

## Sweet Talking: Voice Technology and Virtual Assistants in Clinical Diabetes Management

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### Abstract

*Voice technology offers a range of novel and promising strategies for clinical diabetes management. Incorporation of voice-powered virtual assistants (such as Apple Siri and Microsoft Cortana) into diabetes care programs has the potential to improve patient awareness and adherence; facilitate comprehensive provider-patient integration and data collection; and expedite consultations, procedures, and meal preparations. This study will present a qualitative literature review on existing and speculative applications of voice technology in diabetes care.*

### Keywords:

Diabetes Mellitus, Mobile Applications, Speech Recognition Software

### Introduction

Diabetes encompasses a number of related conditions chiefly characterized by dysregulations in glucose metabolism and resultant hyperglycemia. It is a globally recognized health issue with an estimated prevalence of over 400 million people worldwide [1]. Diabetes is primarily represented by two main subtypes: Type 1 diabetes mellitus (T1DM), an autoimmune condition; and Type 2 diabetes mellitus (T2DM), caused by deficient insulin secretion and/or insulin resistance [2]. Both forms of diabetes are lifelong and associated with increased mortality, largely due to cardiovascular and cancer-related causes [3].

Clinically, there are many issues that impair contemporary diabetes management. As diabetes is a chronic condition, patient education and adherence are closely intertwined with overall outcomes [4]. However, long-term adherence remains low, largely due to the complexity and consistency demanded by comprehensive management plans [5]. Surgery represents a prominent challenge in the diabetic population, both due to its fasting requirement and a greater rate of cardiovascular and infectious complications [6]. Additional issues in diabetes management include underdiagnosis, polypharmacy, drug interactions, wound care, and healthcare delivery [7].

Recent advances in digital and online technologies have presented a novel avenue to overcome these challenges [8], though reports on adoption and efficacy remain variable [9]. Smartphone applications have demonstrated efficacy at improving patient adherence and reducing blood glucose levels [10]. Similarly, artificial intelligence systems may allow patients and healthcare providers to better navigate the complexity of diabetes [11].

Voice technology, including virtual assistants such as Amazon Alexa, Apple Siri, and Google Home, offers a highly personalized and accessible approach to diabetes management. This study aims to summarize the current state of voice technology in diabetes management, as well as report on upcoming and potential applications.

### Methods

A review of the literature was conducted to identify relevant peer-reviewed articles, conference abstracts, and technical reports. Databases searched included PubMed, Scopus, ACM Digital Library, and IEEE Digital Library. Google Scholar was used to identify relevant grey literature. The eligibility criteria for this study included English-language articles published from 01/01/2010 to 31/12/2018, as well as assessments of topical relevance, reliability, and data quality.

To find studies involving both diabetes and voice technology, a two-pronged search strategy was developed. Diabetes-related search terms included “diabetes”, “blood glucose”, and “blood sugar”. Voice technology search terms included “Amazon Alexa”, “Amazon Echo”, “Apple Siri”, “Microsoft Cortana”, “Google Assistant”, “Google Glass”, “Google Home”, “interactive voice”, “virtual assistant”, “voice assistant”, “voice intervention”, “voice recognition”, “voice interface”, and “voice response”. Overall, 28 peer-reviewed publications and 2 grey literature articles met the eligibility criteria for this study.

### Results

#### Patient Adherence and Education

Interactive voice response (IVR) systems provide automated phone consultations through the use of voice recognition software [12]. Multiple studies have shown that IVR improves medication and lifestyle modification adherence in T2DM patients, ultimately resulting in HbA<sub>1c</sub> and outcome reductions [12; 13]. By providing personalized advice and a range of answers to common medical questions, voice-driven technologies are also effective at educating and informing patients [14].

Insulin therapy is considered to be clinically underused in T2DM, largely due to difficulties in manually calculating one’s bolus dose [15]. In conjunction with a machine learning algorithm for nutrient determination [16], Foltynski et al. report on a smartphone application that can synthesize verbal descriptions of meals and accurately return the corresponding insulin bolus dose [17]. A similar voice-activated initiative was successfully trialled in patients with diabetic retinopathy [18]. Further development and distribution of these programs have the potential to greatly expedite insulin therapy for existing users, as well as promote its adoption in current non-users.

#### Healthcare Delivery

IVR and virtual assistants allow patients to easily book health appointments, as well as rapidly notify care providers about hypoglycemic and cardiovascular events [14]. Voice recognition software has successfully been used to transcribe endocrine consultations, improving healthcare efficiency and continuity [19]. Taken together, these systems allow for

doctors' advice and recommendations to be repeated at home, improving patient recall and adherence [14].

Surgeries in diabetic patients are often complex and demand significant expertise [6]. Armstrong et al. document the use of proprietary Google Glass software during diabetic limb salvage surgery to facilitate clinician communication and consultation, reducing errors and improving patient outcomes [20].

### Surveillance and Diagnosis

Notably, voice recognition software appears capable of identifying early diabetic [21] and acutely hyperglycemic [22] patients from alterations in their vocal characteristics. Basatneh et al. additionally propose integrating virtual assistants with wearable sensors, such as foot mats and 'smart' wound dressings. This would facilitate wound self-care, early notification of risky behavior, and timely alerts to health providers [14].

### Conclusions

Voice technology is swiftly gaining traction in contemporary diabetes management, with studied applications in intervention adherence, medication guidance, healthcare access, intra-operative consultation, and surveillance. Future expansions include the potential for further integration with existing diabetes technologies and machine learning systems, improving symptom detection and reducing intervention complexity. While voice technology currently holds a relatively niche role in diabetes management, the rapidly increasing prevalence of virtual assistants and speech recognition software heralds far greater adoption in the years to come.

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