectroscopy.

Electrochemical techniques identified included amperometry and the enzymatic detection of glucose.

What the public and healthcare professionals think

We involved people with diabetes and their carers by asking their views on the NIGM technologies that we identified. People with diabetes and their carers were very interested in the development of NIGM technologies and thought their use could potentially improve their quality of life. In addition to emphasising the importance of safety, reliability and accuracy, many patients and carers expressed preferences about the physical design characteristics and functionality that would be needed to be acceptable to users for long-term use. Healthcare professionals commented on clinical need, potential benefits and barriers to adoption, and user acceptability. For many technologies development is still in the early stages so there was limited information regarding safety and effectiveness.

HSRIC will monitor the identified products through later clinical development, informing key health service and research policy and decision makers when appropriate. HSRIC wrote an Alert on the Oxford Medical Diagnostics Breath Ketone Device for monitoring type 1 diabetes in October 2014.

For further details of the technologies we identified and references, please read the full NIHR HSRIC report which is free to download.