Utilizing inkjet printing for low-cost glucose monitoring

Diabetes is a disease affecting more and more people across the world every year. In low-income countries, this growth is most detrimental since they lack the healthcare infrastructure necessary to deal the growing problem. Work is being done to try to prevent the number of cases from growing, but affordable solutions for treating those already affected are not available yet in these low-resource areas. One of the main devices needed by diabetics in order to properly manage their disease and minimize some of the long-term complications is a glucose meter. These meters use test strips to detect how much sugar is in someone's blood.

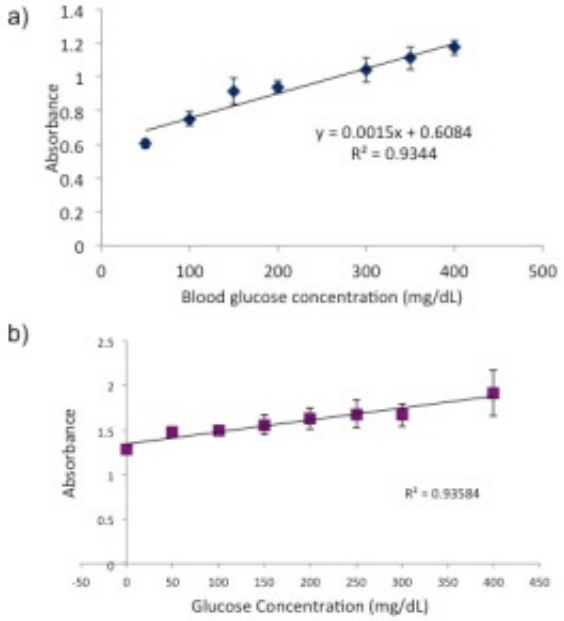

Fig.1.

Unfortunately, these test strips and meters are not affordable for people living in low-resource areas. Thus, diabetics living in low-income countries simply cannot monitor and manage their disease. Therefore to address this critical problem with diabetic care, we have developed a meter that uses inkjet printed test strips as a low-cost alternative to traditional monitoring.

Our novel glucose meter and strip system costs fractions of standard meters. We are using a standard desktop inkjet printer as a manufacturing method because it is simple and lower cost. By filling the cartridges with enzymes and dye, we can create a strip that changes color in the presence of sugar. When used, the strips turn blue in response to glucose; the more glucose there is, the darker the strip becomes.

In order for this system to work, we need a consistent relation between the amount of sugar and the intensity of the color. We use a sensor and a specific LED light to detect this intensity and to figure out what the sugar level is based on that measurement. Shown in Figure 1a, our experiments with cow blood have shown a very linear (consistent) relationship between the two factors. We have also established that the printing process does not damage the enzymes (Fig. 1b). The final version of the strips has two sides to it. One is the testing side, and the other is the control side. This is illustrated in Figure 2a,b. By designing it this way, the meter can detect the color intensity on both sides and subtract the control side from the testing side. This makes the reading more accurate and ensures that the paper itself and other factors are not interfering with the result. More testing is being designed to ensure that the strips work as well for human blood. This will guarantee that the strips meet the FDA standard for accuracy so they can be used by those who need them.

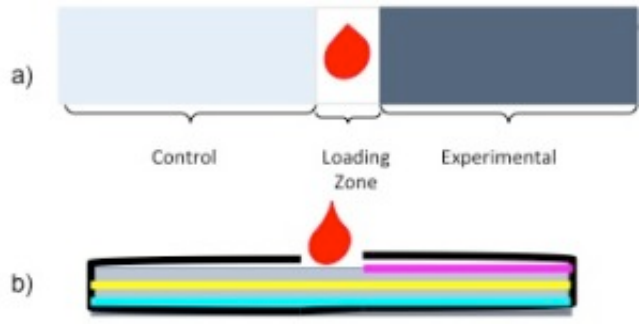

Fig.2.

These results indicate that the inkjet printed strip system is feasible for a low-resource setting to monitor blood sugar levels. The new manufacturing practice would allow the strips to be made locally, increasing access in remote regions. The strips use a colorimetric assay that change color in response to a patient's blood glucose. Because this color change is easy to see, these strips might be able to be used without any external meter. This could further cutting costs and allowing even patients in the poorest regions to monitor and manage their diabetes. Thus, this system has the potential to address the dire need for glucose monitoring in low-resource settings.

Publication

A Low-Cost Inkjet-Printed Glucose Test Strip System for Resource-Poor Settings.
Gainey Wilson K, Ovington P, Dean D.
J Diabetes Sci Technol. 2015 Jun 12