



510(k) SUBSTANTIAL EQUIVALENCE DETERMINATION DECISION SUMMARY

I Background Information:

A 510(k) Number

K251152

B Applicant

Diabeloop

C Proprietary and Established Names

Diabeloop DBLG2

D Regulatory Information

Product Code(s)	Classification	Regulation Section	Panel
QJI	Class II	21 CFR 862.1356	CH – Clinical Chemistry

E Purpose for Submission:

New device

Establish a Predetermined Change Control Plan (PCCP) for qualifying and integrating with compatible FDA-cleared integrated continuous glucose monitors (iCGMs) and compatible FDA-cleared alternate controller enabled (ACE) pumps.

II Intended Use/Indications for Use:

A Intended Use(s):

See Indications for Use below.

B Indication(s) for Use:

DBLG2, a mobile application with algorithm technology, is intended for use with compatible integrated continuous glucose monitors (iCGM) and alternate controller enabled (ACE) insulin infusion pumps to automatically increase, decrease, and suspend delivery of basal insulin based on iCGM readings and predicted glucose values. It can also deliver correction boluses when glucose values are predicted to exceed a predefined threshold. To do this, the DBLG2 software

takes into account the patient's profile, glycemia (current and predicted), announced meals and physical activities.

DBLG2 is intended for the management of type 1 diabetes mellitus in persons 12 years of age and greater.

DBLG2 is intended for single patient use.

DBLG2 is Rx - For Prescription Use Only.

C Special Conditions for Use Statement(s):

Rx – For Prescription Use Only

The DBLG2 system is compatible with the following U100 insulin types: Humalog (insulin lispro) and Novolog (insulin aspart).

This medical device is contraindicated for the following people:

- DBLG2 should not be used by anyone who is unable to notice alerts, alarms, and reminders because of physical limitations, such as severe uncorrected hearing impairment or severe uncorrected problems of visual acuity.
- DBLG2 should not be used by anyone who is unable to follow the instructions for use.
- DBLG2 should not be used by anyone that is unable to maintain contact with their healthcare provider.
- DBLG2 should not be used by patients suffering from a serious illness or undergoing treatment that might significantly impair diabetes physiology (e.g., irregular treatment by steroids) and which might interfere with the medical device.
- DBLG2 should not be used by patients receiving a total daily dose of insulin lower than 8 units.
- DBLG2 should not be used by patients using any insulin that is not 100 U/mL rapid-acting insulin analog.

III Device Description

Diabeloop DBLG2 is a software-only device intended for managing glucose levels in people with type 1 diabetes. The DBLG2 software algorithm resides on a mobile application that can be downloaded to qualified mobile devices (i.e., Android) and it is designed to be compatible with Alternate Controller Enabled (ACE) insulin pumps and integrated continuous glucose monitors (iCGMs). The device uses a regulation algorithm that processes glycemic data from a compatible iCGM along with patient inputs regarding meals and physical activities to calculate insulin dosing. This information is then transmitted to a compatible ACE pump which delivers the calculated insulin quantity. With an ACE pump and iCGM, the device is designed to form a hybrid closed-loop system for automated insulin delivery (AID). The DBLG2 algorithm transmits alarms and alerts from both the ACE pump and iCGM.

The DBLG2 functions by modulating basal insulin rates every 5 minutes. The software can transmit data to the pump to have the pump deliver basal insulin over a given period of time, a

correction bolus, or a meal bolus (in 1 or 2 shots). DBLG2 typically acts by modulating the basal rate of insulin delivery. However, in some cases, it can deliver automatic correction boluses if necessary. The meal bolus calculator allows the patient to enter only his or her meal and the system will deliver a meal bolus if necessary. The software can also ask the patient to take a calculated amount of carbohydrates if the system determines that the patient would go into hypoglycemia even if the insulin basal rate is brought down to zero. In addition, DBLG2 has a self-learning module for the meal learning ratio that applies updates to the patient's algorithm parameters based on estimated glycemia history and insulin delivery quantities from the patient's history.

The DBLG2 System offers several operating modes:

- Loop mode: Hybrid closed-loop mode when the DBLG2 software uses data from the CGM and issues insulin delivery commands to the insulin pump
- Zen mode: Provides modified regulation parameters for situations where stress may impact blood glucose levels or where hypoglycemia would be particularly problematic, such as during long drives, important meetings, or unusual eating schedules.
- Data Transfer Mode: Enhanced data privacy; Data are not transferred to YourLoops for a user-specified period of time (3, 12, 24, or 72 hours)
- Wi-Fi preference: Conserves cellular data usage

In the event of a loss of communication between the device and the ACE pump or iCGM, or if the patient wants to return to manual control over the system, the software returns to the treatment plan prescribed and recorded by the physician (i.e., reference basal rate). The device operates continuously, making glucose predictions up to 5 hours in the future and insulin delivery predictions up to 2 hours.

IV Substantial Equivalence Information:

A Predicate Device Name(s):

Tidepool Loop

B Predicate 510(k) Number(s):

K203689

C Comparison with Predicate(s):

Device & Predicate Device(s):	<u>K251152</u>	<u>K203689</u>
Device Trade Name	DBLG2	Tidepool Loop
General Device Characteristic Similarities		

Intended Use/Indications For Use	Mobile app intended for managing glucose levels in people with type 1 diabetes using a hybrid closed loop approach (automated basal insulin delivery with manual bolusing for meals). DBLG2 requires an insulin pump and a continuous glucose monitor (CGM) to fulfill its intended use.	Same
Compatible Insulins	Novolog or Humalog U-100 insulin	Same
General Device Characteristic Differences		
Age range of intended users	Patients 12 years and older with type 1 diabetes	Patients 6 years and older with type 1 diabetes
Algorithm platform	Android	iPhone
User-configurable settings	• Target glucose level: 100 – 130 mg/dL (default is 110 mg/dL) • Hyperglycemia Threshold: 170 – 220 mg/dL (default is 180 mg/dL) • Hypoglycemia Threshold: 60 – 85 mg/dL (default is 70 mg/dL) • Aggressiveness during hyperglycemia: 40-190%, default 100% • Aggressiveness during normoglycemia: 60-150%, default 100% • Aggressiveness during meals: 50-200%, default 100% • Physical activity: Target, meal ratio, aggressivity, insulin action time, and	• Correction range: 87 – 180 mg/dL • Pre-meal range: Glucose Safety Limit (67-110) – 130 mg/dL • Workout range: the higher of 85 mg/dL or the Glucose Safety Limit (67-100) – 250 mg/dL

	rescue carbohydrate settings is automatically adjusted based on baseline settings during the physical activity declaration • Zen mode: raise target glucose and hypoglycemia threshold based on baseline setting • Night mode: delay certain alerts and lowers hypoglycemia threshold for rescue carbohydrates	
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Predetermined Change Control Plan (PCCP): In addition to the similarities and differences between the candidate and the predicate device listed in the table above, the candidate device has an authorized PCCP for qualifying and integrating new compatible FDA-cleared iCGMs and ACE pumps. The PCCP includes a description of the modifications, a modification protocol, and an impact assessment. The PCCP specifies the testing methods, validation activities, and performance requirements to implement the specified modifications such that Diabeloop DBLG2 remains as safe and as effective as the predicate device and continues to comply with 21 CFR 862.1356(b). The sponsor's PCCP comprises the following for each subject iAGC and ACE pump:

- A new candidate iCGM must have demonstrated compatibility to established minimum iCGM performance, compatibility, and sensor specifications before proceeding with qualification. Once a compatible candidate iCGM is identified, the sponsor will conduct virtual clinical trial testing with virtual patients, with pre-defined acceptance criteria based on virtual patient equivalency testing and glycemic outcomes from the iAGC clinical study. Software design integration of the new iCGM with the subject iAGC will then be completed, and integration V&V testing will be conducted according to the established PCCP. If integration V&V testing meets the PCCP's prespecified acceptance criteria, the iCGM may be added as an interoperable component to the subject iAGC
- A new candidate ACE pump must have demonstrated compatibility to established minimum ACE pump compatibility and performance specifications defined in the PCCP before proceeding to software design integration with the subject iAGC. Integration V&V testing will then be conducted according to the established PCCP. If integration V&V testing meets the PCCP's prespecified acceptance criteria, the ACE pump may be added as an interoperable component to the subject iAGC.
- Related iAGC labeling will be revised as needed to identify new qualified and integrated compatible devices or to remove previously compatible devices found to no longer be compatible. Communication will be provided through various channels to notify users about a new compatible device or previously compatible but now incompatible device.

V Standards/Guidance Documents Referenced:

- Special controls established under 21 CFR 862.1356
- ISO 20417 First edition 2021-04 Corrected version 2021-12 – Medical devices – Information to be supplied by the manufacturer
- ISO 14155 Third edition 2020-07 – Clinical investigation of medical devices for human subjects – Good clinical practice
- AMSI/AAMI/ISO 14971:2019 – Medical devices – Applications of risk management to medical devices
- ISO 15223-1 Fourth edition 2021-07 – Medical devices – Symbols to be used with information to be supplied by the manufacturer – Part 1: General requirements
- ANSI/AAMI/IEC 62304:2006/A1:2016 – Medical device software – Software life cycle processes [Including Amendment 1 (2016)]
- ANSI/AAMI/IEC 62366-1:2015+AMD1:2020 – Medical devices Part 1: Application of usability engineering to medical devices including Amendment 1
- IEC 81001-5-1 Edition 1.2 2021-12 – Health software and health IT systems safety, effectiveness and security – Part 5-1: Security – Activities in the product life cycle

VI Performance Characteristics:

A. Analytical Performance

The Diabeloop DBLG2 device is a software-only device, therefore analytical performance characteristics are not applicable.

B. Other Supportive Instrument Performance Characteristics Data

Summary of Clinical Testing

DBLG2 has been evaluated in a series of clinical studies. Six key prospective clinical studies (SP7, SP8, SP12, SP13, SP20, and INLOOP) were used to support substantial equivalence of the subject device. These studies used functionally identical algorithms to the to-be-marketed device. All studies were performed outside the US.

Baseline Demographics

The majority of studies enrolled current pump users, but SP13, SP20, and INLOOP enrolled users on multiple daily injections (MDI). The table below describes the baseline characteristics of subjects in each clinical study. Certain demographic information (such as socioeconomic, educational, and racial/ethnicity data) was not available for all subjects due to restrictions in the regions where the clinical studies were conducted.

Table 1: Baseline Characteristics at Enrollment

Study (type)	Study Arm	N	Study Duration	Patient Weeks	Age, Mean years $\pm$ SD (range)	Sex, % female
¹ SP7 (RCT in crossover)	Overall	63	12 weeks	772	48.2 $\pm$ 13.4 (22 – 76)	61.9

¹ SP12 (before-after comparison) - ITT Analysis	Overall	111	12 months	4425	41.2 ± 14.5 (19-75)	68.5
² SP12 (before-after comparison) - PP Analysis	Overall	59	12 months	3133	41.7 ± 15.1 (21 – 75)	71.2
¹ INLOOP (before-after comparison)	Overall	166	12 months	8680	44.1 ± 14.4 (19 – 81)	62
¹ SP8 (RCT in parallel) - ITT Analysis	Control	34 adults	12 weeks	207 (teens) 666 (adults)	43.3 ± 12.5 (19 – 70)	61.8
	Closed Loop	106 adults			43.1 ± 13.2 (19 – 73)	65.1
¹ SP8 (before-after comparison (adults) and single arm (teens)) - ITT Analysis	Overall	106 adults 36 teens			36.1 ± 16.6 (14 – 73)	62.7
² SP8 (RCT in parallel) - PP Analysis	Control	11 adults	6 weeks	106 (teens) 467 (adults)	NA	NA
	Closed Loop	73 adults			NA	NA
² SP8 (before-after comparison (adults) and single arm (teens)) - PP Analysis	Overall	73 adults 18 teens			NA	NA
¹ SP20 Main (before-after comparison) - ITT Analysis	Overall	90	6 weeks	387	45.4 ± 14.1 (18 – 75)	68.9
¹ SP20 Extension (before-after comparison) - ITT Analysis	Overall	47	9 additional weeks	395	44.4 ± 13.6 (18 – 73)	63.8
² SP20 Main (before-after comparison) - PP Analysis	Overall	55	6 weeks	344	45.1 ± 13.7 (18 – 73)	63.6
² SP20 Extension (before-after comparison) - PP Analysis	Overall	35	9 additional weeks	320	45.2 ± 13.3 (18 – 69)	60.0
¹ SP13 (RCT in crossover)	Overall	49 teens	8 weeks	403 (teens)	15.1 ± 1.7 (12.2 – 17.9)	57.1

¹ SP13 (real-world extension)	Overall	25 teens	12 months	984 (teens)	15.0 ± 1.7 (12.2 – 17.8)	56.0
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N: number of subjects; SD: standard deviation; RCT: randomized control trial

¹SP7, SP12, INLOOP, SP8, SP20, and SP13 information is for the intention to treat population (ITT)

²SP12, SP8, and SP20 information the per protocol population (PPP) analysis was leveraged in addition to the ITT analysis due to significant numbers of patients withdrawing from these studies for reasons unrelated to the study device. The high dropout rate during the SP12 study was due to the 12-month intended study duration. The SP8 study was truncated early due to the impact of the COVID-19 pandemic. The SP20 study was suspended midway due to a YourLoops technical error, and 23 subjects withdrew during the suspension. Another 11 subjects withdrew due to technical issues with the connected insulin pump, which is not included in this 510(k).

Safety Results

The table below summarizes the incidence of severe hypoglycemia and diabetic ketoacidosis events throughout each clinical study. The duration of each study can be found in Table 1 above.

Table 2: Adverse Events by Study Treatment Group in Each Clinical Study

Study	Study Arm	N	Severe Hypoglycemia, # of events	Severe Hyperglycemia, # of events
¹ SP7	Open-loop	63	4	0
	Closed-loop	63	5	0
¹ SP12 - ITT Analysis	Open-loop	93	³ 0.5	³ 1.6
	Closed-loop	93	³ 0.1	³ 0.2
² SP12 - PP Analysis	Open-loop	59	³ 0.5	³ 1.6
	Closed-loop	59	³ 0.1	³ 0.2
¹ INLOOP	Usual treatment	166	⁴ 28.5 (10.6 – 76.1)	⁴ 7.2 (2.7 – 19.1)
	Closed-loop	149	⁴ 1.7 (0.3 – 9.7)	⁴ 6.5 (1.5 – 27.8)
¹ SP8 (RCT) - ITT Analysis	Open-loop	34	NA	NA
	Closed-loop	106	NA	NA
¹ SP8 (before-after comparison) - ITT Analysis	Open-loop	106 adults, 36 teens	NA	NA
	Closed-loop		NA	NA
² SP8 (RCT) - PP Analysis	Open-loop	11	NA	NA
	Closed-loop	73	NA	NA
² SP8 (before-after comparison)	Open-loop	73 adults, 18 teens	NA	NA
	Closed-loop		NA	NA

- PP Analysis				
¹ SP20 (main) - ITT Analysis	Usual treatment	90	0	0
	Closed-loop	80	0	0
¹ SP20 (extension) - ITT Analysis	Usual treatment	47	0	0
	Closed-loop	47	0	1
² SP20 (main) - PP Analysis	Usual treatment	55	0	0
	Closed-loop	55	0	0
² SP20 (extension) - PP Analysis	Usual treatment	35	0	0
	Closed-loop	35	1	0
¹ SP13 (main)	Usual treatment	49	0	0
	Closed-loop	49	0	0
¹ SP13 (extension)	Usual treatment	25	0	0
	Closed-loop	25	1	0

N: number of subjects; SD: standard deviation; RCT: randomized control trial

¹SP7, SP12, INLOOP, SP8, SP20, and SP13 information is for the intention to treat population (ITT)

²SP12, SP8, and SP20 information is for the per protocol population (PPP).

³Incidence rate per 1000 patient-days

⁴Incidence rate per 100 patient years (95% confidence intervals)

Observed Results

The data below describe how the device performed during the clinical studies.

Table 3: Overall Glycemic Outcomes During the Clinical Studies

Study	Study Arm (# of subjects)	% time in range 70-180 mg/dL, mean $\pm$ SD	% time below 70 mg/dL, mean $\pm$ SD	% time below 54 mg/dL, mean $\pm$ SD	% time above 250 mg/dL, mean $\pm$ SD	Mean Glucose (mg/dL), mean $\pm$ SD
¹ SP7	Open-loop (N = 63)	59.4 $\pm$ 10.3	4.3 $\pm$ 2.4	⁵ 0.7 $\pm$ 0.79	11.7 $\pm$ 6.4	164.9 $\pm$ 16.7
	Closed-loop (N = 63)	68.5 $\pm$ 9.5	2.0 $\pm$ 2.4	⁵ 0.2 $\pm$ 0.79	7.4 $\pm$ 6.4	158.5 $\pm$ 16.7
¹ SP12 - ITT Analysis	Open-loop (N = 93)	47.4 $\pm$ 13.9	1.99 $\pm$ 1.76	0.38 $\pm$ 0.49	20.5 $\pm$ 12.1	189.5 $\pm$ 26.2
	Closed-loop (N = 93)	60.7 $\pm$ 8.6	1.03 $\pm$ 0.76	0.23 $\pm$ 0.23	12.3 $\pm$ 5.7	174.1 $\pm$ 13.5
² SP12	Open-loop (N = 59)	46.9 $\pm$ 12.7	1.89 $\pm$ 1.79	0.36 $\pm$ 0.51	20.4 $\pm$ 10.9	189.6 $\pm$ 22.6

- PP Analysis	Closed-loop (N = 59)	61.2 ± 9.0	1.03 ± 0.81	0.22 ± 0.23	11.8 ± 5.2	173.0 ± 13.4
^{1,6} INLOOP	Usual treatment (N = 149)	56.6 (53.4-59.8)	3.69 (3.23-4.20)	0.79 (0.67-0.93)	15.5 (13.3-17.7)	171.5 (165.4-177.5)
	Closed-loop (N = 149)	69.1 (65.9-72.3)	1.39 (1.15-1.65)	0.31 (0.22-0.41)	8.2 (6.02-10.4)	158.9 (152.8-164.9)
¹ SP8 (RCT) - ITT Analysis	Open-loop (N = 34)	NA	NA	NA	NA	NA
	Closed-loop (N = 106)	NA	NA	NA	NA	NA
¹ SP8 (before-after comparison) - ITT Analysis	Open-loop (N = 106 adults, 36 teens)	NA	NA	NA	NA	NA
	Closed-loop (N = 106 adults, 36 teens)	NA	NA	NA	NA	NA
^{2,7} SP8 (RCT) - PP Analysis	Open-loop (N = 11)	51.7 (44.2, 59.3)	2.31 (1.47, 3.14)	0.30 (0.01, 0.59)	17.57 (13.02, 22.12)	180 (169, 191)
	Closed-loop (N = 73)	67.3 (64.6, 70.0)	1.38 (1.09, 1.68)	0.27 (0.17, 0.37)	8.22 (6.58, 9.87)	162 (158, 166)
² SP8 (before-after comparison) - PP Analysis	Open-loop (N = 73 adults, 18 teens)	55.0 ± 15.5	2.8 ± 2.5	0.5 ± 0.8	15.3 ± 11.7	175.0 ± 28.4
	Closed-loop (N = 73 adults, 18 teens)	66.6 ± 11.0	1.5 ± 1.1	0.3 ± 0.4	8.8 ± 6.5	163.0 ± 17.5
¹ SP20 (main) - ITT Analysis	Usual treatment (N = 90)	56.7 ± 13.2	2.74 ± 2.36	0.51 ± 0.70	13.3 ± 8.25	171.5 ± 23.0
	Closed-loop (N = 80)	65.7 ± 11.0	1.61 ± 1.20	0.33 ± 0.36	10.5 ± 7.34	165.6 ± 18.8
¹ SP20 (extension) - ITT Analysis	Usual treatment (N = 47)	57.5 ± 12.6	2.95 ± 2.58	0.55 ± 0.80	13.3 ± 7.82	170.6 ± 22.3
	Closed-loop (N = 47)	69.2 ± 9.23	2.07 ± 1.28	0.42 ± 0.45	8.75 ± 5.43	159.4 ± 15.4

² SP20 (main) - PP Analysis	Usual treatment (N = 55)	58.2 ± 12.4	3.12 ± 2.52	0.59 ± 0.79	12.9 ± 8.00	169.0 ± 22.5
	Closed- loop (N = 55)	67.8 ± 8.60	1.78 ± 1.06	0.36 ± 0.35	9.07 ± 5.65	161.7 ± 14.9
² SP20 (extension) - PP Analysis	Usual treatment (N = 35)	57.2 ± 12.7	2.86 ± 2.55	0.49 ± 0.84	13.2 ± 7.79	170.5 ± 22.0
	Closed- loop (N = 35)	70.7 ± 7.80	1.99 ± 1.16	0.41 ± 0.39	7.96 ± 4.69	157.2 ± 12.6
¹ SP13 (main)	Usual treatment (N = 49)	401. ± 12.8	2.94 ± 2.67	0.70 ± 1.10	30.9 ± 14.7	207.7 ± 33.6
	Closed- loop (N = 49)	56.7 ± 9.5	2.38 ± 1.44	0.62 ± 0.52	17.6 ± 8.8	180.9 ± 20.2
¹ SP13 (extension)	Usual treatment (N = 25)	40.2 ± 10.5	3.91 ± 2.84	1.07 ± 1.39	29.4 ± 11.1	203.5 ± 24.8
	Closed- loop (N = 23)	51.7 ± 5.9	3.66 ± 1.57	1.12 ± 0.67	23.5 ± 6.4	190.6 ± 15.9

N: number of subjects; SD: standard deviation; RCT: randomized control trial

¹SP7, SP12, INLOOP, SP8, SP20, and SP13 information is for the intention to treat population (ITT)

²SP12, SP8, and SP20 information is for the per protocol population (PPP).

⁵For the SP7 study, % time below range 50 mg/dL is reported instead of 54 mg/dL

⁶For INLOOP study, glycemic outcomes are reported with 95% confidence interval

⁷For SP8 RCT study, glycemic outcomes are reported with 99% confidence interval

Table 4: Available HbA1c Observed During the Clinical Studies

Study	Study Arm (# of subjects)	Baseline HbA1c (%), mean ± SD	HbA1c at end of study (%), mean ± SD
^{1,8} SP7	Open-loop (N = 63)	7.6 ± 0.9	-0.14 ± 0.56
	Closed-loop (N = 63)	7.6 ± 0.9	-0.29 ± 0.56
¹ SP12 - ITT Analysis	Open-loop (N = 93)	8.88 ± 0.94	8.86 ± 0.85
	Closed-loop (N = 93)	8.88 ± 0.94	7.65 ± 0.96
² SP12 - PP Analysis	Open-loop (N = 59)	8.78 ± 0.88	8.78 ± 0.88
	Closed-loop (N = 59)	8.78 ± 0.88	7.45 ± 0.65
^{1,6} INLOOP	Usual treatment (N = 149)	7.6 ± 1.1	7.61 (7.39-7.83)
	Closed-loop (N = 149)	7.6 ± 1.1	6.99 (6.76-7.21)

¹ SP8 (RCT) - ITT Analysis	Open-loop (N = 34)	7.8 ± 1.0	NA
	Closed-loop (N = 106)	7.8 ± 0.9	NA
¹ SP8 (before-after comparison - ITT Analysis	Open-loop (N = 106 adults, 36 teens)	8.0 ± 1.1	NA
	Closed-loop (N = 106 adults, 36 teens)	8.0 ± 1.1	NA
² SP8 (RCT) - PP Analysis	Open-loop (N = 11)	7.8 ± 1.0	NA
	Closed-loop (N = 73)	7.8 ± 0.9	NA
² SP8 (before-after comparison) - PP Analysis	Open-loop (N = 73 adults, 18 teens)	8.0 ± 1.1	NA
	Closed-loop (N = 73 adults, 18 teens)	8.0 ± 1.1	NA
¹ SP20 (main) - ITT Analysis	Usual treatment (N = 90)	7.59 ± 0.85	NA
	Closed-loop (N = 80)	7.59 ± 0.85	NA
¹ SP20 (extension) - ITT Analysis	Usual treatment (N = 47)	7.47 ± 0.82	7.47 ± 0.82
	Closed-loop (N = 47)	7.47 ± 0.82	7.04 ± 0.63
² SP20 (main) - PP Analysis	Usual treatment (N = 55)	7.51 ± 0.86	NA
	Closed-loop (N = 55)	7.51 ± 0.86	NA
² SP20 (extension) - PP Analysis	Usual treatment (N = 35)	7.46 ± 0.75	7.46 ± 0.75
	Closed-loop (N = 35)	7.46 ± 0.75	6.94 ± 0.47
¹ SP13 (main)	Usual treatment (N = 49)	9.1 ± 1.0	NA
	Closed-loop (N = 49)	9.1 ± 1.0	NA
¹ SP13 (extension)	Usual treatment (N = 25)	9.1 ± 0.8	NA
	Closed-loop (N = 23)	9.1 ± 0.8	NA

N: number of subjects; SD: standard deviation; RCT: randomized control trial

¹SP7, SP12, INLOOP, SP8, SP20, and SP13 information is for the intention to treat population (ITT)

²SP12, SP8, and SP20 information is for the per protocol population (PPP).

⁶For INLOOP study, glycemic outcomes are reported with 95% confidence interval

⁸For SP7, end of study HbA1c is reported as the change in HbA1c from the beginning to end of study

Real-World Evidence

The sponsor conducted analysis of real-world data to support the overall safety of DBLG2. Obs37 consisted of a meta-analysis of SP13 and SP20 (described above), in combination

with Obs36, and analyzed CGM metrics and adverse events associated with the use of the high and the low range of configurable settings and Zen and Physical Activity modes. Obs36 was an observational study of 1,085 adult subjects who used the system for 9 months in the real-world setting.

Obs36 provided a large data set of real-world use of the device in the to-be-marketed configuration by adults over a longer period of time than the clinical studies. Drawing upon this study, SP20 (adult clinical study), and SP13 (adolescent clinical study), Obs37 demonstrated that use of the wide range of configurable settings (including Physical Activity and Zen modes) did not result in significantly worse CGM metrics or concerning increase in adverse events compared to the default settings. For example, subjects who chose the higher tertial of aggressivity for normoglycemia/hyperglycemia/meals did not have an increase in time below 54 mg/dL or rate of severe hypoglycemia events. Conversely, subjects who chose a lower aggressivity setting did not experience a significant increase in time above 250 mg/dL or rate of severe hyperglycemia events. Interestingly, Obs37 noted that throughout the three studies, most subjects modified the configurable settings, but not far beyond the default selection.

Human Factors

Human Factors validation testing was conducted with the DBLG2 app installed on an Android smartphone. Diabeloop conducted an online survey to gather feedback about the design of the device from current users of DBLG1, the previous version of the product that is marketed OUS. The survey was shared with online groups in France, Germany, and the Netherlands, and a total of 133 responses were collected. From these responses, the sponsor made 3 design changes prior to the summative study conducted with DLBG2. The subject device was evaluated across two distinct user groups: 1) Adults diagnosed with Type 1 Diabetes 18+ years old and 2) Pediatrics diagnosed with Type 1 Diabetes who are partially dependent on a caregiver and who are 12-18 years old with a total of 34 users/dyad evaluated. The DBGL2 device specific training was split across multiple days through two modes, the first being individual learning/training through videos and electronic content provided prior to a 2-hour in-person training session with a Diabeloop certified trainer. Users who passed the associated testing with a score of 80% or better (unlimited ability to retake the assessment) were then provided a 1-hour decay period followed by simulated use testing that evaluated users' ability to use the device in a simulated home use setting. Usability evaluations assessed comprehension of device alerts and alarms and usability of the device for critical device tasks. The results from the simulated use testing of the Diabeloop device demonstrate that the subject device is substantially equivalent to the predicate device.

User and Provider Training

User training for the human factors validation study was representative of how users will be trained to use the to-be-marketed device. Users will undergo individual learning/training through videos and electronic content prior to a 2-hour in-person training session with a certified training. After completing the training, users will take an online questionnaire. Only users who score an 80% or greater on the training questionnaire will be allowed to proceed to use the device.

In order to prescribe and start patients on this device, prescribing healthcare providers must complete a separate training and certification that includes detailed modules on parameter adjustment and appropriate selection for device settings. Healthcare providers must score an

80% or better to begin prescribing the device. The training plan guides prescribers on appropriate selection for diverse patient populations and clinical scenarios, in order to instruct healthcare providers on when specific parameter values may not be clinically appropriate based on individual patient characteristics and risk factors.

Hazard Analysis

A comprehensive hazard analysis was provided for this device, in which design inputs and outputs, risks, and risk mitigations for software and interoperable hardware components associated with the safe and effective functioning of the device were reviewed. The hazard analysis provided in this submission accounted for the unique design elements, intended use, and risks of the DBLG2 design. In particular, this hazard analysis accounted for the risks associated with interoperability between the software device developed by the sponsor and commercial off-the-shelf (COTS) hardware device it was installed on, as well as with other third-party interoperable devices. This analysis identified hazards which could reasonably be anticipated to impact the proper use of the device, traced all identified risks to adequate design controls, and demonstrated that design features were appropriately implemented and validated.

Data Logging

The sponsor provided software documentation and bench testing to demonstrate that the device is able to record critical events, including information related to its state (e.g., commands and confirmations/acknowledgements, delivery rates/volumes, malfunctions/errors, alarms/alerts, and connectivity/connection events), user inputs, and device settings. The sponsor also provided specific information that they would collect from all interoperable components connected to DBLG2, including the iCGM and ACE pump components. All log entries are time-stamped, and the logs are generated when the events occur.

Predetermined Change Control Plan (PCCP)

A predetermined change control plan (PCCP) for integrating with FDA-cleared iCGMs and ACE pumps was provided according to the FDA Guidance “Design Considerations and Premarket Submission Recommendations for Interoperable Medical Devices - Guidance for Industry and Food and Drug Administration Staff.” The PCCP includes a description of modifications, a modification protocol and an impact assessment, and was determined to be adequate to support and clearly specify expectations, requirements, and interface specifications for compatible iCGMs and ACE pumps. The sponsor has performed software and bench testing to verify and validate that these interface control specifications meet the special controls and their controller’s requirements for performance, communications, and data logging. In addition, the plans provided by the sponsor covered their approach to working with connected device companies regarding contractual issues, interfaces for data communication and exchange, and post-market reporting procedures and responsibilities (e.g., who is responsible for investigating and reporting complaints, malfunctions, and adverse events).

The sponsor additionally provided software protocols intended to ensure secure, accurate, and reliable communication with digital interfacing devices, as well as failsafe design features to mitigate the risks associated with interruption of communication with digitally connected devices. These protocols were executed in the comprehensive software testing

performed by the sponsor which included hardware prototype testing and software integration testing.

By design, DBLG2 can only be used with compatible iCGM and ACE Pump devices with which it has been validated for use. Diabeloop will not allow use of an unvalidated ACE pump or iCGM. To support the future integration of compatible ACE pumps and iCGMs with DBLG2, the sponsor also provided protocols (“DBLG2US-RD-PCCP-002-Rev4-Predetermined change control plan” and “QA-WI-017”) outlining their validation strategy for determining compatibility of new devices with DBLG2. The protocols included pre-specified procedures, validation strategies, and acceptance criteria for software, cybersecurity, device interoperability, human factors, labeling, and training materials, with the anticipated features and specifications of ACE pumps and iCGMs as these are anticipated changes foreseen at the time of the submission. These protocols, along with the software testing conducted, were found to be adequate to support the robustness of the sponsor’s software test protocols to validate future integration of digitally connected devices that meet the pre-specified specifications and acceptance criteria. FDA has determined that when a modification is made in accordance with “DBLG2US-RD-PCCP-002-Rev4-Predetermined change control plan” and “QA-WI-017” and the validation strategy described in this 510(k), then no new 510(k) would be required. Changes made that are inconsistent with the modifications described in “DBLG2US-RD-PCCP-002-Rev4-Predetermined change control plan” and “QA-WI-017” could be significant modifications that could significantly affect the safety and/or effectiveness of this device (e.g., such changes could compromise the clinical functionality or performance specifications that are directly associated with the intended use of the device), in which case a new premarket submission would be required (see 21 CFR 807.81(a)(3)).

Cybersecurity

Detailed information on cybersecurity of the device was reviewed and was found to be acceptable. The sponsor provided detailed information relating to the penetration testing conducted as part of their cybersecurity evaluation. The sponsor also provided a software bill of materials. This included all manufacturer-developed, commercially licensed, open source, partner, and off-the-shelf software components (including firmware, as relevant), along with relevant version and/or model information and details on whether each component was actively supported by its manufacturer or legacy licensed.

VII Proposed Labeling:

The labeling supports the finding of substantial equivalence for this device.

VIII Conclusion:

The submitted information in this premarket notification is complete and supports a substantial equivalence decision.