Remote Glucose Monitoring of Hospitalized, Quarantined Patients With Diabetes and COVID-19

Gilat Shehav-Zaltzman,[1,2] Gad Segal,[1,2] Noa Konvalina,[3] and Amir Tirosh[2,3]

The rapid growth in diagnosed patients with severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) led to national directives for hospital emergency preparedness. Sheba Medical Center, a government hospital in Israel, undertook emergency measures to expand the inpatient quarantine capacity and converted two general medical wards to isolation wards with enhanced ventilation support capabilities.

Diabetes is associated with increased severity, complications, and mortality from coronavirus disease 2019 (COVID-19) (1). The care of patients with diabetes under strict isolation poses significant competing challenges of maintaining adequate quality of care achieved by multiple daily glucose measurements while minimizing risk of staff exposure, highlighting timely blood glucose management for the COVID-19 outbreak as an urgent need (2). To prevent patient-staff transmission while maintaining standard of care for hospitalized patients with diabetes, a way to monitor glucose levels remotely—from outside the designated isolated rooms—is required.

We report our experience in activating five monitoring stations per department based on personal continuous glucose monitoring (CGM) systems. We used CGM transmitters (Guardian Connect, MMT-7820ME; Medtronic) connected to glucose sensors (Enlite, MMT-7020; Medtronic) transmitting glucose values every 5 min through Bluetooth connectivity to designated mobile devices that upload data to the web through a Guardian Connect application. Real-time glucose monitoring in the control, viral-free area was viewed continuously by the team using CareLink personal websites. To allow data visualization of several patients on one control screen, the CareLink personal websites were accessed via different browsers and minimized to allow a view of real-time continuous glucose levels of up to four patients on a single screen. Training for physicians and nurses was provided by trained staff from the hospital's Division of Endocrinology, Diabetes and Metabolism. Teams were also provided with educational material and designated short videos for weekly replacement of sensors and instructions for timely calibrations. Calibrations were performed twice daily.

The request for remote glucose monitoring was made by the hospital on 18 March, and all monitoring stations were fully operational the following day. The first subjects who completed a week of remote glucose monitoring were one patient with type 1 diabetes on continuous subcutaneous insulin infusion and three patients with type 2 diabetes on a basal-bolus insulin regimen. Mean $\pm$ SD daily glucose measurements decreased from 3.75 $\pm$ 0.86 to 1.94 $\pm$ 0.31 with remote CGM ($P = 0.005$), with significant improvement in mean glucose levels from 258.2 $\pm$ 25.3 to 169.3 $\pm$ 7.9 mg/dL, respectively, $P = 0.0006$. Patient characteristics and glucose management parameters are detailed in Table 1. The main challenges included training alternating teams with the calibration procedure and cost. The analysis and report of the data were approved by the Institutional Review Board of Sheba Medical Center.

In summary, converting a personal CGM system originally designed for diabetes self-management to team-based, real-time remote glucose monitoring offers a novel tool for inpatient diabetes control in COVID-19 isolation facilities. Such a solution in addition to ongoing remotely monitored clinical parameters (such as pulse rate, electrocardiogram, and oxygen saturation) adds to quality of diabetes care while

Table 1—Characteristics of patients with COVID-19 and diabetes remotely managed with CGM

	Patient 1	Patient 2	Patient 3	Patient 4
Age (years)	26	63	76	82
Sex	F	F	M	M
Diabetes type	Type 1	Type 2	Newly diagnosed type 2	Type 2
COVID-19 severity	Mild	Moderate	Severe	Severe
Need for oxygen support	Room air	Oxygen 4 L/min	Ventilator	High-flow oxygen
Additional comorbidities	None	Ischemic CVA, HTN	HTN, NAFLD, CKD, hypothyroidism	HTN and dyslipidemia status post mechanical AVR, osteoporosis, past smoker
Diabetes treatment	CSII	MDI	MDI	MDI
Glucose management before CGM				
Mean blood glucose tests per day	4.7	2.8	3.75	3.0
Mean $\pm$ SD blood glucose (mg/dL)	127 $\pm$ 33	382 $\pm$ 188	192 $\pm$ 79	183 $\pm$ 14
Glucose management with remote real-time CGM				
Mean blood glucose tests per day	2.3	1.5	1.8	2.1
Mean $\pm$ SD blood glucose (mg/dL)	127 $\pm$ 32	200 $\pm$ 54	168 $\pm$ 63	145 $\pm$ 45
Time with transmitted data (%)	96.3	72.3	90.8	97.2
TIR >250 mg/dL (%)	0.0	13.2	13.7	1.7
TIR 180–250 mg/dL (%)	5.7	56.7	29.0	14.2
TIR 110–180 mg/dL (%)	60.4	30.0	32.7	64.2
TIR 70–110 mg/dL (%)	33.1	0.1	23.9	12.6
TIR <70 mg/dL (%)	0.8	0.0	0.7	5.6
TIR <54 mg/dL (%)	0.0	0.0	0.0	1.7

AVR, aortic valve replacement; CSII, continuous subcutaneous insulin infusion; CVA, cerebrovascular accident; HTN, hypertension; MDI, multiple daily injections of insulin; NAFLD, nonalcoholic fatty liver disease; TIR, time in range.

minimizing risk of staff exposure and burden.

References

1. Huang C, Wang Y, Li X, et al. Clinical features of patients infected with 2019 novel coronavirus in Wuhan, China. Lancet 2020;395:497–506
2. Wang A, Zhao W, Xu Z, Gu J. Timely blood glucose management for the outbreak of 2019 novel coronavirus disease (COVID-19) is urgently needed. Diabetes Res Clin Pract 2020; 162:108118