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
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.