

Background

- Hemoglobin A1c (HbA1c) is a lab value taken every 3 months that is used as the gold standard for assessing glycemic control.¹
- Self-monitored blood glucose (SMBG) is a real-time measurement taken via fingerstick by the patient, and can be used to help trend glycemic control on a day-to-day basis.²
- SMBG monitoring is recommended for type 2 diabetes (T2DM) patients by ADA guidelines and can direct therapy.³
- Historically, T2DM patients often intentionally, or unintentionally, misreport SMBG values, resulting in misrepresentation of their glycemic control status which may lead to therapeutic inertia and inappropriate pharmacological interventions.⁴

A1c	eAG
>6.4%	>137 mg/dL
6.5%	140 mg/dL
7.0%	154 mg/dL
7.5%	169 mg/dL
8.0%	183 mg/dL
8.5%	197 mg/dL
9.0%	212 mg/dL
9.5%	226 mg/dL
10.0%	240 mg/dL

Estimated Average Glucose Equation⁵
$eAG = 28.7 \times A1c - 46.7$

Objectives

- Assess alignment of SMBG values with HbA1c
- Evaluate the impact of percent difference between SMBG and HbA1c values on diabetes management interventions implemented by pharmacists
- Identify trends in glycemic control using HbA1c within the study period, as well as a year beyond

Methods

Study design: Observational, retrospective chart review

Study population: Adults ≥ 18 years old with T2DM who were seen by a PharmD for DM management at PC East or Endo Clinic at Los Angeles General Medical Center

Inclusion criteria: T2DM with history of ≥ 2 outpatient diabetes visits with PharmD during study period, ≥ 1 HbA1c measurement taken within the 3-4 months prior to visits, a record of SMBG values documented at these appointments that correspond to HbA1c values

Exclusion criteria: Pregnant, recent hospitalization within 3 months of study period, any condition that makes HbA1c unreliable

Data collection: Study period took place from March 2022 to November 2023. From Mar 2022 - Nov 2022, SMBG levels, HbA1c values, appointment dates, and therapeutic intervention information were collected. From Dec 2022 - Nov 2023, additional A1c values were collected.

Data analysis:

- Use A1c-derived average glucose (ADAG) study equation to convert A1c values to estimated average glucose (eAG):⁵
 - $28.7 \times A1c - 46.7 = eAG$
- Calculate % difference between patients' SMBG levels with eAG values derived from corresponding A1c
- Develop a pie chart to categorize patients into discrepancy (% difference) groups reflective of the reliability of their SMBG reporting
- Identify variations in pharmacological interventions at PharmD visits based on % difference
- Compare average first and last A1c based on % difference groups and conduct t-test for statistical analysis

Table 1. Baseline Characteristics (N=65)

Age in years, mean (SD)	55 \pm 10.1
Male [n, (%)]	24 (36.9)
Primary language [n, (%)]:	
Spanish	54 (83.1)
English	8 (12.3)
Other	3 (4.6)
Ethnicity, [n, (%)]:	
Hispanic/Latino	60 (92.3)
Asian	4 (6.2)
African American	1 (1.5)
Health insurance [n, (%)]:	
MediCal	61 (93.8)
Medicare (13 eligible)	8 (12.3)
Comorbid conditions [n, (%)]:	
Arthritis	9 (13.8)
CAD	8 (12.3)
Cancer	10 (15.4)
CKD Stage 3/4	9 (13.8)
Depression	13 (20.0)
Dyslipidemia	41 (63.1)
GERD/PUD	12 (18.4)
Hepatic disease	9 (13.8)
Hypertension	46 (70.8)
Obesity	48 (73.8)
Medication [n, (%)]:	
Metformin	56 (86.2)
Basal Insulin	52 (80.0)
Bolus Insulin	40 (61.5)
SGLT2-Inhibitor	9 (13.8)
TZD	8 (12.3)
NPH 70/30 Combo/NPH	7 (10.8)
DPP4-Inhibitor	6 (9.2)
U-500 Insulin	5 (7.7)
GLP1RA	3 (4.6)
SU	2 (3.1)

*Screening: 302 patients were screened and 237 were excluded because they did not meet inclusion criteria

Table 2. Results from Independent, One-tailed, T test (Significance of 0.05)

P-value	0.13
t-value	-1.15
Degrees of freedom (df)	
<25% group	24
>50% group	10
Standard Deviation (SD)	
<25% group	1.691
>50% group	1.689

Results

Figure 1. Percent Discrepancy Between SMBG and eAG Based on A1c Values from PharmD Visits

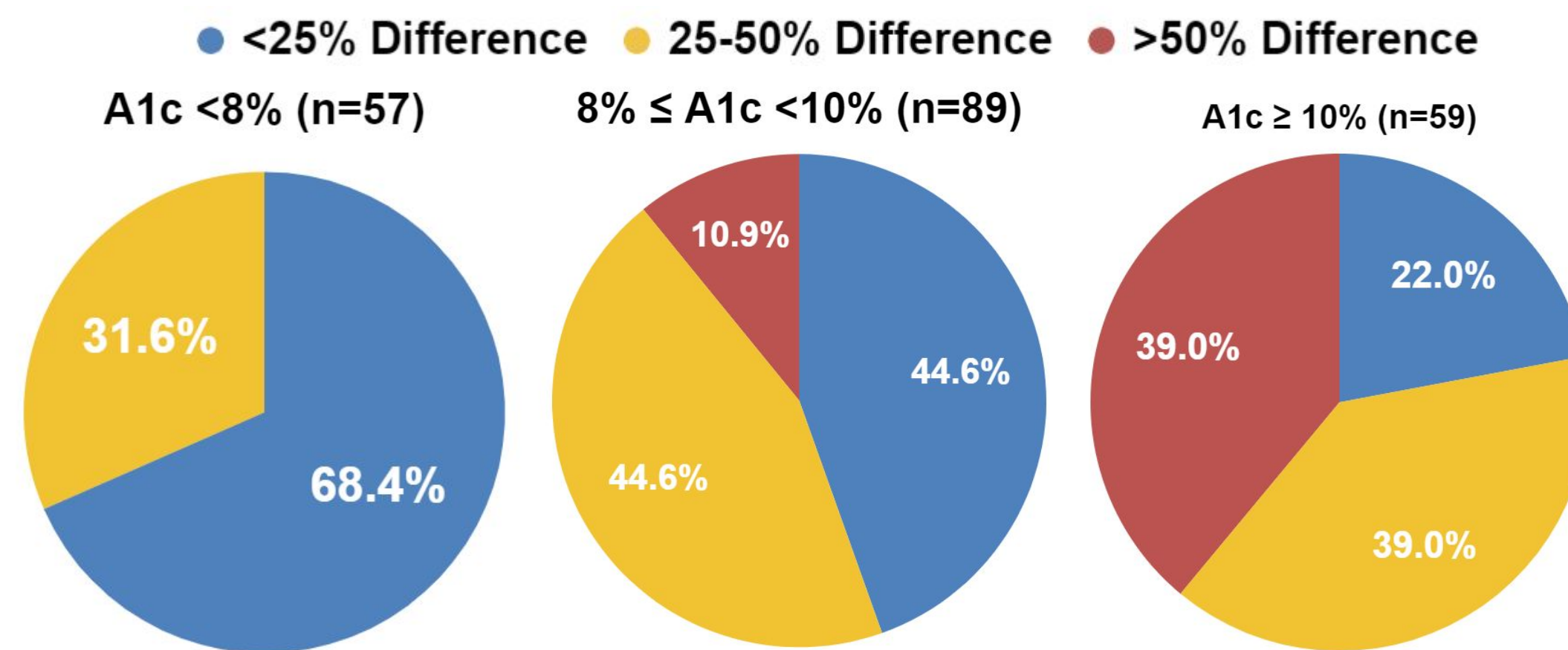


Figure 2. Medication Interventions Based on % Difference if A1c \geq 10% at PharmD Visit

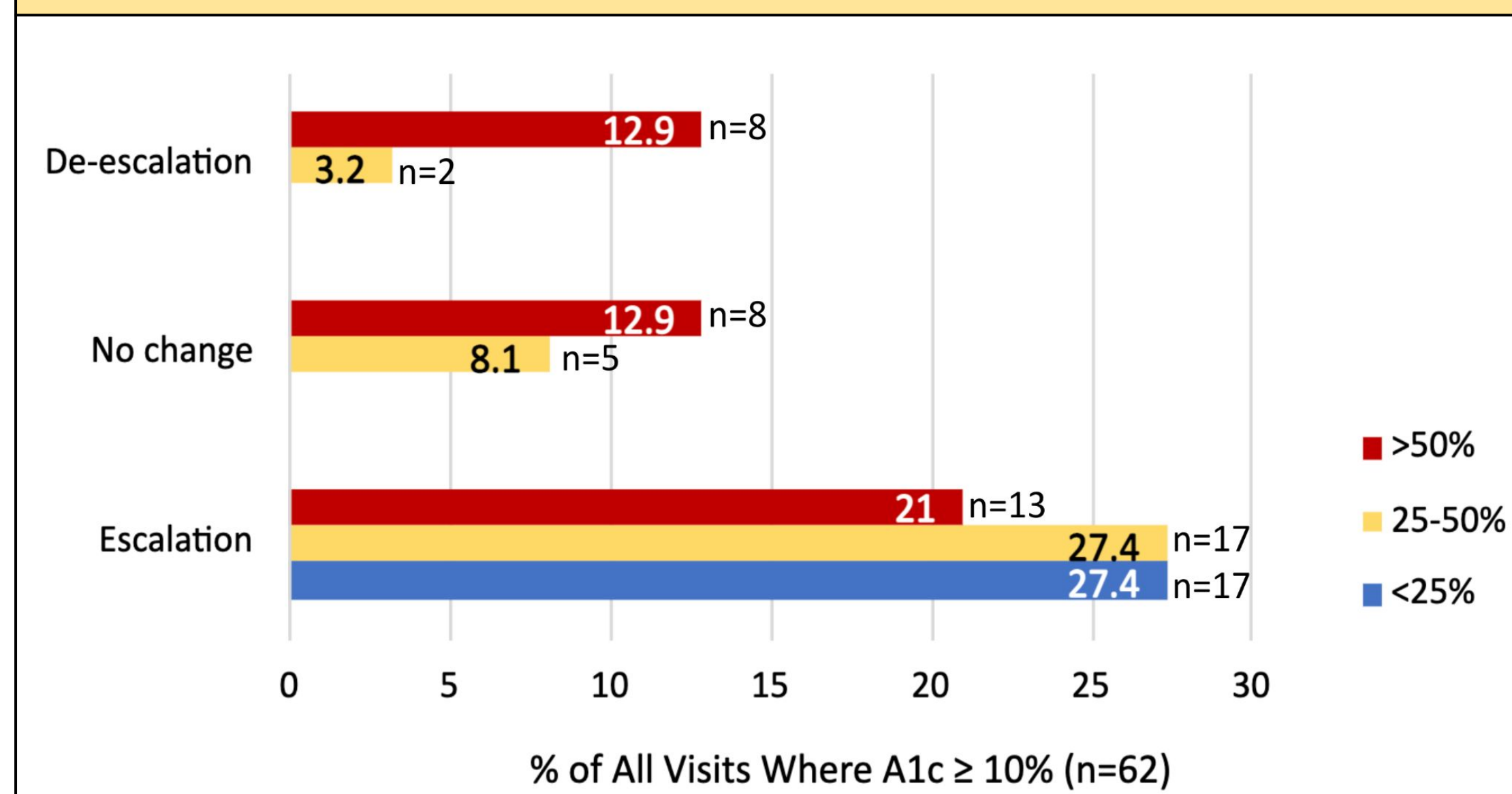
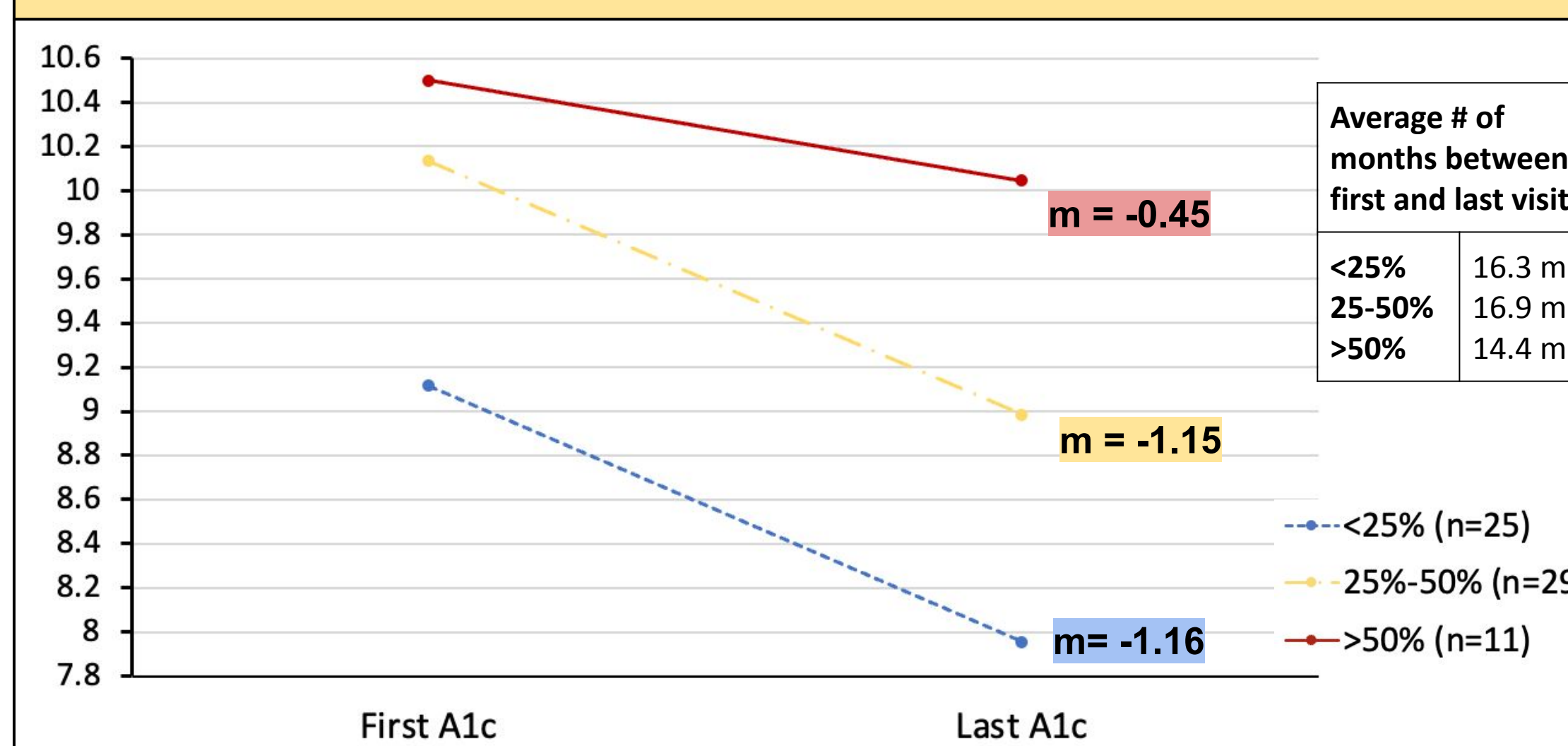


Figure 3. Average Change in A1c From First to Last Visit Based on Percent Difference Between eAG and SMBG Value



Discussion

- On average, patients reported SMBG values that were lower than their estimated average glucose values.
- Patients with higher A1c values displayed a greater discrepancy between their SMBG and eAG values.
- Patients with an A1c $\geq 10\%$ with SMBGs that more closely aligned with their eAG (<25%) were more likely to experience therapy intensification than those with poorer alignment, which may have contributed to achieving better glycemic control.
- Patients with an A1c $\geq 10\%$ with SMBGs that poorly aligned with their eAG (>50%) were more likely to experience a de-escalation or no change in therapy than those with closer alignment.
- Patients with poor alignment (>50%) between their SMBG and eAG values displayed higher A1cs with less change from their first to last A1c. Patients with closer alignment (<25%) displayed lower A1cs and showed a more drastic reduction when comparing their first to last A1c. These trends could indicate that those who reported accurately received appropriate interventions that better established glycemic control.
- When conducting an independent, one-tailed T-test at a significance level of 0.05, we found that the 25 patients who had a discrepancy of <25% compared to the 11 patients who had a discrepancy of >50% failed to demonstrate significant alignment between ADAG and SMBG, $t(34) = -1.15$, $p = .13$, despite attaining a greater difference between first and last A1c. The lack of statistical significance is likely due to small sample size.
- The standard deviation for both groups are < 2 (1.691, 1.689), indicating that the values are relatively spread out from the mean value (-1.16, -0.45). This may also be due to the small sample size of patients.

Conclusion

- Patients with suboptimal glycemic control are more inclined to report inaccurate SMBG values, leading to a false representation of their glycemic control status.
- Misreporting of SMBG values may contribute to therapeutic inertia and inappropriate clinical therapy modifications.
- Increasing awareness of SMBG misrepresentation could aid in progressing the implementation of continuous glucose monitoring (CGM) in order to have a more accurate understanding of a patient's glycemic control that does not rely on self-reporting.
- Future studies should observe the correlation of A1c-derived eAG with CGM data to assess alignment between the two values and determine their impact on therapy modifications.

References

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