Observed Glycemic and Psychosocial Benefits in the Prospective Bigfoot Unity Real World Study (BURST): A 6-Month Analysis

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Background

- The Bigfoot Unity Diabetes Management System integrates CGM data from Abbott FreeStyle Libre 2 into a smart pen cap and mobile app enabling clinician-directed insulin dose recommendations and real-time alerts.
- The objective was to analyze real world 6-month glycemic control in a prospective study for individuals using the System for multiple daily insulin injections (MDI).

Methods

- BURST is a prospective, single arm study real world study (NCT05088265). We conducted a pre-specified, 6-month, 100+ person per-protocol analysis.
- The pre-specified protocol, consent forms, data collections forms and recruitment materials were approved by the JAEB Center for Health Research (JCHR) institutional review board (IRB).
- Participants reported baseline demographics, adverse events and other surveys electronically. Either at-home kit or electronic medical record A1C data were collected. De-identified CGM and other System data, collected after System initiation, were transferred from the sponsor to JCHR for analysis.
- The per-protocol cohort included all participants with baseline and 6-month A1C and ≥50% CGM data availability at 6 months, reflecting N=102 of 232 in the study.
- Patient reported outcomes (PRO) included the 28-item Type 1 Diabetes Distress Scale (T1-DDS) and the Hypoglycemia Confidence Scale (HCS) at baseline, and 3 and 6 months; scores calculated as described.[1,2]
- Though T1-DDS was initially developed for T1D, it was deemed the better choice for assessing diabetes distress, since the study sample included a mix of adults with T1D and T2D using insulin.
- Serious adverse events were categorized as follows: Severe hypoglycemia (loss of consciousness or impairment where assistance was required by a third party); Diabetic ketoacidosis (DKA; reported DKA diagnosis from a healthcare facility); Serious hyperglycemia (treated in a healthcare facility other than DKA).
- A longitudinal linear regression model was used to test A1C and PRO change from baseline. An estimate of the change from baseline, 95% confidence interval, and p-value were calculated at 3 and 6 months.

Results

- In the per-protocol cohort, median age was 59 years, ranging from 22 to 82 years; 62% were White non-Hispanic, 87% had T2D and 13% T1D (Table 1).
- There was substantial improvement in glycemic metrics from baseline (prior to System use) to 6 months. Mean A1C decreased from 9.1 ± 1.7% to 8.0 ± 1.2%. Similar improvements were seen in mean glucose, time in range 70-180 mg/dL, and time >180 mg/dL, estimated at baseline from the A1C level (Table 2). Improvement was evident quickly after initiation of System use as the mean glucose management indicator (GMI) was calculated to be 7.7 ± 1.0% over the first 2 weeks of System use and it remained stable through 6 months (7.6 ± 1.0% in month 6). Percent time spent in hypoglycemia (1.0 ± 1.4%) was very low in month 6 (Table 2).
- Table 3 shows that there was significant decrease in total diabetes distress (mean -0.7 points, 95%CI -0.9 to -0.5, P < 0.001) from baseline to 6 months and a corresponding rise in hypoglycemia confidence (mean 0.4 points 95%CI 0.2 to 0.5, P < 0.001). Significant improvement in all seven T1-DDS subscales were also observed; of particular interest were the drops in powerlessness, management distress and hypoglycemic distress. Mean system usability was 80.7.
- The median number of rapid-acting insulin doses per day was 2.4 and median long-acting doses per week was 6.9 in the 6th month of use. At 6 months, when a long-acting dose alert was issued, a median of 71% of long-acting dose alerts were followed by a dose within 2 hours of receiving the alert (Table 2).
- Six severe hypoglycemia events in 4 participants (incidence 6.7 events per 100 person years) occurred and were not related to the System; no DKA/severe hyperglycemia occurred in the cohort. Six-month data represents 89.9 person-years of use.

Table 1: Patient Characteristics

	Per-Protocol Cohort (N=102)
Age in years, median (range)	59 (22-82)
Female, n (%)[a]	58 (59)
Type 2 Diabetes, n (%)	89 (87)
BMI, mean (SD)[a]	35.1 (8.0)
Basal Dose at Baseline (Units), median (quartiles)	26 (20, 50)
Race/Ethnicity, n (%)[a]	
White non-Hispanic	61 (62)
Black/African-American	26 (27)
Hispanic or Latino	9 (9)
Other[b]	2 (2)
Prefer not to answer	0 (0)
Duration of Prior CGM Use, n (%)[a]	
No prior CGM use	57 (58)
Less than 6 months	7 (7)
6 months - <1 year	5 (5)
≥ 1 year	29 (30)

[a]Four (4) in the per-protocol cohort were missing baseline surveys. [b]Other race: 1 participant selected Native Hawaiian/Other Pacific Islander and 1 selected multiple races in the per-protocol cohort.

Table 2: Glycemic and Use Outcomes (N=102)

	Baseline	Month 6
A1C (%), mean (SD)	9.1 (1.7)	8.0 (1.2)
Mean Glucose (mg/dL), mean (SD)	216 (47)[a]	181 (41)
Percent Time 70-180 mg/dL, mean (SD)	33 (25)[a]	56 (23)
Percent Time >180 mg/dL, mean (SD)	67 (28)[a]	43 (24)
Glucose Management Indicator (GMI), mean (SD)	-	7.6 (1.0)
Percent Time >250 mg/dL, mean (SD)	-	16 (18)
Percent Time <70 mg/dL, mean (SD)[b]	-	1.0 (1.4)
Percent Time <54 mg/dL, mean (SD)[b]	-	0.04 (0.14)
Glucose Coefficient of Variation (%), mean (SD)	-	31 (6)
Daily Rate of Sensor Scans, median (quartiles)	-	5.2 (3.8, 7.9)
Daily Rate of Rapid-Acting Insulin Doses, median (quartiles)	-	2.4 (1.9, 3.0)
Weekly Rate of Long-Acting Insulin Doses, median (quartiles)	-	6.9 (6.3, 7.0)
Long-Acting Dose Alerts/person/week, median (quartiles)	-	1.5 (0.5, 2.3)
Percent Long-Acting Alerts followed by dose within 2 hours, median (quartiles)	-	71 (50, 100)
# Participants with ≥ 1 Rapid-Acting Insulin Dose Adjustments, n (%)[c]	-	19 (19)
# Participants with ≥ 1 Long-Acting Insulin Dose Adjustments, n (%)[c]	-	14 (14)

[a]Baseline values were estimated from the baseline A1C value using formulas published in: Beck et al.[9] [b]Robust means and standard deviations are reported. [c]Adjustments made to the System recommended insulin dose settings in the 6-month period.

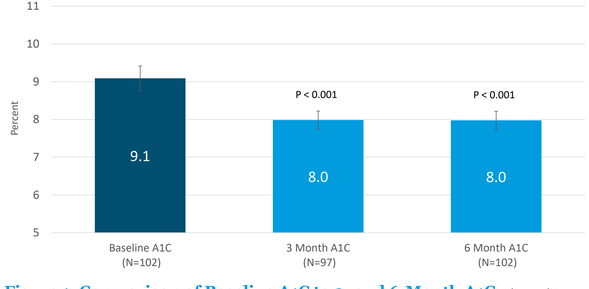

Figure 1: Comparison of Baseline A1C to 3- and 6-Month A1C. The median timing of baseline A1Cs prior to System start was 16 days. Data represent mean and 95% confidence interval.

Table 3: Patient Reported Outcomes

	Baseline[a]	Month 6[a]	Change from Baseline (CI) [p-value][b]
Diabetes Distress Scale (DDS)	N=91	N=95	N=99
Total	2.4 (0.9)	1.7 (0.6)	-0.7 (-0.9, -0.5) [<0.001]
Powerlessness	2.9 (1.3)	2.0 (0.9)	-0.9 (-1.1, -0.6) [<0.001]
Management Distress	3.0 (1.2)	1.7 (0.8)	-1.3 (-1.5, -1.0) [<0.001]
Hypoglycemia Distress	2.2 (1.3)	1.7 (0.9)	-0.5 (-0.8, -0.3) [<0.001]
Negative Social Perceptions	1.6 (0.9)	1.4 (0.7)	-0.2 (-0.4, -0.1) [0.01]
Eating Distress	3.0 (1.2)	2.0 (1.0)	-1.0 (-1.2, -0.7) [<0.001]
Physician Distress	1.8 (1.2)	1.3 (0.7)	-0.5 (-0.8, -0.3) [<0.001]
Friend/Family Distress	1.9 (1.2)	1.6 (0.8)	-0.3 (-0.6, -0.1) [0.003]
Hypoglycemia Confidence Scale (HCS)	N=91	N=95	N=99
Total	2.8 (0.7)	3.1 (0.7)	0.4 (0.2, 0.5) [<0.001]
System Usability Scale (SUS)	-	N=95	-
Total	-	80.7 (17.3)	-

[a]Data reflect mean (SD); median timing of baseline questionnaire completion was 6 days prior to System start. [b]Change from baseline reflect mean (95% CI). P-values were estimated using a longitudinal linear model adjusted for multiplicity using the two-step adaptive Benjamini-Hochberg procedure; 99 participants had a baseline or 6-month outcome analyzed in the model estimating change from baseline.

Conclusions

- In this cohort, primarily older adults with T2D using MDI, substantial glycemic improvement occurred using Bigfoot Unity for 6 months. The 1.1% A1C improvement occurred with little hypoglycemia; the cohort average for percent time below range <70 and <54 mg/dL, suggests most were meeting established targets of <4% and <1%, respectively.[3-5]
- Based on the GMI estimate of A1C and comparison with the baseline A1C, there was rapid glycemic improvement observed within the first 2 weeks of using Bigfoot Unity which remained stable through month 6.
- Observations of improved glycemic control were coupled with statistically significant improvements in diabetes distress and hypoglycemia confidence. For context, the estimated minimally clinically important difference (MCID) for the 28-item T1-DDS total score is 0.19 (and e.g., 0.44 for powerlessness and management and hypoglycemia distress subscales) in an insulin requiring type 1 diabetes population;[6] comparing the observed average improvement in Table 3 with the MCIDs suggest that for the majority of participants, there may have been clinically meaningful improvement. Furthermore, it is notable that the group was on average above the critical T1-DDS threshold at baseline (>2.0), indicating clinically relevant diabetes distress, but then fell below that threshold at 6 months.[6] Similarly, the average baseline hypoglycemia confidence was below the clinically meaningful threshold (<3.0) indicating low confidence but increased above that threshold at 6 months.[2]
- A median of 6.9 long-acting doses per week in month 6 is encouraging. The average of 1.5 long-acting dose alerts/person/week in the 6th month represents between 1-2 potentially forgotten long-acting doses; data that 71% of such alerts are followed by a dose taken within 2 hours supports good engagement with the System in helping participants to remember to take long-acting insulin.
- Occurrences of severe hypoglycemia at 6.7 events per 100 person years are in line with other literature with estimates ranging between 7-110 events per 100 person years in insulin requiring diabetes.[7,8]
- Limitations of this study include the single-arm study design with no concurrent control group and relatively small sample size in the per-protocol cohort. The study design also did not include baseline CGM metrics.

References

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Acknowledgements

This study was funded by Abbott