Online Supplemental Material

Supplemental Table S1. Participant Characteristics at Extension Phase Baseline by Cohort

	SAP-CLC (N=22[a])	CLC-CLC (N=78[a])
Age (years)		
Mean ± SD	11.0 ± 2.4	11.6 ± 2.0
[Range]	6.9 to 14.3	6.8 to 14.3
Diabetes Duration (years)		
Mean ± SD	6.4 ± 2.9	5.3 ± 2.8
[Range]	1.5 to 13.0	1.6 to 12.0
BMI Percentile - Mean ± SD	65 ± 26	65 ± 26
Sex – Female	11 (50%)	38 (49%)
Race/Ethnicity		
White non-Hispanic	17 (77%)	64 (82%)
Hispanic or Latino	2 (9%)	6 (8%)
Black/African-American	0 (0%)	0 (0%)
Asian	1 (5%)	1 (1%)
More than one race	2 (9%)	7 (9%)
Parent Education[b]		
≤ H.S. diploma	0 (0%)	2 (3%)
Associates Degree or Some College but no Degree	1 (5%)	5 (6%)
Bachelor's Degree	9 (41%)	32 (41%)
Master's Degree	10 (45%)	34 (44%)
Doctoral or Prof Degree	2 (9%)	5 (6%)
Annual Household Income[b]		
< $25,000	0 (0%)	0 (0%)
$25,000 - <$35,000	0 (0%)	2 (3%)
$35,000 - <$50,000	2 (10%)	1 (1%)
$50,000 - <$75,000	0 (0%)	5 (7%)
$75,000 - <$100,000	4 (20%)	13 (18%)
$100,000 - <$200,000	8 (40%)	27 (36%)
≥ $200,000	6 (30%)	26 (35%)
Health Insurance[b]		
Private	20 (91%)	70 (90%)
CHP or other government sponsored/Medicaid	1 (5%)	6 (8%)
Military	1 (5%)	2 (3%)
Other	0 (0%)	0 (0%)
None	0 (0%)	0 (0%)
Central Lab HbA1c		
Mean ± SD	7.6 ± 0.9	7.0 ± 0.8
[Range]	5.6 to 9.1	5.7 to 10.0

a- Missing data (SAP-CLC/ CLC-CLC): BMI 1 (5%)/0 (0%), income 2 (9%)/4 (5%), central lab HbA1c 0 (0%)/1(1%).

b- Only assessed at enrollment.

Supplemental Table S2. Unscheduled visits and contacts in the extension study by cohort

	SAP-CLC (N=22 participants)	CLC-CLC (N=78 participants)
Unscheduled Visits – *no. of participants [no. of visits]*	0	2 (3%) [2]
Reason for Visit - *no. of visits*		
Participant had a potential device deficiency/issue	0	2
Unscheduled Contacts[a] – *no. of participants [no. of visits]*	7 (32%) [16]	33 (42%) [54]
Reason for Contact[a,b] **-** *no. of visits*		
Site asked participant to review/confirm time on device	6	22
Participant had a potential device deficiency/issue	1	12
Participant had a question or problem with diabetes management	5	7
Site notified participant of a potential device deficiency/issue	2	4
Participant needed study supplies	1	5
Make-up for missed contact	1	3
Issue related to device data	2	1
Related to medication or medical condition not associated with an AE	0	3
Participant had a potential adverse event	0	2
COVID-19 virtual visit	0	2

a- Includes any phone call, email or text contact.

b- More than one reason may be selected for each contact.

Supplemental Table S3. CGM-measured Outcomes by Daytime and Nighttime in the SAP-CLC Cohort

	RCT Baseline (N=23)	RCT Follow-up (N=22)	Extension Phase Follow-up (N=22)
Daytime (06:00-23:59)			
Hours of CGM Data *mean ± SD*	232 ± 18	1958±88	1479 ± 67
Glucose Control *mean ± SD*			
Percent Time in Range 70-180 mg/dL	51% ± 16%	56% ± 14%	61% ± 11%
Mean Glucose (mg/dL)	190 ± 32	179 ± 27	171 ± 20
Glucose Coefficient of Variation (%)	38% ± 4%	40% ± 4%	38% ± 4%
Hyperglycemia			
Percent Time >180 mg/dL *mean ± SD*	48% ± 17%	42% ± 15%	37% ± 11%
Percent Time >250 mg/dL *median (IQR)*	22.5% (7.5%, 35.4%)	17.1% (9.6%, 26.2%)	10.5% (7.4%, 17.0%)
Hypoglycemia *median (IQR)*			
Percent Time <70 mg/dL	0.98% (0.27%, 2.02%)	1.78% (1.31%, 3.34%)	1.57% (1.05%, 2.01%)
Percent Time <54 mg/dL	0.10% (0.00%, 0.31%)	0.24% (0.15%, 0.65%)	0.27% (0.12%, 0.35%)
Nighttime (00:00-05:59)			
Hours of CGM Data *mean ± SD*	79 ± 6	650±42	502 ± 21
Glucose Control *mean ± SD*			
Percent Time in Range 70-180 mg/dL	54% ± 22%	54% ± 16%	75% ± 13%
Mean Glucose (mg/dL)	185 ± 43	180 ± 28	153 ± 21
Glucose Coefficient of Variation (%)	35% ± 5%	37% ± 5%	35% ± 6%
Hyperglycemia			
Percent Time >180 mg/dL *mean ± SD*	45% ± 22%	44% ± 16%	24% ± 13%
Percent Time >250 mg/dL *median (IQR)*	20.4% (6.4%, 32.4%)	18.8% (9.0%, 24.1%)	6.6% (1.9%, 9.9%)
Hypoglycemia *median (IQR)*			
Percent Time <70 mg/dL	0.89% (0.00%, 3.18%)	1.33% (0.59%, 2.68%)	0.78% (0.54%, 1.15%)
Percent Time <54 mg/dL	0.00% (0.00%, 0.34%)	0.15% (0.03%, 0.61%)	0.20% (0.05%, 0.32%)

Supplemental Table S4. HbA1c Outcomes in the SAP-CLC Cohort

	End of RCT (N=22)	End of Extension Phase (12 weeks) (N=21)	Change from End of RCT to End of Extension Phase (N=21)	P-value[a] End of Extension Phase vs. End of RCT
HbA1c (%) *mean ± SD*	7.6 ± 0.9	7.3 ± 0.7	-0.19 ± 0.55	0.41
HbA1c <7.0%	4 (18%)	4 (19%)	NA	>0.99
HbA1c <7.5%	10 (45%)	13 (62%)	NA	0.48
Reduction ≥0.5% from Extension Baseline	NA	6 (29%)	NA	NA
Worsening ≥0.5% from Extension Baseline	NA	4 (19%)	NA	NA

a- P-values from a paired t-test or McNemar's test, as appropriate. P-values were adjusted to control the false discovery rate.

Supplemental Table S5. CGM-measured Outcomes by Daytime and Nighttime in the CLC-CLC Cohort

	RCT Baseline (N=77)	RCT Follow-up (N=78)	Extension Phase (N=78)
Daytime (06:00-23:59)			
Hours of CGM Data *mean ± SD*	228 ± 26	1975 ± 99	1478 ± 107
Glucose Control *mean ± SD*			
Percent Time in Range 70-180 mg/dL	53% ± 17%	63% ± 11%	61% ± 11%
Mean Glucose (mg/dL)	184 ± 35	167 ± 21	171 ± 21
Glucose Coefficient of Variation (%)	38% ± 6%	38% ± 4%	37% ± 4%
Hyperglycemia			
Percent Time >180 mg/dL *mean ± SD*	45% ± 18%	35% ± 11%	37% ± 12%
Percent Time >250 mg/dL *median (IQR)*	17.4% (8.4%, 30.0%)	9.3% (6.1%, 17.1%)	10.9% (7.6%, 17.4%)
Hypoglycemia *median (IQR)*			
Percent Time <70 mg/dL	1.13% (0.44%, 2.32%)	1.55% (0.77%, 2.76%)	1.51% (0.66%, 2.30%)
Percent Time <54 mg/dL	0.13% (0.00%, 0.34%)	0.23% (0.10%, 0.51%)	0.20% (0.05%, 0.35%)
Nighttime (00:00-05:59)			
Hours of CGM Data *mean ± SD*	78 ± 9	663 ± 37	502 ± 39
Glucose Control *mean ± SD*			
Percent Time in Range 70-180 mg/dL	54% ± 20%	80% ± 9%	79% ± 11%
Mean Glucose (mg/dL)	181 ± 36	146 ± 16	148 ± 18
Glucose Coefficient of Variation (%)	36% ± 7%	34% ± 6%	34% ± 6%
Hyperglycemia			
Percent Time >180 mg/dL *mean ± SD*	44% ± 20%	19% ± 9%	20% ± 11%
Percent Time >250 mg/dL *median (IQR)*	14.8% (5.8%, 25.5%)	4.2% (1.9%, 7.0%)	4.5% (2.1%, 8.2%)
Hypoglycemia *median (IQR)*			
Percent Time <70 mg/dL	0.70% (0.00%, 2.44%)	0.91% (0.44%, 1.82%)	0.95% (0.44%, 1.62%)
Percent Time <54 mg/dL	0.00% (0.00%, 0.30%)	0.14% (0.04%, 0.39%)	0.13% (0.03%, 0.28%)

Supplemental Table S6. HbA1c Outcomes in the CLC-CLC Cohort

	RCT Baseline (N=78)	**End of RCT (16 weeks) (N=77)**	**End of Extension Phase (28 Weeks) (N=76)**
HbA1c (%) *mean ± SD*	7.6 ± 1.0	7.0 ± 0.8	7.2 ± 0.9
HbA1c <7.0%	22 (28%)	39 (51%)	32 (42%)
HbA1c <7.5%	35 (45%)	57 (74%)	48 (63%)
Reduction ≥0.5% from RCT Phase Baseline	NA	40 (52%)	33 (43%)
Worsening ≥0.5% from RCT Phase Baseline	NA	2 (3%)	4 (5%)
Reduction ≥0.5% from End of RCT Phase	NA	NA	2 (3%)
Worsening ≥0.5% from End of RCT Phase	NA	NA	17 (23%)

Supplemental Table S7. Frequency of CGM Use by Cohort

	SAP-CLC		CLC-CLC	
	RCT (N=22)	**Extension Phase (N=22)**	**RCT (N=78)**	**Extension Phase (N=78)**
% time CGM use [*median (Q_1, Q_3)*]	96% (92%, 98%)	97% (95%, 98%)	97% (95%, 98%)	97% (95%, 98%)
≥90%	19 (86%)	21 (95%)	75 (96%)	72 (92%)
80%-<90%	3 (14%)	1 (5%)	2 (3%)	5 (6%)
70%-<80%	0 (0%)	0 (0%)	0 (0%)	0 (0%)
60%-<70%	0 (0%)	0 (0%)	1 (1%)	0 (0%)
50%-<60%	0 (0%)	0 (0%)	0 (0%)	1 (1%)
<50%	0 (0%)	0 (0%)	0 (0%)	0 (0%)
0%	0 (0%)	0 (0%)	0 (0%)	0 (0%)

Supplemental Table S8. Frequency of Closed-loop Mode Use by Cohort

	SAP-CLC	CLC-CLC	
	Extension Phase (N=22)	**RCT (N=78)**	**Extension Phase (N=78)**
% time closed-loop use [*median (Q_1, Q_3)*]	94% (92%, 95%)	93% (91%, 95%)	94% (92%, 96%)
≥90%	19 (86%)	64 (82%)	67 (86%)
80%-<90%	3 (14%)	10 (13%)	8 (10%)
70%-<80%	0 (0%)	3 (4%)	2 (3%)
60%-<70%	0 (0%)	0 (0%)	0 (0%)
50%-<60%	0 (0%)	1 (1%)	0 (0%)
<50%	0 (0%)	0 (0%)	1 (1%)
0%	0 (0%)	0 (0%)	0 (0%)

Supplemental Table S9. System Usability Scale Item Responses in the SAP-CLC Cohort

	End of the Extension Phase (28 Weeks)						
	N	**Mean score[1]**	**Strongly Disagree 1**	**2**	**3**	**4**	**Strongly Agree 5**
	Parent (1st row) Child (2nd row)						
1. I think that I would like to use this system frequently	22	4.5	9%	-	5%	-	86%
	14	4.6	-	-	7%	21%	71%
2. I found the system unnecessarily complex	22	1.8	64%	18%	5%	-	14%
	14	1.4	57%	43%	-	-	-
3. I thought the system was easy to use	22	4.4	5%	-	5%	32%	59%
	14	4.2	-	7%	-	57%	36%
4. I think that I would need the support of a technical person to be able to use this system	22	1.7	59%	23%	9%	5%	5%
	14	1.4	71%	21%	7%	-	-
5. I found the various functions in this system were well integrated	22	4.3	5%	-	9%	32%	55%
	14	4.1	-	7%	14%	36%	43%
6. I thought there was too much inconsistency in this system	22	1.5	68%	18%	9%	-	5%
	14	1.5	64%	29%	-	7%	-
7. I would imagine that most people would learn to use this system very quickly	22	4.3	5%	-	14%	23%	59%
	14	4.1	7%	-	-	57%	36%
8. I found the system very cumbersome to use	22	1.3	86%	9%	-	-	5%
	14	1.4	64%	29%	7%	-	-
9. I felt very confident using the system	22	4.3	5%	-	14%	23%	59%
	14	4.2	7%	-	-	50%	43%
10. I needed to learn a lot of things before I could get going with this system	22	2.1	50%	5%	36%	5%	5%
	14	2.4	36%	14%	29%	14%	7%

1. Scale 1-5, for shaded items a higher score indicates worse perceived usability for each item otherwise a higher score indicates better perceived usability

Supplemental Table S10. System Usability Scale Item Responses in the CLC-CLC Cohort

	End of the RCT (16 Weeks)							End of the Extension Phase (28 Weeks)						
	N	Mean score[1]	Strongly Disagree 1	2	3	4	Strongly Agree 5	N	Mean score[1]	Strongly Disagree 1	2	3	4	Strongly Agree 5
	Parent (1st row) Child (2nd row)							Parent (1st row) Child (2nd row)						
1. I think that I would like to use this system frequently	78	4.8	-	3%	1%	14%	82%	77	4.7	6%	-	3%	3%	88%
	57	4.4	2%	2%	12%	23%	61%	57	4.5	5%	-	9%	16%	70%
2. I found the system unnecessarily complex	78	1.5	67%	21%	8%	5%	-	77	1.4	71%	19%	5%	1%	3%
	57	1.7	49%	39%	9%	2%	2%	57	1.7	54%	33%	5%	5%	2%
3. I thought the system was easy to use	78	4.5	-	4%	4%	32%	60%	77	4.5	3%	3%	6%	23%	65%
	57	4.2	2%	3%	9%	45%	41%	57	4.4	-	2%	9%	35%	54%
4. I think that I would need the support of a technical person to be able to use this system	78	1.4	69%	19%	9%	4%	-	77	1.6	64%	23%	4%	4%	5%
	57	1.7	61%	19%	11%	3%	5%	57	1.6	58%	28%	11%	2%	2%
5. I found the various functions in this system were well integrated	78	4.4	-	4%	9%	32%	55%	77	4.3	5%	1%	8%	30%	56%
	56	3.9	2%	5%	25%	39%	29%	57	4.1	2%	2%	23%	37%	37%
6. I thought there was too much inconsistency in this system	78	1.5	67%	23%	5%	4%	1%	77	1.4	68%	29%	-	-	4%
	56	1.7	50%	34%	14%	2%	-	57	1.7	51%	32%	12%	5%	-
7. I would imagine that most people would learn to use this system very quickly	78	4.2	1%	6%	10%	40%	42%	77	4.2	4%	3%	10%	31%	52%
	57	4.1	2%	4%	18%	42%	35%	57	4.0	2%	4%	25%	32%	39%
8. I found the system very cumbersome to use	78	1.4	74%	13%	9%	4%	-	77	1.4	74%	19%	1%	1%	4%
	55	1.7	44%	42%	11%	4%	-	56	1.7	55%	27%	11%	5%	2%
9. I felt very confident using the system	78	4.5	3%	-	9%	22%	67%	77	4.4	6%	1%	4%	23%	65%
	57	4.1	3%	3%	19%	32%	42%	57	4.2	4%	2%	16%	28%	51%
10. I needed to learn a lot of things before I could get going with this system	78	1.9	50%	27%	12%	9%	3%	77	1.9	55%	22%	10%	8%	5%
	56	2.0	41%	32%	16%	7%	4%	57	1.9	44%	26%	25%	5%	-

1. Scale 1-5, for shaded items a higher score indicates worse perceived usability for each item otherwise a higher score indicates better perceived usability

Supplemental Table S11: Safety Outcomes in the Extension Phase

	Overall (N=100 participants)	**SAP-CLC (N=22 participants)**	**CLC-CLC (N=78 participants)**
Adverse Events			
Any Adverse Event			
No. of events	10	3	7
No. of patients (%)	8 (8%)	2 (9%)	6 (8%)
No. of events per 100 person-years	42.1	57.6	37.8
Specific Events – *no. of patients [no. of events]*			
Serious Adverse Events	0	0	0
Severe Hypoglycemia[a]	0	0	0
Diabetic Ketoacidosis[a]	0	0	0
Hyperglycemia or Ketosis (without Diabetic Ketoacidosis) Related to Infusion Set Problem	6 (6%) [8]	1 (5%) [2]	5 (6%) [6]
Hyperglycemia or Ketosis (without Diabetic Ketoacidosis) Related to CGM Problem	1 (1%) [1]	0	1 (1%) [1]
Other Adverse Events	1 (1%) [1][b]	1 (5%) [1]	0
Other Safety Outcomes			
Days with ≥ 1 Blood Ketone Measurement >1.0 mmol/L – *no. of days (%)*	16 (0.08%)	6 (0.14%)	10 (0.06%)

a. Severe hypoglycemia defined as hypoglycemia requiring assistance due to altered consciousness and diabetic ketoacidosis as defined by the Diabetes Control and Complications Trial (1).

b. Other adverse event was ketosis due to illness.

Supplemental Table S12: Insulin Use and Body Mass Index in the SAP-CLC Cohort

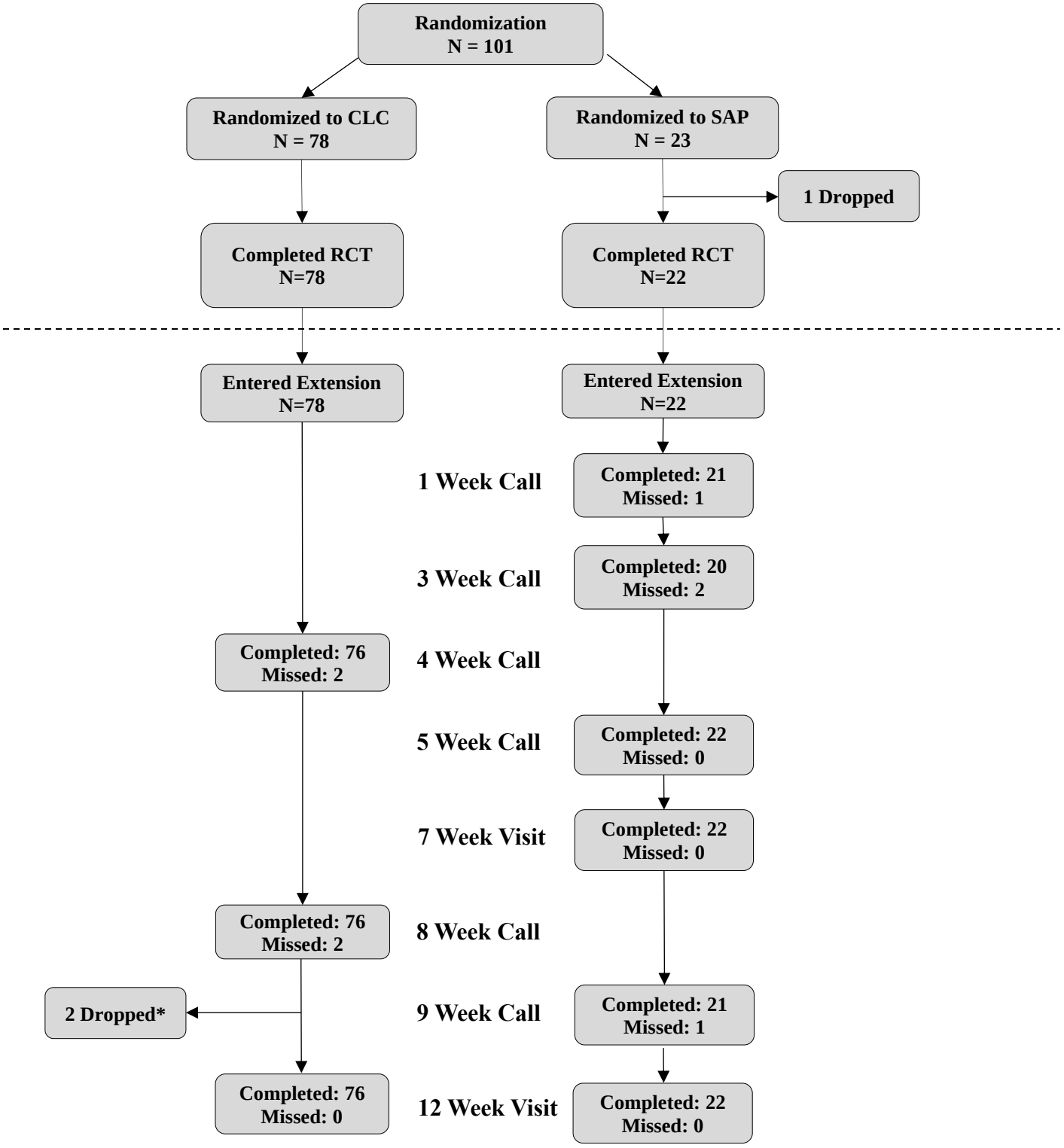
	End of RCT (16 Weeks)	End of Extension Phase (28 Weeks)	Change from End of RCT to End of Extension Phase	P-value[a] End of Extension Phase vs. End of RCT
Total Daily Insulin (U/kg/day)				
N	21	22	21	
mean ± SD	0.98 ± 0.32	1.04 ± 0.34	0.07 ± 0.17	0.10
BMI Percentile				
N	21	21	21	
mean ± SD	65 ± 26	67 ±26	2.2 ± 6.9	0.07

a- P-values from a paired t-test or Wilcoxon signed-rank test, as appropriate. P-values were adjusted to control the false discovery rate.

Supplemental Table S13: Insulin Use and Body Mass Index in the CLC-CLC Cohort

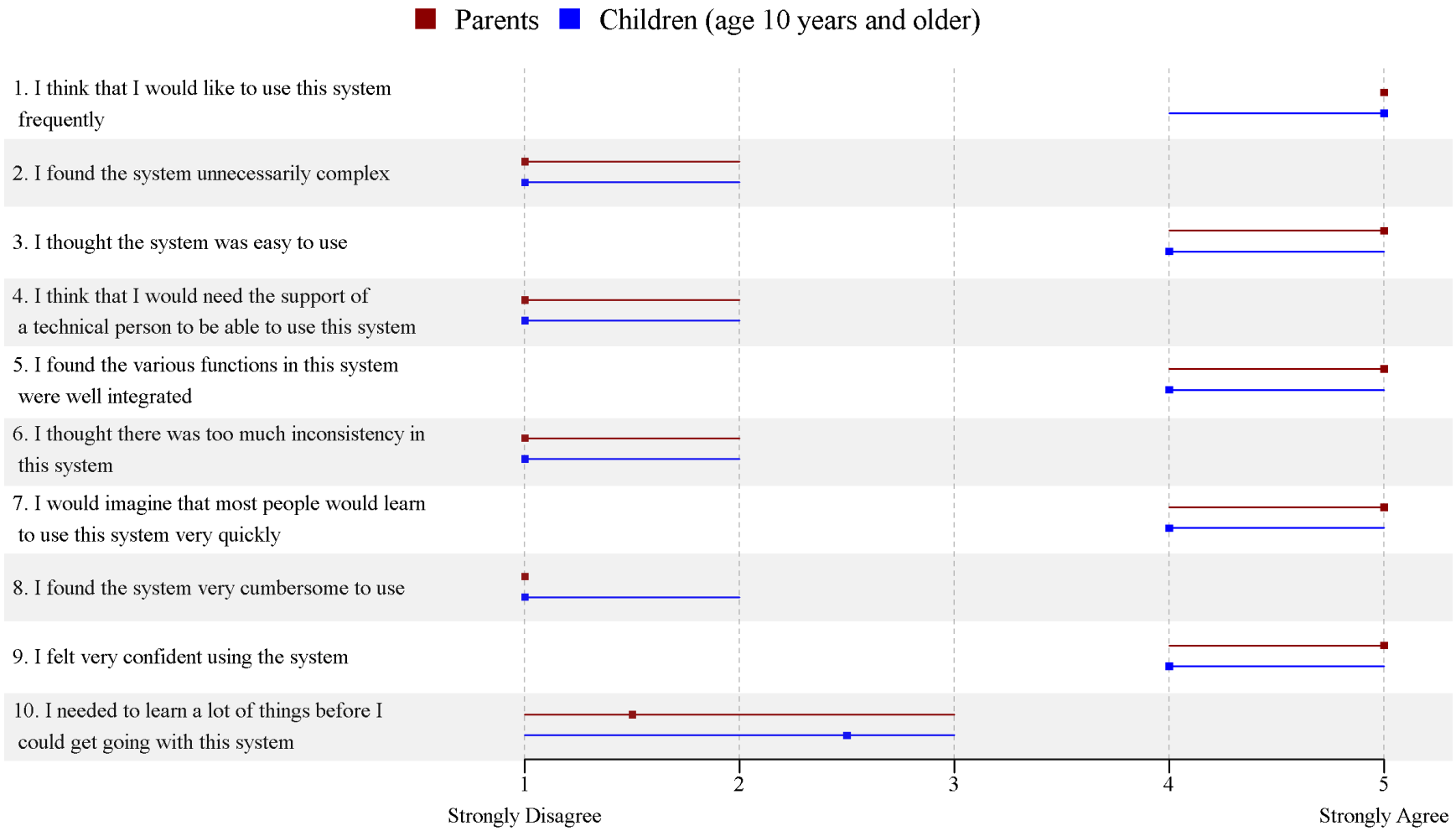
	RCT Baseline	End of RCT (16 Weeks)	End of Extension Phase (28 Weeks)
Total Daily Insulin (U/kg/day)			
N	77	78	76
mean ± SD	0.89 ± 0.24	0.94 ± 0.25	0.93 ± 0.25
BMI Percentile			
N	78	78	73
mean ± SD	62 ± 28	65 ± 26	64 ± 26

Supplemental Figure S1. Extension phase flowchart

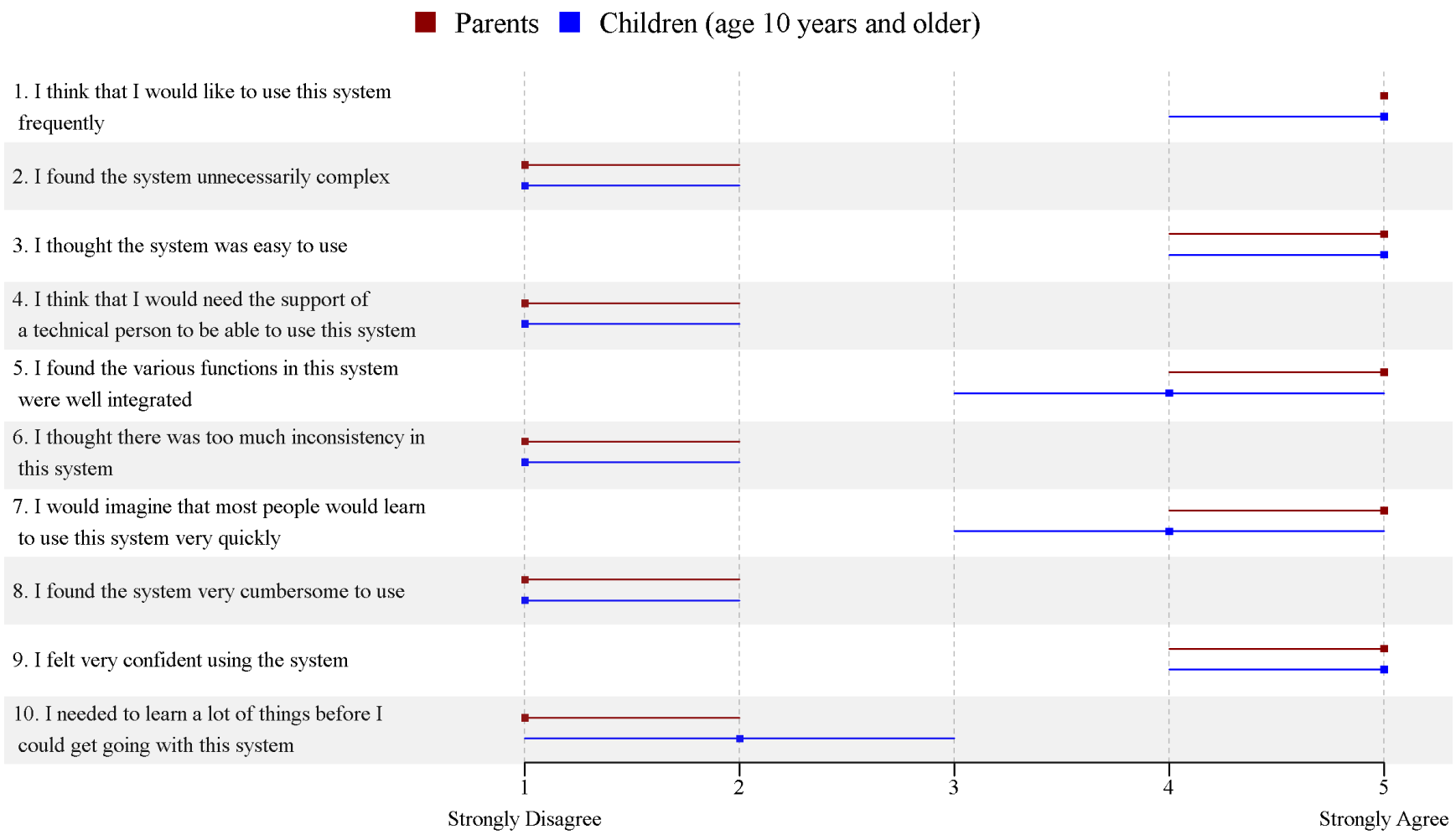


*Two participants in the CLC-CLC cohort were not able to come into the clinic to complete their final visit due to COVID-19. Instead these participants had an unscheduled phone contact.

Supplemental Figure S2A. System Usability Scale Item Responses at 28 Weeks in the SAP-CLC Cohort
Plot of responses to the items on the System Usability Scale. Squares represent the median response and bars represent the interquartile range. For shaded items lower is better, otherwise higher is better.



Supplemental Figure S2B. System Usability Scale Item Responses at 28 Weeks in the CLC-CLC Cohort



APPENDIX

A. The International Diabetes Closed Loop (iDCL) Trial Study Group (Site Investigators Noted):

University of Virginia, Center for Diabetes Technology, Charlottesville, VA: Melissa Schoelwer (PI), Marc Breton (Grant PI), Mark DeBoer (I), Linda Gonder-Frederick (I), Daniel Cherñavvsky (I), Jessica Robic, Emma Emory, Mary Voelmle, Katie Conschafter, Kimberly Morris, Charlotte Barnett, Kelly Carr, Jacob Hellmann, Matthew Kime, Mary Oliveri

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Department of Pediatrics, Division of Pediatric Endocrinology and Diabetes, Stanford University School of Medicine: Bruce Buckingham (PI), David Maahs (I), Rayhan Lal (I), Laya Ekhlaspour (I), Lisa Norlander (I), Korey Hood (I), Marissa Town, Christine Weir, Kerren Smith, Liana Hsu, Deanna Shinksy, Julia Viana

Yale University: Eda Cengiz (PI), Stuart Weinzimer (I), Kate Weyman (I), Lori Carria, Melinda Zgorski

Jaeb Center for Health Research: Katrina Ruedy, Roy Beck, Sarah Borgman, Jessica Rusnak, Lauren Kanapka, Craig Kollman, Carlos Murphy

National Institute of Diabetes and Digestive and Kidney Diseases (NIDDK): Guillermo Arreza-Rubin (Project Scientist), Neal Green (Project Manager)

iDCL Steering Committee Members: Boris Kovatchev, Sue Brown, Stacey Anderson, Marc Breton, Lori Laffel, Jordan Pinsker, Carol Levy, Yogish C. Kudva, R. Paul Wadwa, Bruce Buckingham, Francis Doyle III, Eric Renard, Claudio Cobelli, Yves Reznik, Guillermo Arreza-Rubin, John Lum, Roy Beck, Katrina Ruedy

B. Central Laboratory

University of Minnesota Advanced Research and Diagnostic Laboratory: Robert Janicek, Deanna Gabrielson

C. Data Safety Monitoring Board (DSMB)

Steven H. Belle (Chair), Jessica Castle; Jennifer Green, Laurent Legault, Steven M. Willi, Carol Wysham, Thomas Eggerman (DSMB Executive Secretary for NIDDK)

1. The Diabetes Control and Complications Trial Research Group: The effect of intensive treatment of diabetes on the development and progression of long-term complications in insulin-dependent diabetes mellitus. N Engl J Med 1993;329:977-986