Commentary

Role of digital health monitoring in the management of diabetic patients with hypertension

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ABSTRACT

As we have entered a digital era, which is exponentially growing, there is definitive need for the health sector to embrace and utilize the benefits of information and technology for better control of highly prevalent chronic health disorders like diabetes mellitus and hypertension. Despite few challenges and limitations, numerous research studies and data have demonstrated that the digital health monitoring can result in better control of hypertension and diabetes and prevent complications in large number of high-risk patients.

Key words: Digital health monitoring, Diabetes mellitus, Hypertension.

In routine clinical practice, most of the diabetic and hypertensive patients generally do not visit hospital for regular follow up unless they have some symptoms. This can be because of multiple reasons like consultation cost, travel time and lack of awareness regarding importance of regular or periodic visits. Digital health applies digital transformation to the healthcare field, incorporating software, hardware, and services. Digital health includes mobile phone health (mHealth) apps, electronic medical records, wearable devices, telehealth, telemedicine, and personalized medicine. Among these, the mobile phone health has become the most common and feasible means of communication in both developed as well as developing countries. Digital health emphasizes engaging patients in selfcare and includes tools like patient portals that allow patients to access their health information, track their progress, and communicate with their care team. Digital health technologies often include strategies that encourage healthy behavior and self-management of chronic diseases like hypertension, diabetes, etc. [1]. Type 2 diabetes mellitus (DM) and Hypertension (HT) are among the most common chronic no communicable diseases, which require long term follow up for proper management and prevention of complications. [2, 3] Epidemiological study ICMR- INDIAB, depicted that the overall prevalence of diabetes by Oral glucose tolerance test was 11·4% (95% CI 10·2–12·5; 10 151 of 107 119 individuals), and the prevalence of hypertension was 35·5% (95% CI 33·8–37·3; 35 172 of 111 439 individuals) in India [4].

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As per the data from the National Family Health Survey 2015–16, India, prevalence rate of HT among diabetic individuals was approximately 37 % [5]. The occurrence of HT in DM patients substantially increases the risk of cardiovascular and cerebrovascular diseases, nephropathy, and retinopathy. When HT coexists with DM, the risk of cardiovascular disease (CVD) is increased by 75%, which further contributes to the overall morbidity and mortality of already high-risk patients. This combination is further enhanced by the fact that both blood pressure as well as blood glucose levels can vary due to multiple factors like physiological, pathological, medications dosage and frequency, unhealthy food habits and stress levels [2,3].

HYPERTENSION

Hypertension, also known as high or raised blood pressure (BP), is a chronic condition in which the systemic blood vessels have persistently raised pressure above140/90 mmHg. Blood pressure variability (BPV) is the dynamic fluctuations in blood pressure levels occurring over lifetime and the pathophysiologic BP variation is related to heart rate, respiration, complex responses of the autonomic nervous system, vascular reactivity, and arterial thickening and stiffness. A single office blood pressure measurement can depict an individual's BP at a single point of time and fails to demonstrate blood pressure variability. Hence, a remote digital continuous/ periodic BP monitoring is essential to identify BP variability. As of date, the remote blood pressure monitoring devices mainly include upper-arm electronic automatic devices (wired or wireless), smartphone applications with external wireless blood pressure monitors,

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smartphones acting as sleeveless blood pressure monitors, smart watches, smart bracelets, and finger photoplethysmography. Data collected are transferred to smartphones, home centers, smart boxes, tablets, desktop computers, laptops [6-10]. Blood pressure variability (BPV) is a strong and independent risk factor for cardiovascular diseases, chronic kidney disease (CKD), dementia, and stroke, as well as hypertension-related morbidity and mortality. The Valsartan Antihypertensive Long-term Use Evaluation trial (VALUE), involving 14,000 hypertensive patients, found 10% increase in risk of death and a 15% increase in risk of Cardiovascular events for 5 mmHg increase in standard deviation (SD) of visit-to-visit and within-visit systolic BPV, respectively. [11]

Palatini and co-workers, involving 1206 hypertensive patients (mean age 33 ± 8 years), found that a 24-hour higher systolic BP variability was associated with a greater number of fatal and non-fatal Cardiovascular events during a median follow up of 15.4 years [12]. Telemonitoring and self-management in the control of hypertension (TASMINH2) study demonstrated that after 12 months of follow-up, blood pressure reduced in both the non-self-administered and self-administered groups, with an average reduction of 12.8 mmHg systolic and 3.4 mmHg diastolic and 18.3 mmHg systolic and 7.7 mmHg diastolic respectively [13]. Another study depicted that remote blood pressure monitoring and management significantly improved blood pressure control in patients with acute ischemic stroke, and intensive blood pressure management reduced stroke recurrence by 22% [14,15]. A research study utilizing remote blood pressure monitoring for the monitoring of blood pressure and screening for complications during pregnancy and suggested that telemetric blood pressure monitoring help in the management and improvement of hypertension during pregnancy. Concordantly, Hoppe et al, found that remote blood pressure monitoring and management reduced readmissions at six weeks postpartum in patients with hypertension during pregnancy [16-18]. Hence, with a remote blood-pressure monitoring strategy, more blood pressure data can be collected from patients to assess their BPV, can predict the risk of cardiovascular and cerebrovascular events, guide medication, and improve lifestyle for better control of blood pressure.

DIABETES MELLITUS

Diabetes mellitus (DM) is a chronic metabolic disorder, characterized by inappropriately elevated blood glucose levels due to insulin deficiency or insulin resistance. Glycemic variability (GV) refers to blood glucose level fluctuations throughout the day and it includes hypoglycemic episodes, postprandial surge, and blood glucose fluctuations that occur at particular time on different days. Glycemic variability is associated with increased risk of hypoglycemia, microvascular and macrovascular complications, and mortality in patients with diabetes, independent of glycated hemoglobin (HbA1c) levels [19,20].

Continuous glucose monitor (CGM) can automatically estimate blood glucose levels, throughout the day and night and thus the GV which neither HbA1c nor the single glucometer random blood sugar (GRBS) reading can identity. CGM measures interstitial sugar levels, which increase and decrease in response to blood sugar levels, with a possible lag time of 5 to 15 minutes. CGM device downloads display three measures of glucose variability: interquartile range, Standard deviation around the mean, and coefficient of variation. There are 3 types of CGMS, “real-time” CGM devices transmit and display information to patient's smartphone or receiver automatically. “Intermittent-scan” CGM estimates glucose levels continuously and requires scanning the CGM with a separate receiver or smartphone every few hours to view and store the data. A third type of CGM collects data about blood glucose level for treating physician to download and review later. An artificial pancreas, is an automated insulin delivery system (AID), simulating a healthy pancreas, which controls blood sugar in the body. It includes a CGM, an insulin pump, and a software program that shares information between the CGM and insulin pump. CGM estimates sugar levels and wirelessly sends the information to a software program on a smartphone or insulin pump and then the program calculates how much insulin is needed, and the insulin pump delivers the insulin when glucose levels rise higher than the target levels. On the other hand, if the patient's glucose levels fall lower than normal levels, the artificial pancreas can lower or stop the amount of insulin given by the insulin pump [20-22].

In the year 2020, the Diabetes Technology Society (DTS) sponsored a panel of experts in inpatient diabetes management to review the evidence for use of CGM in the hospital. The panel confirmed that CGM can improve clinical outcomes, particularly for patients who are unable to communicate signs or symptoms of hypoglycemia and suggested that the patients who are admitted with personal CGM devices should be allowed to continue use of such devices under the condition that they are capable to self-manage the CGM devices on their own and are followed and supervised up by an experienced diabetologist who is specifically trained in CGM usage [23]. A study conducted utilizing the French national claims database, in which 74,011 patients with type 1 or type 2 diabetes started on intermittently scanned glucose monitoring depicted that 98% persisted with the device at 12 months and patients had a 39-49% reduction in hospitalizations for acute diabetic complications - severe hypoglycemia, diabetic ketoacidosis, and a 32-40% reduction in diabetes-related coma. Further, the reduction in hospitalizations was seen beyond 2 years of follow up [24, 25]. Another study conducted in Belgium, involving 1913 adults with type 1 diabetes, subjected for digital monitoring before and after nationwide

reimbursement of intermittently scanned continuous glucose monitoring demonstrated that there was significant increase in treatment satisfaction, and a significant reduction in admissions for acute complications (severe hypoglycemia or ketoacidosis) [26].

LIMITATIONS OF DIGITAL HEALTH

Privacy and Security Concerns, Technical Challenges and Reliability, Inequalities in Access, Potential for Information Overload, Ethical and Legal Issues. In the present digital era, despite few challenges and limitations, digital health monitoring can result in better control of hypertension and diabetes and prevent complications in large number of high-risk patients.

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