Continuous Glucose Sensor Survival and Accuracy Over 14 Consecutive Days

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Continuous glucose monitoring (CGM) technology provides real-time glucose data and the ability to achieve improved glycemic control; however, widespread adoption has been limited (1). Among the challenges to CGM uptake are cost and the inconvenience of changing the sensor.

In this prospective, multicenter study, the Dexcom G4 PLATINUM system was analyzed over 14 days of continuous sensor wear. Each subject wore two sensors simultaneously. After 7 days, subjects left their original sensors in place and began a second 7-day sensor session. This procedure was then repeated with two new sensors for a second 2-week period.

Blood glucose (BG) readings from Bayer CONTOUR NEXT meters served as reference (2), with absolute relative difference (ARD) defined as the percent error between sensor and matched BG values. The Mann-Whitney rank sum test was used for comparison of sensor accuracy for week 1 versus week 2. The data were analyzed in a generalized linear model to account for the within-patient correlation. Sensor survival is presented in Fig. 1 with Kaplan-Meier survival curves for failures due to adhesive failure and for all causes of failure. Sensor accuracy in Fig. 1 is presented as median (interquartile range [IQR] 25th, 75th centile).

Fifty-seven subjects completed the study (46% male, mean $\pm$ SD age 28.7 $\pm$ 8.7 years and HbA$_{1c}$ 7.4 $\pm$ 0.8% [57 $\pm$ 6.6 mmol/mol]). In total, there were 222 2-week sensor sessions available for analysis, and 56% of sensors functioned for the full 2 weeks. Sensor failures occurred later in the 2-week period, and the main cause of sensor removal was related to failure of the tape adhesive (falling off or accidental dislodgment) ($n = 65$, 29%). Only 10% of sensors were removed for "sensor failure" and 3% for "loss of signal." Sensors tended to be well tolerated with minimal erythema or induration. There was one sensor site infection, which occurred on day 3.
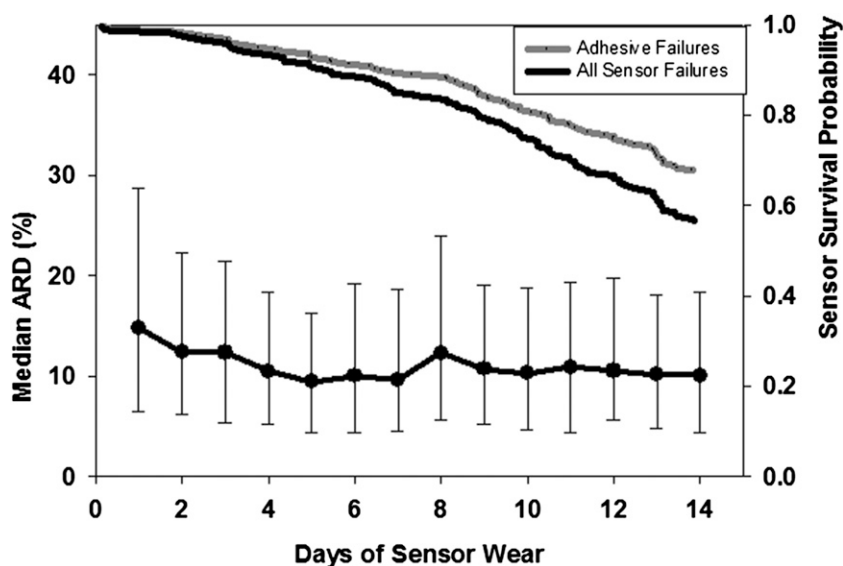

Figure 1—The left y-axis shows the MARD of sensor readings for each day of wear (black circle) with IQR. The right y-axis shows the portion of sensors functioning on each day of wear, with the gray line representing sensor loss related to adhesive failures and the black line representing all sensor failures.

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The median ARD (MARD) across all glucose ranges for week 1 of sensor life ($n = 6,639$ paired values) was 11.2% (IQR 5.1, 20.5) compared with 10.8% (IQR 5.0, 20.0) during week 2 ($n = 4,185$ paired values) ($P = 0.08$). Sensors were more accurate in the hypoglycemic range (BG <70 mg/dL) during week 2 ($n = 219$, MARD 15.6% [IQR 7.5, 31.3]) compared with week 1 ($n = 282$, MARD 20.8% [IQR 10.2, 38.2]) ($P = 0.007$). Accuracy was similar between weeks 1 and 2 in the euglycemic range (BG 70–180 mg/dL) ($P = 0.23$) and hyperglycemic range (BG >180 mg/dL) ($P = 0.30$). On day 8, the increase in MARD and variability was due to sensor recalibration, which is intrinsic to the Dexcom calibration algorithm.

Extending CGM sensor life offers a convenience to patients and may result in cost savings. In our study, the majority of sensors lasted the full 14 days, and accuracy was similar between weeks 1 and 2.

Our data suggest that CGM sensors that remain in place for 14 days may be as accurate in the second week and could be used in closed-loop systems, especially if algorithms for sensor failure are available (3). Future studies should analyze the accuracy of newer sensors (4) over 14 days.

References

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