

IMPORTANCE OF NEW TECHNOLOGIES FOR DIABETES MONITORING

David P. Paul, III
Monmouth University

Joey Preast
Zach Garrett
Alberto Coustasse
Marshall University

What Exactly Is Diabetes?

- **a metabolic disease: a disorder of how the body uses food**
 - Normally, the pancreas produces insulin, which allows blood glucose to be metabolized
 - In individuals with diabetes, the pancreas produces either insufficient or no insulin, or the body's cells do not respond correctly to the insulin which is produced.

What Exactly Is Diabetes?

- **Three types of diabetes**
 - **Type 1 (formally called juvenile diabetes)**
 - **Type 2 (formally called adult onset diabetes)**
 - **Gestational diabetes**

What Exactly Is Diabetes?

- **Type 1 (juvenile)**
 - **5-10% of diagnosed cases in U.S.**
 - **Mostly children, but also adults**
 - **Cause: body attacks insulin-producing cells**
 - **If not treated, results in death**

What Exactly Is Diabetes?

- **Type 2 (adult onset)**
 - **90-95% of diagnosed cases in US**
 - **often associated with**
 - **older age (but occurring more frequently in children and adolescents)**
 - **obesity**
 - **family history of diabetes**
 - **previous history of gestational diabetes**
 - **physical inactivity**
 - **certain ethnicities**

What Exactly Is Diabetes?

- **Type 2 (adult onset)**
 - Usually pancreas produces insulin, but body is unable to use it effectively
 - Incidence (2010): 25.8 million adults over 20 (another 7.1 million undiagnosed)
 - Incidence expected to double between 2005 and 2050
 - Clearly a significant and growing problem

What Exactly Is Diabetes?

- **Gestational diabetes**
 - **Developed by some women during pregnancy**
 - **Women who have had it have a 40-60% likelihood of developing type 2 diabetes within 5-10 years**



What Exactly Is Diabetes?

- **Potential effects of untreated diabetes**
 - **Blindness**
 - **Heart and blood vessel disease**
 - **Stroke**
 - **Kidney failure**
 - **Amputations**
 - **Nerve damage**



What Exactly Is Diabetes?

- **Diabetes treatments**
 - **Type 1**
 - **Healthy diet**
 - **physical activity**
 - **insulin**
 - **Type 2**
 - **Same as above, except oral medication may be substituted for insulin**



What Exactly Is Diabetes?

- **Diabetic patients should see a health care provider regularly; goal is to keep blood glucose, blood pressure, and cholesterol levels as close to normal as possible**
- **Diabetic patients should take responsibility for their own day-to-day care with respect to maintaining appropriate blood glucose levels**

Use of Communication Technologies in Diabetes

- **traditional forms of patient communication are relatively ineffective in improving patient adherence to lifestyle and medical lifestyle changes**
- **new communication and remote monitoring technologies are becoming available so that providers can interact with patients virtually “anywhere, anytime”**

Use of Communication Technologies in Diabetes

- **Telemedicine looks good ...**
 - **Improved access to healthcare, especially settings**
 - **Assistance in overcoming scarcity of trained clinicians**
 - **Reduction of costs while improving (or, at least maintaining) quality**
- **but what telemedicine approaches work best?**

Use of Communication Technologies in Diabetes

- **Goal of telemedicine for type 1 diabetes:**
 - better blood sugar control via insulin dosage
- **Goals of telemedicine for type 2 diabetes:**
 - better blood sugar control via insulin or oral medication
 - better blood sugar control via dietary and/or physical activity changes

Use of Communication Technologies in Diabetes

- **Currently, 2 promising approaches**
 - **Hand-held devices, esp. smartphones, seem to be appropriate for both type 1 and type 2 diabetes**
 - **Systems with an interactive Internet system (or a smartphone coupled with a remote server)**
 - **Primarily aimed at type 2 diabetes patients**
 - **Provide motivational support also**

Type 1 Diabetes Studies

- **Telephone Consultations**
 - **2 studies using landline phones produced positive but non-statistically significant results**
 - **Another landline study produced statistically significant results, but involved 15 minute calls 3X/week. Follow-up required a half-time employee to cover only 23 patients**

Type 1 Diabetes Studies

- **Telephone Consultations**

- **Mobile phone communication allows more frequent and more timely interaction**
- **Most everyone has a mobile phone!**
- **Another approach is a glucose meter combined with the battery pack of a cell phone**
- **Unfortunately, no statistically significant results have been obtained using either approach**



Type 1 Diabetes Studies

- **Telephone Consultations**
 - **Blood Glucose Data Transmission to a Provider with Feedback**
 - **Simple teletransmission of blood glucose values from a glucose meter with a memory function**
 - Many studies, most done by manufacturers of glucose meters
 - Few showed positive results
 - Often the costs of the experimental group were high



Type 1 Diabetes Studies

- **Telephone Consultations**

- **Blood Glucose Data Transmission to a Provider with Feedback**

- **Active Electronic Diaries on Smartphones**

- **Lots of apps (and number is growing)!**
 - **Require a password-protected website**
 - **Complex systems can transmit data such as insulin intake, blood glucose, dietary consumption, and physical activity in a readily available format for the clinician**
 - **can potentially enhance the cost effective self-management of diabetes and improve HbA1c levels**

Type 2 Diabetes Studies

- **Remember, incidence of type 2 diabetes MUCH higher than type 1**
- **Generally larger-scale studies**
- **Type 1 studies also apply to type 2**

Type 2 Diabetes Studies

- **Telephone Consultations**
 - **Many studies in different settings**
 - **showed nurses' telephone follow-up of diabetic patients improved patients' blood glucose**
 - **but, were expensive and time-consuming**
 - **Most, but not all studies demonstrated positive results**

Type 2 Diabetes Studies

- **Blood Glucose Data Transmission with Feedback from a Provider**
 - **Internet-Based Blood Glucose Control Systems**
 - **Some studies take an indirect approach, focusing on diet modification or physical activity**
 - **Unfortunately, many did not report objective measures of blood glucose**

Type 2 Diabetes Studies

- **Blood Glucose Data Transmission with Feedback from a Provider**
 - **Systems Using a Cell Phone with a Remote Server**
 - **A 2008 literature review found that 9 out of 10 studies that examined the use of a cell phone for health information for persons with diabetes or obesity reported significant improvement in HbA1c**
 - **Later studies generally confirmed these results**

Type 2 Diabetes Studies

- **Blood Glucose Data Transmission with Feedback from NO Provider**
 - **Instead of a physician, a “rule engine” was used for patient feedback**
 - **Decrease in HbA1c levels were statistically significant**

Type 2 Diabetes Studies

- **The preponderance of evidence supports the use of mobile telephones combined with web-based electronic communications for better control of blood glucose for type 2 diabetics**



Conclusions

- **Blood glucose monitors alone have little improvement of diabetes health, but do improve patient education**
- **Improvements in HbA1c were often significant, albeit relatively small**
- **Telemedicine shows promise in the monitoring and treatment of diabetes patients**