Lancet-Free Technology for Diabetic Populations

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Ask any sufferer of diabetes who has mastered the art of self-monitoring of blood glucose and they will likely admit it is no easy feat. Load, prick, record, and repeat. No matter how regular the routine becomes, home glucose meters are messy, painful and inconvenient!

While many health care providers preach the importance of tight blood sugar control, the vast majority of their patients will admit to non-compliance with prescribed instructions. What if there was an easier method to check glucose status that was less invasive and would promote more frequent readings at any given time during the day? Over the last couple of years, Google Inc. has sought to deliver a tangible solution to this area of need. A recent collaboration of leaders within their respective fields will likely accelerate this production process. In early July 2014, Novartis pharmaceuticals announced that its eye care division, Alcon, has teamed up with a subgroup of Google Inc. to further develop a type of "smart" contact lens that aims to redefine modern day glucose monitoring. Before the mechanics of such a medical device are outlined, let's review some of the science behind non-invasive tear glucose measurements.

It is a well-known fact that human tears consist of several components including salt, water, proteins, and glucose (Ohashi et al, 2006). In fact, evaluating glucose levels in tears and understanding its correlation to blood sugar levels have been a research topic for over 80 years. Regardless of the method(s) employed to evaluate these specific tear dynamics, a few general conclusions have been established from studies carried out to date:

- Tear glucose concentrations have been shown to be higher in diabetic patients versus non-diabetics (Sen et al, 1980)
- Both blood glucose and tear glucose values increase upon ingestion of a carbohydrate load, albeit not proportionally (Lane et al, 2006)
- Minimal irritation to the ocular environment during assessment provide the most accurate representation of basal tear glucose levels (Baca et al, 2007; Chu et al, 2011)

Our predecessors have carried out the groundwork. While analysis of blood samples remains the gold standard to evaluate glucose levels in the body, human tears are a viable medium to monitor hyperglycemic states. With this in mind, several attempts at glucose-sensing contact lenses have already been theoretically designed. Prototypes that employ chemically driven probes and fluorescent signaling molecules have shown the most promise but have not undergone large-scale clinical trials to validate biocompatibility on eye.

Today, Google has extensive advancements in microtechnology and with a tiny wireless microchip and a miniaturized glucose sensor embedded within the layers of a commercially available Alcon soft contact lens, a pretty sophisticated device can result. The strategic placement of all constituents beyond the pupil boarders will theoretically allow for clear vision for wearers of the contact lens, while maintaining the comfort of an already successful modality.

For current diabetic patients, this latest development in smart devices may not jive with their preconceived notions of caution when it comes to personal use of contact lenses. It has been shown that diabetics exhibit several ocular manifestations such as decreased corneal sensitivity and potential abnormal corneal healing (Schwartz 1974; Friend et al, 1984). The safety of contact lens wear in this health-compromised population quickly became an issue of concern, however subsequent studies showed that the benefits outweighed the risks in these cases (O'Donnell et al, 2001; March et al, 2004). Advancements in soft contact lens materials, frequent replacement modalities, and diligent practitioner care have resulted in numerous successful diabetic contact lens wearers.

The age of "wearable's" in the health care field is upon us. Intricately designed devices that incorporate innovative technology and aim to steadily improve quality of life. It is estimated that in 5 years time, we will be able to offer our patients this new smart lens. Time will tell what further advancements in diabetes management will surface by then.