

## The Role of Real-Time Glucose Monitoring

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Diabetes mellitus is a widespread disease affecting 387 million individuals worldwide and is projected to exceed half a billion by 2035 [1]. Despite spending over \$175 million annually in direct medical costs, there has been an overall lack of success with disease management [2]. One likely contributor to this phenomenon is clinical inertia, or the failure to intensify or modify treatment following lab results that show a patient is not at evidence-based goals. Stain et al. [3] found that impairments in communication are at the heart of clinical inertia [3]. Furthermore, it can be difficult to accurately assess disease progression due to poor documentation and communication of patient-monitored blood sugars. Accurate and efficient communication between the patient and provider needs to be a key factor to efficiently manage the disease.

The most common traditional method for communicating, tracking, and logging blood sugar values is via the use of a handheld glucometer. Patients with diabetes are asked to bring their glucose meters and logs to appointments, which should occur approximately every three months. In practice, patients are not always seen quarterly and they often fail to produce requested information at the office visit, which contributes to the difficulty in the assessment and treatment of the diabetes. Even in cases where patients have followed through with accurate documentation of blood sugars, there is a lack of formal communication channels to evaluate progress and monitor treatment in between the quarterly office visits. Communication between office visits is especially important for those patients using insulin. Correspondence regarding management, and even titration of insulin for optimal blood glucose control between office visits, can lead to better management of the disease, decreasing complications and costs down the road.

One option to improve communication and data exchange between the patient and provider is through the use of real-time blood glucose monitoring that uses wireless technology to transmit health information. For almost a decade, studies have demonstrated the promise of wireless technology and its potential to improve patient care and health outcomes while reducing medical costs. However, these technologies have yet to be implemented in a widespread manner [4].

With the hope of attaining broader adoption, multiple technologies have been developed in the arena of real-time blood glucose monitoring for all types of diabetes patients. Most of these tools utilize traditional handheld glucometer data. There is also continuous glucose monitoring devices that are often used with insulin pumps to capture glucose values and require a monitor be placed into the subcutaneous tissue of the patient monitor the patient's blood glucose and report the value every one to five minutes [5].

Another type of technology, available in both mobile and PC-based applications, assists patients in making complex judgments regarding insulin administration. Decision-support software has been linked to improvement in metabolic regulation in poorly controlled patients with type 1 diabetes [6]. More recently, blood glucose monitoring meters, such as Roche's Accu-Chek Aviva Connect<sup>®</sup>, have integrated the capacity to wirelessly upload data from the meter to web-based

applications that allow providers to review the readings [7]. One study comparing traditional blood glucose logbook data to software-generated reports from the data obtained from Accu-Chek<sup>®</sup> wireless meters demonstrated that patients with diabetes, caregivers, and health care providers were able to utilize the software-generated information with significantly greater accuracy and efficiency compared to the traditional logbook data; this held true even for participants who did not have prior experience with the diabetes data management software [8].

In 2015, Telcare<sup>®</sup> pioneered the first cellular-enabled glucometer. This meter differs from other wireless glucometers in its ability to transmit data via a cellular signal and does not require a supplementary internet connection [9]. The meter can automatically upload the blood sugar readings to a cloud storage server. Users can then access the information through a web browser or the partner mobile application. Health care providers can utilize the meter to provide feedback and set target ranges to individualize patient goals and treatment.

These technologies represent the potential to close the communication gap between patients and health care providers that is necessary for better disease management. Huang et al. [10] performed a systematic review and meta-analysis of randomized control trials to analyze the effects of Telcare<sup>®</sup> interventions on glycemic control in type 2 diabetes. This review of 18 studies and 3798 subjects revealed that Telcare<sup>®</sup> significantly improved the management of diabetes [10]. Telcare<sup>®</sup> has the ability to overcome some of the largest barriers in providing optimal patient care and health care service to patients with chronic disease.

Beyond the simplicity of setting up a patient with a cellular glucometer, the real-time data can assist clinicians in making critical interventions to modify treatment in an efficient and timely manner. The patient's frequency and timing of blood glucose checks are readily accessible in the real-time data reports. This information can quickly and readily be compiled by the server and used to direct therapeutic modifications. An additional feature of the cellular glucometer with tremendous potential for optimizing patient care and diabetes control is its ability to communicate to patients via text message alerts. Alerts can be programmed to "trigger" based on the value of the blood glucose reading. These triggered alerts can be customized to address the anticipated ranges of an individual patient. Alternatively, more

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generalized, universal alerts can be utilized to assist patients in their management efforts.

When synthesizing all of the benefits and challenges of implementing the aforementioned wireless technology into primary care, the alternative of cellular technology that the Telcare<sup>®</sup> meter provides has many attractive features, especially for patients with limited health literacy and technological resources. At a basic level, the cellular glucometer can deliver the benefits of real-time glucose monitoring with minimal retraining to the patients. The device does not require any additional equipment or internet connection. This allows clinicians to utilize the available technology without concern that a patient will be unable to afford or understand potentially complicated instructions to synchronize the data with the server. A pilot study using the Telcare<sup>®</sup> meter is underway to evaluate the use of this device in a large primary care practice.

The field of real-time glucose monitoring has the promise to address a widespread communication barrier between patients and clinicians. Many exciting technologies have been developed with proven results and great potential. Primary care providers have the option of utilizing real-time data with a variety of choices, including cellular and wireless glucometers. Although insurance coverage of strips and supplies will be a major factor in determining the best option for a patient, the utility of real-time glucose monitoring should be considered for patients and providers when managing diabetes.

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