



# A Pilot Study of the Feasibility and Accuracy of Inpatient Continuous Glucose Monitoring

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There are minimal data assessing the accuracy or use of continuous glucose monitoring (CGM) in hospitalized patients. Our group was interested in its use in the perioperative period, since we suspect we would identify more extremes and thus more dangerous blood glucose levels than seen with traditional bedside blood glucose monitoring. Given the lack of data for CGM use in hospitalized patients, and the outbreak of severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), we felt this is a critical time to share our data. Use of CGM could potentially reduce the number of health care provider contacts and use of personal protective equipment.

Eligible patients were adults (age  $\geq 18$  years) with diabetes who used intermittent home blood glucose monitoring and who were scheduled to undergo an elective general surgery at University of Washington Medical Center. The study protocol was approved by the University of Washington Institutional Review Board. The study was also registered as a clinical trial.

Continuous intravenous insulin infusion was used per hospital algorithm (target blood glucose 100 mg/dL [5.6 mmol/L] to 180 mg/dL [10.0 mmol/L]) until oral consumption was resumed, at which time

subcutaneous insulin was initiated. This study used a blinded Dexcom G6 CGM (Dexcom, San Diego, CA). Study staff placed the CGM sensors in the subcutaneous tissue of each patient's upper extremity on the day of surgery. Usual care was followed based on institutional glycemic management protocol with glucose measurements primarily made via point-of-care (POC) glucose meters (Accu-Chek Inform II, Roche Diagnostics, Indianapolis, IN). The CGM measurements were not used for clinical care. For determining the accuracy, we calculated the mean absolute relative difference (MARD) for CGM glucose values compared with the POC glucose measurements

Ten adult patients with diabetes (seven requiring insulin) were enrolled in this prospective study. Mean  $\pm$  SD age and BMI were  $61.5 \pm 6.3$  years and  $35.9 \pm 10.0$  kg/m<sup>2</sup>, respectively. Eight were women, mean A1C was  $7.4 \pm 1.3\%$  ( $57.4 \pm 14.2$  mmol/mol), and all required both intraoperative and postoperative insulin therapy. The reasons for surgery were malignancy ( $n = 7$ ), hernia ( $n = 1$ ), morbid obesity ( $n = 1$ ), and renal calculus ( $n = 1$ ). Morbidities included cardiovascular ( $n = 9$ ), renal ( $n = 3$ ), hepatic ( $n = 3$ ), and pulmonary ( $n = 2$ ) disease. All

patients received general endotracheal anesthesia, none remained intubated postoperatively, and none were admitted to the intensive care unit (ICU). One patient had to be excluded due to incorrect insertion protocol. Mean CGM glucose was 146 mg/dL (8.1 mmol/L), with a coefficient of variation of 15%. Time in range (1) was 89%. The median duration of CGM monitoring per patient was 62 h. Per usual clinical care, 178 postoperative blood glucose values were obtained and compared against the corresponding CGM measurements.

The MARD between CGM and POC was 9.4%. Correlation between the CGM and POC values yielded a correlation coefficient of 0.76. Mean bias was  $-0.37$  mg/dL, and 95% limits of agreement (average difference  $\pm 1.96$  SD of the difference) were 41.7 mg/dL and  $-42.4$  mg/dL. Color-coded surveillance error grids are shown in Fig. 1. Overall, 89% of paired glucose values were within the no-risk surveillance error grid zone.

In summary, postoperatively, Dexcom G6 has an MARD of 9.4%, like the package insert information of 9.0% (2). This is remarkable, as we were using POC hospital glucose readings and not a laboratory method for non-ICU patients receiving

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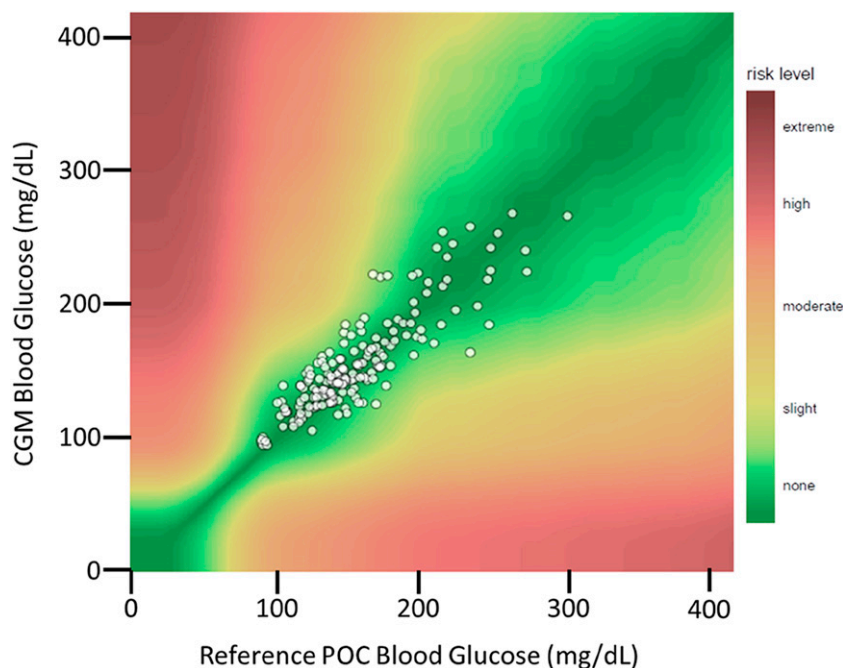
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**Figure 1**—Surveillance error grid for CGM measurements during postoperative period.

both intravenous and subcutaneous insulin. This device has a “non-adjunctive” labeling, meaning outpatient insulin doses can be provided without fingerstick glucose confirmation. In addition, this device is designated as an “integrated continuous glucose monitoring system,” meaning it can reliably and securely transmit glucose measurement data to digitally connected devices (3). While this was not a study assessing automatic insulin delivery, it appears our accuracy was close to that level of agreement sufficient for use for

hospitalized patients receiving both intravenous and subcutaneous insulin.

While there are limitations to these data including a small sample size, lack of blood glucose laboratory confirmation, and non-ICU admissions, we feel confident that the Dexcom G6 can be used safely in the hospital for patients infected with SARS-CoV-2. Now that the U.S. Food and Drug Administration has emergently approved CGM for use in the hospital, it will be easier to test all CGM devices in the hospital setting. This could potentially have

major implications for inpatient glycemic management after the pandemic, and cost-to-benefit ratios will be important to consider. In our current situation, use of CGM could reduce the number of health care provider contacts and the need for personal protective equipment.

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