

Factors predicting achievement of recommended time in range and HbA1c 12-months following Closed-Loop in individuals with elevated baseline HbA1c levels

TSJ Crabtree^{1,2,3}, TP Griffin⁴, P Narendran⁵, G Gallen⁶, MA Karamat⁵, A Liarakos^{1,2}, A Lumb⁷, REJ Ryder³, P Choudhary^{4,8}, EG Wilmot^{1,2} on behalf of all ABCD Closed-Loop pilot audit contributors

1. University of Nottingham; 2. University Hospitals of Derby and Burton NHS Trust; 3. Sandwell & West Birmingham Hospitals NHS Trust; 4. University Hospitals of Leicester NHS Trust; 5. University Hospitals of Birmingham NHS Trust; 6. King's College Hospital NHS Trust; 7. Oxford University Hospitals NHS Trust; 8. University of Leicester

Introduction

The ABCD audit captured data from the NHS England Hybrid Closed-Loop (HCL) pilot which funded HCL for individuals using an insulin pump, FreeStyle Libre 2 and with an above target HbA1c (≥ 69 mmol/mol). The initial report of the 6-month outcomes has been published and demonstrated significant improvements in HbA1c, sensor glucometrics and improvements in quality of life with reductions in diabetes distress(1).

The aim of this analysis is to identify factors that predict achievement of target time-in-range (TIR, 3.9-10mmol/L) $\geq 70\%$ or HbA1c ≤ 58 mmol/mol by 12-months of follow-up. **The HbA1c and sensor outcomes at 12-months are displayed in poster P244.**

Methods

Participants who had data recorded on the secure online tool and were using HCL therapy at baseline and at 12-months (9-24 months range) were included. The following variables were assessed for their predictive value using both multiple and univariate regression models: TIR, time below range (< 3.9 mmol/L), HbA1c, age, gender, duration of pump therapy, Diabetes Distress Score, ethnicity, time in closed loop (%), index of multiple deprivation and weight. Analysis was performed in Stata16.

Results

Data were included for 235 individuals: age 41.1 ± 13.6 years, baseline HbA1c 78.4 ± 12.4 mmol/mol, median diabetes duration was 18.0years (IQR 13.7-29.2), and median pump therapy duration was 8.2 years (IQR 4.7-11.2). The majority were female (63.4%) and White British (92.5%), median index of multiple deprivation decile was 6 (IQR 3-9). Median follow-up was 1.3 years (IQR 1.0-1.8).

At follow-up, 77 (32.7%) of individuals had a HbA1c ≤ 58 mmol/mol and 71 (30.2%) had a TIR $\geq 70\%$. The baseline characteristics are summarised in **table 1** below.

Table 1. Baseline characteristics of the cohort

Baseline Characteristics		
Variable	Measure	Total n=235
Age, year	Mean \pm SD	41.1 \pm 13.6
Gender, Female	n (%)	149 (63.4)
Diabetes duration, years	Median (IQR)	21.3 (13.7-29.2)
Pump Duration, years	Median (IQR)	8.2 (4.7-11.2)
Ethnicity, White British	n (%)	211 (92.5)
Index of multiple deprivation, decile	Median (IQR)	6 (3-9)
Weight, kg	Mean \pm SD	82.1 \pm 17.7
HbA1c, mmol/mol	Mean \pm SD	78.4 \pm 12.4
Time above range, % > 10 mmol/L	Mean \pm SD	61.7 \pm 16.5
Time in range, % 3.9-10mmol/L	Mean \pm SD	36.2 \pm 15.8
Time below range, % < 3.9 mmol/L	Mean \pm SD	2.1 \pm 2.7

References

1. Crabtree et al, Diabetes Care 2023

Acknowledgments. The authors extend a special thanks to Professor Partha Kar, and his team at NHS England, who led the delivery of the NHS England closed-loop pilot.

Results

Only baseline time in range predicted achievement of either 70% TIR or HbA1c at target after 1.3 years of follow-up in the multivariate model.

Univariate associations were noted. For HbA1c ≤ 58 mmol/mol, increased time in closed-loop, lower baseline HbA1c and higher time-in-range were associated with an increased chance of achieving this target. This is shown in **table 2**.

For TIR 70% or more, lower baseline HbA1c and higher baseline time-in-range were associated with an increased chance of achieving this target. Individuals with a longer duration of diabetes were also more likely to reach this target but there was no impact of time spent in closed-loop (P=0.06). This is shown in **table 3**.

Table 2. Univariate associations between various characteristics and achievement of target HbA1c

HbA1c ≤ 58 mmol at follow-up		
Variable	Univariate	
	Coefficient	P-Value
Age, year	0.005	0.64
Gender, Female	0.094	0.75
Diabetes duration, years	0.016	0.22
Pump Duration, years	0.004	0.66
Ethnicity, White British	-0.253	0.75
Index of multiple deprivation, decile	-0.013	0.72
Weight, kg	0.012	0.16
HbA1c, mmol/mol	-0.095	<0.001
Time in range, % 3.9-10mmol/L	0.05	<0.001
Time below range, % < 3.9 mmol/L	-0.002	0.97
Time in closed loop, %	0.077	0.02

Table 3. Univariate associations between various characteristics and achievement of target time in range

Time in range $\geq 70\%$ at follow-up		
Variable	Univariate	
	Coefficient	P-Value
Age, year	0.019	0.11
Gender, Female	0.456	0.16
Diabetes duration, years	0.036	0.01
Pump Duration, years	-0.008	0.82
Ethnicity, White British	-1.22	0.17
Index of multiple deprivation, decile	0.014	0.73
Weight, kg	0.006	0.52
HbA1c, mmol/mol	-0.059	<0.001
Time in range, % 3.9-10mmol/L	0.043	<0.001
Time below range, % < 3.9 mmol/L	0.007	0.91
Time in closed loop, %	0.042	0.06

Conclusions

In the NHS England pilot, none of the clinical or patient characteristics assessed predicted achievement of recommended TIR or HbA1c targets at follow-up in multivariate analysis. Those closest to the targets are more likely to achieve them with HCL. All users in the real-world benefit equally irrespective of ethnicity, gender and deprivation status - care must be taken to ensure anyone meeting criteria can access these systems and receive the potential benefits during the future roll-out