Knowledge of HbA1c in diabetic eye patients: implications and effect of education

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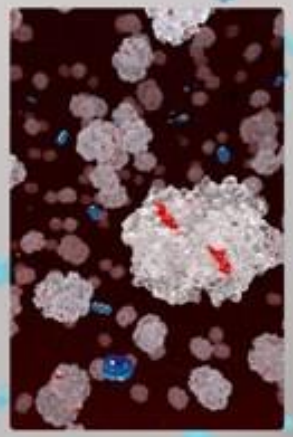
Introduction

- NICE guidance for managing diabetic patients involves agreeing a target HbA1c and informing patients of their results
- Landmark trials demonstrate that tight HbA1c control improves diabetic retinopathy, however, studies show few diabetic patients know their HbA1c, which may impact diabetic control

Glycated Hemoglobin (HbA1c)

Interactive Teaching Model for Diabetes Education



Hemoglobin (Hb) is the protein inside red blood cells. It gives our blood its red color and transports oxygen molecules throughout the body.

Glycated Hemoglobin (HbA1c) is an important marker for the long-term management of diabetes. Since a red blood cell's lifespan is only around 90 days, a fresh batch of blood cells circulate the body every 3 months. The American Diabetes Association recommends measurement of HbA1c typically 3-4 times per year for type 1 and poorly controlled type 2 diabetic patients, and 2 times per year for well-controlled type 2 diabetic patients.

After sugary meals, if Hemoglobin (Hb) is exposed to elevated levels of blood glucose for too long, glucose will permanently attach to hemoglobin through a process known as "Glycation."

The Glycated Hemoglobin (HbA1c) Teaching Model interactively demonstrates protein glycation using magnetized glucose molecules. By attaching and detaching glucose (Blue), the model is designed to represent different levels of HbA1c.

~4" in size in diameter
Actual photo!

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Landmark Trial Findings

Study	Effects on microvascular complications	Effect on macrovascular complications	Effect on total mortality
DCCT	Reduced retinopathy, nephropathy, neuropathy	No effect on major cardiovascular and peripheral vascular endpoints	No effect
UKPDS	Reduced microvascular endpoints	No effect on myocardial infarctions	No effect
ACCORD	Reduced retinopathy, nephropathy, neuropathy	No effect on major adverse cardiovascular events (MACE)	Increased mortality
ADVANCE	Reduced nephropathy	No effect on MACE	No effect
VADT	Reduced albuminaemia progression	No effect on major cardiovascular and peripheral vascular endpoints	No effect

Landmark Trial Findings- Retinopathy

	DCCT	UKPDS	ACCORD
Number of patients	1441	5102	2856
Type of diabetes	1	2	2
Follow up (years)	1-15 (mean 6.5)	12	4
Comparison	Standard Hb1Ac target	Standard fasting glucose <15 mmol l^{-1}, BP <180/105 (later <180/95)	Standard 7-7.9%, BP <140 or statin
	Intensive Hb1Ac target <6.05%	Intensive fasting glucose 6 mmol l^{-1}, BP <150/85	Intensive 6%, BP <120 or statin & fenofibrate
HbA1c difference between groups	2%	0.90%	1.10%
Intensive risk of retinopathy	↓76%	↓34%	
Intensive reduced V/A (3 lines+)		↓47%	
Intensive progression	↓54%	↓21%	↓30% (fenofibrate ↓36%)
Intensive severe NPDR/PDR	↓47%		
Intensive need for laser		↓29%	
Early worsening	Standard 7.6%		
	Intensive 13.1%		

NICE Guideline for management of Diabetes in Adults

- Adults with Type 1 Diabetes (2015 updated 2016) NICE guideline NG17
  - Inform adults with type 1 diabetes of their HbA1c results after each measurement and ensure that their most recent result is available at the time of consultation
  - Support adults with type 1 diabetes to aim for a target HbA1c level of 48 mmol/mol (6.5%) or lower, to minimise the risk of long-term vascular complications.
  - Agree an individualised HbA1c target with each adult with type 1 diabetes, taking into account factors such as the person's daily activities, aspirations, likelihood of complications, comorbidities, occupation and history of hypoglycaemia.

- Adults with Type 2 Diabetes (2015 updated 2017) NICE guideline NG28
  - Involve adults with type 2 diabetes in decisions about their individual HbA1c target. Encourage them to achieve the target and maintain it unless any resulting adverse effects (including hypoglycaemia), or their efforts to achieve their target, impair their quality of life.
  - Offer lifestyle advice and drug treatment to support adults with type 2 diabetes to achieve and maintain their HbA1c target
  - For adults with type 2 diabetes managed either by lifestyle and diet, or by lifestyle and diet combined with a single drug not associated with hypoglycaemia, support the person to aim for an HbA1c level of 48 mmol/mol (6.5%). For adults on a drug associated with hypoglycaemia, support the person to aim for an HbA1c level of 53 mmol/mol (7.0%).

NICE Guideline for management of Diabetes in Children
(2015) NICE guideline NG18

- Children and young people with type 1 diabetes
  - Explain the benefits of safely achieving and maintaining the lowest attainable HbA1c to children and young people with type 1 diabetes and their family members or carers (as appropriate).
  - Explain to children and young people with type 1 diabetes and their family members or carers (as appropriate) that an HbA1c target level of 48 mmol/mol (6.5%) or lower is ideal to minimise the risk of long-term complications.
  - Explain to children and young people with type 1 diabetes who have an HbA1c level above the ideal target of 48 mmol/mol (6.5%) and their family members or carers (as appropriate) that any reduction in HbA1c level reduces the risk of long-term complications.
  - Agree an individualised lowest achievable HbA1c target with each child or young person with type 1 diabetes and their family members or carers (as appropriate), taking into account factors such as daily activities, individual life goals, complications, comorbidities and the risk of hypoglycaemia.
  - Support children and young people with type 1 diabetes and their family members or carers (as appropriate) to safely achieve and maintain their individual agreed HbA1c target level.

- Children and young people with type 2 diabetes
  - Explain to children and young people with type 2 diabetes and their family members or carers (as appropriate) that an HbA1c target level of 48 mmol/mol (6.5%) or lower is ideal to minimise the risk of long-term complications.
  - Explain to children and young people with type 2 diabetes who have an HbA1c level above the ideal target of 48 mmol/mol (6.5%) and their family members or carers (as appropriate) that any reduction in HbA1c level reduces the risk of long-term complications.
  - Explain the benefits of safely achieving and maintaining the lowest attainable HbA1c to children and young people with type 2 diabetes and their family members or carers (as appropriate).
  - Agree an individualised lowest achievable HbA1c target with each child or young person with type 2 diabetes and their family members or carers (as appropriate), taking into account factors such as daily activities, individual life goals, complications and comorbidities.

The Relationship Between Knowledge of Recent HbA_{1c} Values and Diabetes Care Understanding and Self-Management

Heisler M, Piette J, Spencer M, Kieffer E, Vijan S

Diabetes Care 28:816 – 822 2005

- Survey of 663 adults with type 2 diabetes
- 66% reported that they did not know their last HbA1c
- value
- 25% accurately reported HbA1c
- Respondents who knew their HbA1c values reported significantly better diabetes care understanding and assessment of their biomedical level of glycaemic control than those who did not.
- Knowledge of HbA1c alone, however, was not associated with better diabetes care self-efficacy and self-management behaviours

Improving patients' knowledge on the relationship between HbA1c and mean plasma glucose improves glycaemic control among persons with poorly controlled diabetes.

Iqbal N, Morgan C, Maksoud H, Idris I

Ann Clin Biochem. 45(Pt 5):504-7 2008

- Questionnaire survey among 111 patients attending a hospital diabetes clinic
- 40.5% (45/111) were familiar (F) (31 type 1, 14 type 2)
- 59.5% (66/111) were unfamiliar (U) (23 type 1, 43 type 2) with the term HbA1c
- All given information about the interpretation of HbA1c
- Following education patients with poorly controlled diabetes (HbA1c >9%) showed a significant reduction in HbA1c levels if they were from group U (10.7% vs. 9.5%, P = 0.04) but not from group F (10.5 vs. 9.8, P = 0.28)
- Patients with moderately poor glycaemic control (HbA1c 7.5-9%) showed no significant change in HbA1c levels following intervention (8.3% vs. 8.2%, P = 0.57 group U; 8.3% vs. 8.2%, P = 0.79 group F)

Immediate feedback of HbA1c levels improves glycemic control in type 1 and insulin-treated type 2 diabetic patients.

Cagliero E, Levina E, Nathan D

Diabetes Care. 22(11):1785-9 1999

- RCT with 201 diabetic patients
- Randomised to either having immediate or delayed HbA1c result at every clinic visit
- HbA1c levels, changes in insulin therapy, and use of health care resources were assessed during a 12-month follow-up period
- HbA1c levels decreased significantly at 6 and 12 months in the immediate assay group (-0.57 +/- 1.44 and -0.40 +/- 1.65%, respectively; $P < 0.01$) but did not change in the control group (-0.11 +/- 0.79 and -0.19 +/- 1.16%, respectively; NS)
- The changes were similar for both type 1 and type 2 diabetic patients
- There were no differences in the rates of hypoglycemic events or use of health care resources
- These results persisted for the 12-month follow-up period

The Effect of Oral Antidiabetic Agents on A1C Levels
A systematic review and meta-analysis

Sherifali D, Nerenberg K, Pullenayegum E, Cheng J, Gerstein H
Diabetes Care. 33(8):1859-64 2010

- 61 trials
- 26,367 study participants
- Looked at reduction in HbA1c levels (old units)
- Biguanides (Metformin)
  - reduction of ~1% versus placebo
- Sulfonylureas (Gliclazide)
  - reduction of ~1.25% versus placebo
- DPP-4 inhibitors (Gliptins)
  - reduction of ~0.75% versus placebo
- Meglitinides (Nateglinide, Repaglinide)
  - reduction of ~0.75% versus placebo
- TZDs (Glitazones)
  - reduction of ~1% versus placebo
- Alpha glucosidase inhibitors (Acarbose)
  - reduction of ~1% versus placebo

Purpose

- We assessed what proportion of patients referred for diabetic eye disease know their HbA1c, and what effect this has on HbA1c level
- We explore the effect of nurse-led diabetic education on patients' HbA1c, and whether knowing one's level changes the impact of education

Methods

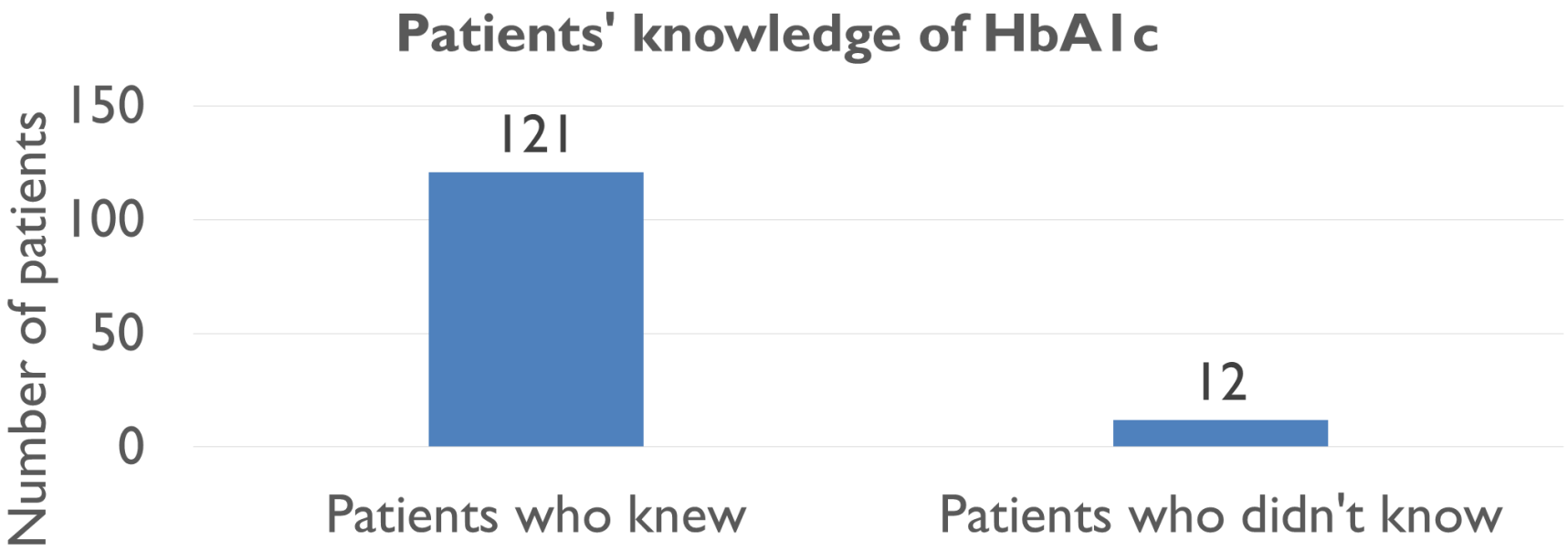
- Repeated measures study design
- 133 patients referred with diabetic eye disease over 3 months had their last HbA1c result and their knowledge of this recorded
- Nurse-led diabetic education was given
- The following HbA1c was recorded

Nurse-led diabetic education

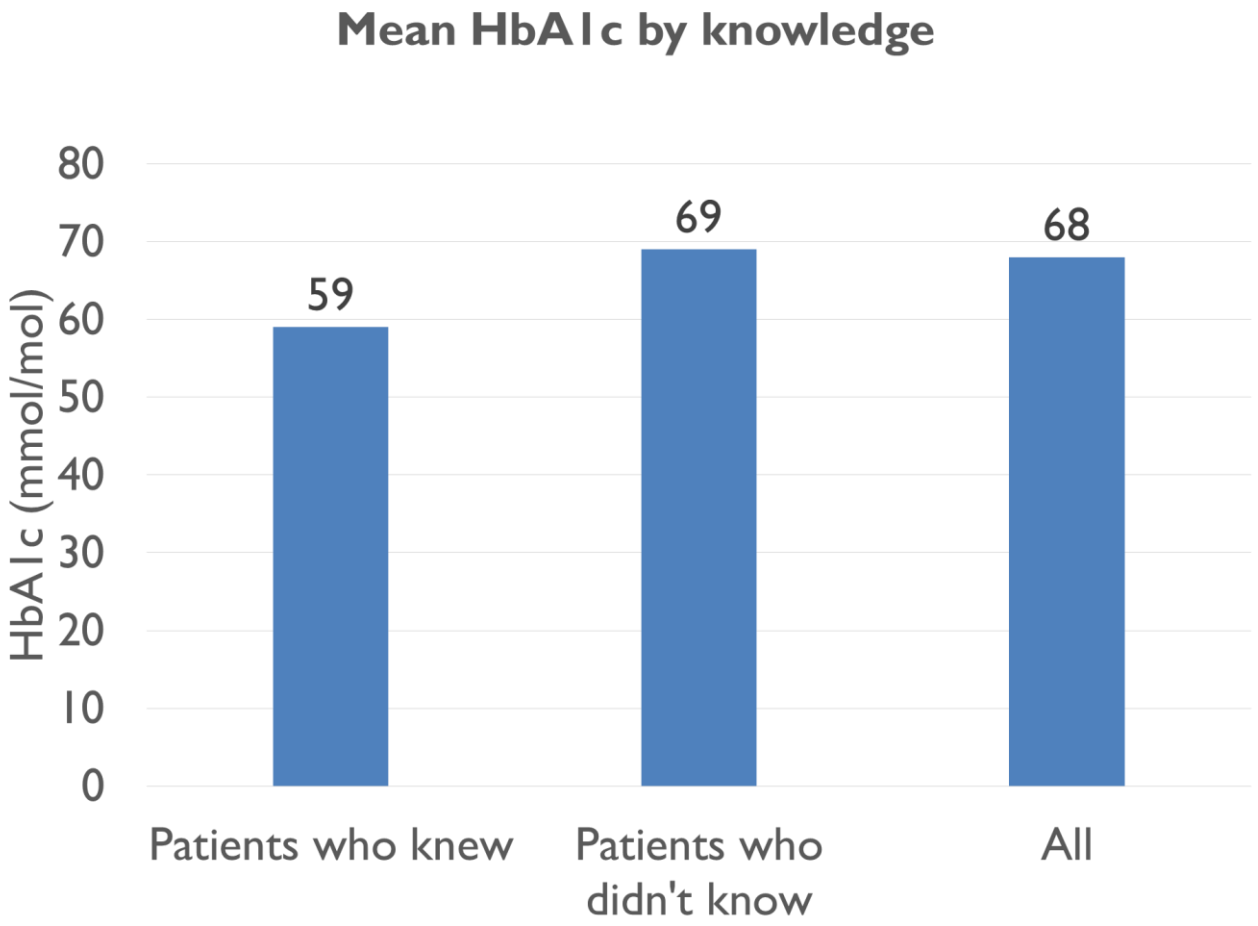
Nurse led education on:

- HbA1c and blood sugar ranges
- Blood pressure result and target range
- Cholesterol levels
- Diet and low glycaemic index
- Exercise and walking

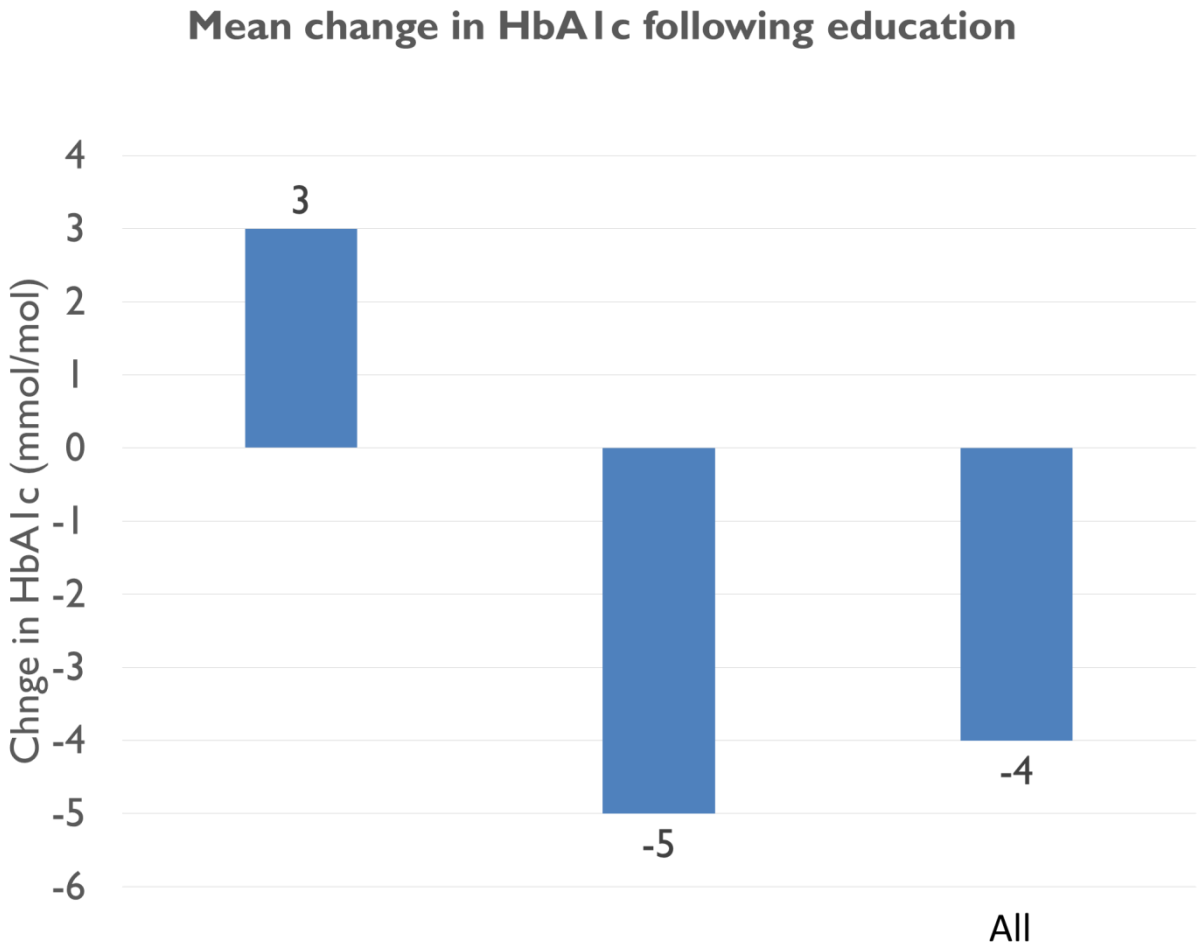
Results



9% of patients knew their last HbA1c

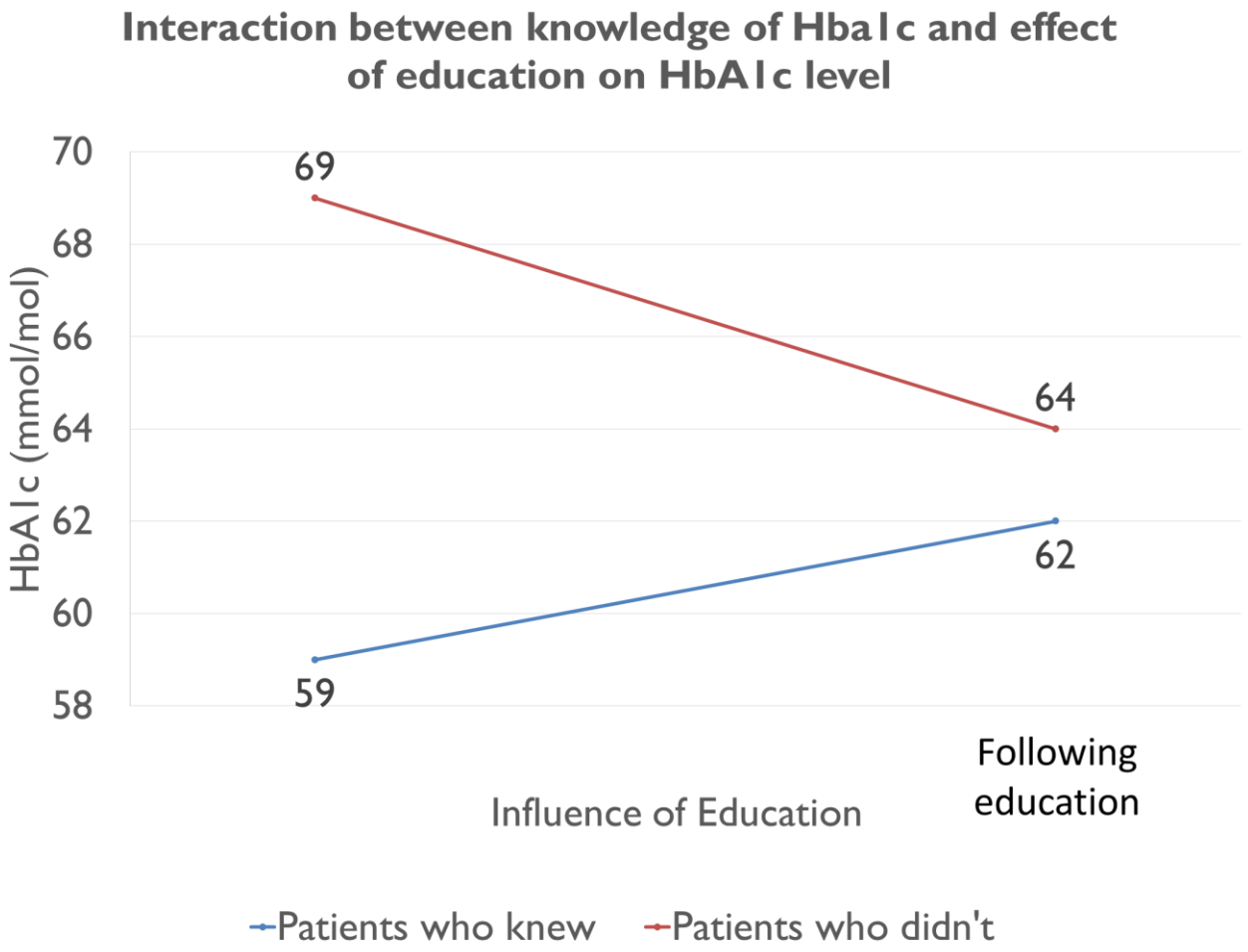


For patients who knew, mean HbA1c was 59mmol/mol, compared with 69mmol/mol for those that didn't (p=0.027)



Following education, mean HbA1c reduced from 68mmol/mol, to 64mmol/mol (p=0.025).

The impact of education on HbA1c was significantly different between the two groups (p=0.014), with no significant change for those who knew (p=0.186) compared to a significant reduction for those who didn't (p=0.015).



Significant interaction between

Conclusions

- HbA1c knowledge is poor in patients with diabetic eye disease, suggesting little active patient involvement in management
- Patients who know their HbA1c have better diabetic control
- Nurse-led patient education can help achieve better diabetic control in patients who don’t know their HbA1c but has no impact on those that do

Limitations

- There is no control group looking at change in HbA1c levels in patients not receiving our education.
  - Do patients HbA1c values tend to improve anyway over time, due to ongoing medical treatments?
  - We have not looked at the long term effect. Does the effect persist or lessen with greater time passed?

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