

Increasing initial follow-up improves glycaemic control in children with type 1 diabetes

Rebecca Mander, Vellore Abitha Kujambal, Mihirani Balapatabendi, Susan Matthai, Sarah Cheney

Good quality education following the diagnosis of type 1 diabetes is important in helping individuals understand their diabetes and how best to control their glucose levels. This can result in fewer microvascular and macrovascular complications. The paediatric diabetes multidisciplinary team in Gloucestershire wanted to improve education following diagnosis of type 1 diabetes, with an aim to improve glycaemic control. The intervention was for all children and young people (CYP) with type 1 diabetes to have at least four face-to-face contacts in the first 60 days following diagnosis. This retrospective study analysed the HbA_{1c} of 64 CYP to see whether improvements in glycaemic control were more evident in those with a greater number of initial face-to-face contacts.

Type 1 diabetes is a serious chronic condition that can cause microvascular and macrovascular complications. People with diabetes who are able to maintain glycaemic control are able to reduce the incidence of complications, comorbidities and death (Herman et al, 2018). Education following diagnosis is important to help individuals understand how to manage their diabetes, which promotes good glycaemic control (Hopkins et al, 2012). Our study was to see whether increasing the frequency of initial follow-up after the diagnosis of type 1 diabetes improves the long-term glycaemic control, from 3 months until 4 years after diagnosis.

Background

Current NICE (2016) guidance recommends that children and young people (CYP) with type 1 diabetes, and their family or carers, should have education from diagnosis. Education topics should include insulin therapy; blood glucose monitoring; effects of diet, exercise and intercurrent illness; and detecting and managing hypoglycaemia

and hyperglycaemia. There is no current NICE standard for frequency of initial follow-up, although ongoing follow-up is expected to occur four times per year (NICE, 2016).

NICE (2016) recommends an HbA_{1c} target of ≤ 48 mmol/mol (6.5%) to minimise the risk of long-term complications. This was adjusted in 2015 from the previous NICE guidance (2004), which recommended aiming to achieve an HbA_{1c} ≤ 58 mmol/mol (7.5%; Dalton et al, 2015). The National Paediatric Diabetes Audit (NPDA, 2018–19) showed approximately only one in ten CYP with type 1 diabetes manage to achieve a target of ≤ 48 mmol/mol. The present study also looks at CYP achieving a HbA_{1c} of ≤ 58 mmol/mol, recognising that, while not ideal, there is still evidence that this helps to reduce long-term complications when compared with a higher HbA_{1c} (Nathan et al, 2014).

In Gloucestershire, standard practice prior to November 2013 included hospital admission for education at diagnosis, carbohydrate counting from diagnosis and use of an expert meter.

Citation: Mander R, Kujambal VA, Balapatabendi M, Matthai S, Cheney S (2021) Increasing initial follow-up improves glycaemic control in children with type 1 diabetes. *Diabetes Care for Children & Young People* 10: [early view publication]

Article points

- 1 Type 1 diabetes is a serious chronic condition that can cause microvascular and macrovascular complications.
- 2 Current NICE guidance suggests aiming for a HbA_{1c} target level of 48 mmol/mol or lower to minimise the risk of long-term complications.
- 3 There is no current NICE standard for frequency of initial follow-up after diagnosis.
- 4 Increasing the frequency of initial face-to-face follow-up helps improve long-term glycaemic control.

Key words

- Follow-up
- HbA_{1c}
- Paediatric diabetes

Authors

Author details can be found at the end of the article.

Table 1. Baseline characteristics before and after intervention.

Characteristic	Historical group (N=28)	Intervention group (N=26)
Age at diagnosis (mean)	9	8
Gender (%)		
Male	54	58
Female	46	42
Patients who had HbA_{1c} recorded at diagnosis (%)	86	69
HbA_{1c} (mmol/mol) at diagnosis (median)	98	97
Length of hospital stay following diagnosis in days (median)	4	4
DKA at diagnosis (%)	29	23
Management		
Novorapid on a pump (%)	21	35
Novorapid/Detemir MDI (%)	57	38
Novorapid/Glargine MDI (%)	21	24
Novomix (%)	0	4

There was no standard for frequency of initial follow-up. The diabetes multidisciplinary team (MDT) in Gloucestershire wanted to improve initial follow-up as there was a desire to improve education and enable better self-management. Aggressive management of hyperglycaemia early in diagnosis is thought to be important for long-term control, also referred to as the “metabolic memory” effect (Testa et al, 2017). Furthermore, the team wanted to standardise care for all people with diabetes following diagnosis.

Aims

Our aim was to see if increasing the frequency of initial contact with CYP who have been newly diagnosed with type 1 diabetes increases the number of individuals who achieve the suggested target HbA_{1c} of ≤ 48 mmol/mol or ≤ 58 mmol/mol at 3 months, 6 months, 12 months, 2 years and 4 years.

Methods

This was a retrospective study analysing HbA_{1c} levels following an increase in the initial contact received following diagnosis. This research consists solely of retrospective analysis of routinely collected, anonymised data following a change in clinical practice. Therefore, ethics committee approval was not necessary.

The intervention starting in November 2013 was for CYP with newly diagnosed type 1 diabetes to have four or more contacts in the first 60 days. This 60-day period started after hospital discharge, following their initial diagnosis. The type of contact included was face-to-face time with a consultant, nurse or dietitian in clinic, at home or in a ward setting.

Thirty-two CYP were selected chronologically prior to the intervention, from 9th May 2012 to 2nd November 2013, and labelled as the “historical group”. Thirty-two CYP were then selected after the intervention date, between 8th November 2013 and 13th January 2015, and labelled as the “intervention group”. CYP were excluded if they were transferred into or out of the Trust in the first four years following diagnosis. They were also excluded if they were in the historical group and had received four or more contacts in the first 60 days, or if they were in the intervention group and had received fewer than four contacts in the first 60 days. There were no other clinical or service changes in this time period. All CYP were younger than 16 years of age at diagnosis.

The types of contact excluded were psychologist appointments, hospital admission for illness (not education), nurse visits to the school or nursery, telephone calls and the initial inpatient stay. A diabetes database was used to collect information. Data were compiled in a Microsoft Excel spreadsheet and were anonymised.

HbA_{1c} levels were taken at routine clinic follow-up at 3 months, 6 months, 12 months, 2 years, 3 years and 4 years following diagnosis. The percentage of CYP who achieved HbA_{1c} levels of ≤ 48 mmol/mol, and also ≤ 58 mmol/mol, at these time points were plotted on a bar chart. *P*-values were calculated using Fisher’s exact test.

Results

A total of 64 CYP were analysed between 9th May 2012 and 13th January 2015. Ten CYP were

excluded; two CYP were transferred into or out of the Trust, four were in the historical group and had received four or more contacts in the first 60 days, and four were in the intervention group and had received fewer than four contacts in the first 60 days. This left 28 CYP in the historical group and 26 CYP in the intervention group. Both groups had similar baseline demographics, which are shown in *Table 1* (previous page).

In the historical group, CYP had a mean of two contacts with a consultant, nurse or dietitian in the first 60 days. In the intervention group, they had a mean of five contacts. In the historical group, all CYP were seen at least once by a consultant. Ten (36%) of the CYP saw a consultant twice. In the intervention group, all CYP saw a consultant at least three times, with 11 (42%) seeing a consultant four times. In the intervention group, 79% of contacts were with consultants compared with 59% of contacts in the historical group (*Figure 1* and *Figure 2*).

The number of CYP achieving an HbA_{1c} of ≤48 mmol/mol was higher at all time points in the intervention group compared with the historical group. At 3 months following diagnosis, 54% of CYP in the intervention group achieved an HbA_{1c} ≤48 mmol/mol compared with 14% in the historical group ($P=0.003$). At 6 months, 42% of CYP in the intervention group had achieved an HbA_{1c} ≤48 mmol/mol compared with 14% in the historical group ($P=0.033$). In the intervention group, 19% achieved an HbA_{1c} ≤48 mmol/mol at 12 months ($P=0.021$), 12% at 2 years ($P=0.105$), 12% at 3 years ($P=0.105$) and 4% at 4 years ($P=0.481$) following diagnosis. At 12 months, 2 years and 4 years, no CYP in the historical group achieved an HbA_{1c} ≤48 mmol/mol (*Figure 3*, overleaf).

The number of CYP achieving an HbA_{1c} of ≤58 mmol/mol was higher at all time points in the intervention group compared with the historical group. At 3 months following diagnosis, 77% of individuals in the intervention group achieved an HbA_{1c} ≤58 mmol/mol compared with 39% in the historical group ($P=0.007$). At 6 months, 69% of CYP in the intervention group had achieved an HbA_{1c} ≤58 mmol/mol compared with 32% in the historical group ($P=0.013$). A higher percentage

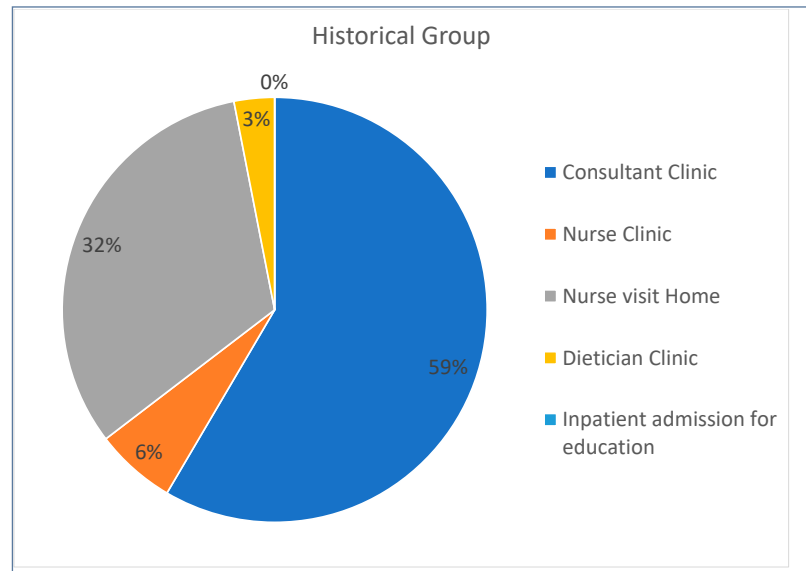


Figure 1. Percentage of contacts by different healthcare professionals in the historical group.

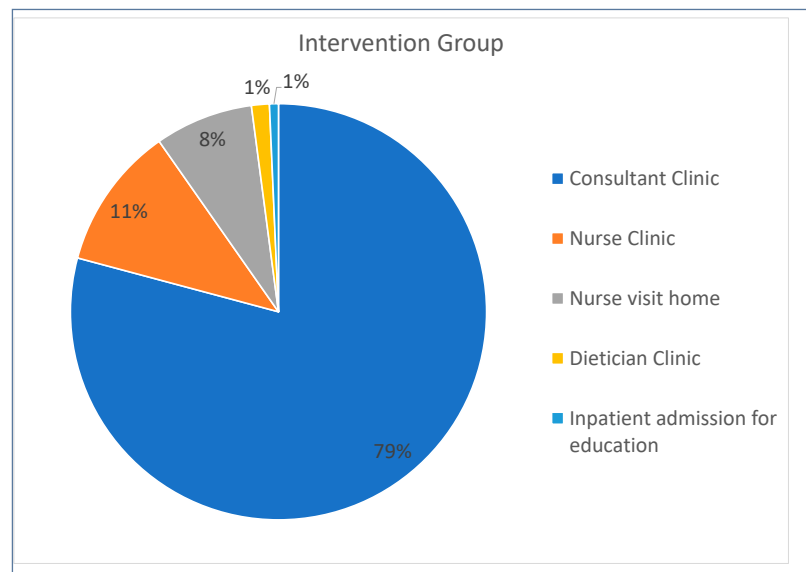


Figure 2. Percentage of contacts by different healthcare professionals in the intervention group.

in the intervention group achieved an HbA_{1c} ≤58 mmol/mol at 12 months ($P=0.053$), 2 years ($P=0.409$), 3 years ($P<0.001$) and 4 years ($P=0.053$) following diagnosis (*Figure 4*, overleaf).

Discussion

These results show a statistically significant increase in CYP achieving HbA_{1c} levels of ≤48 mmol/mol in the intervention group at 3, 6 and 12 months, compared with the historical group. There was also a statistically significant

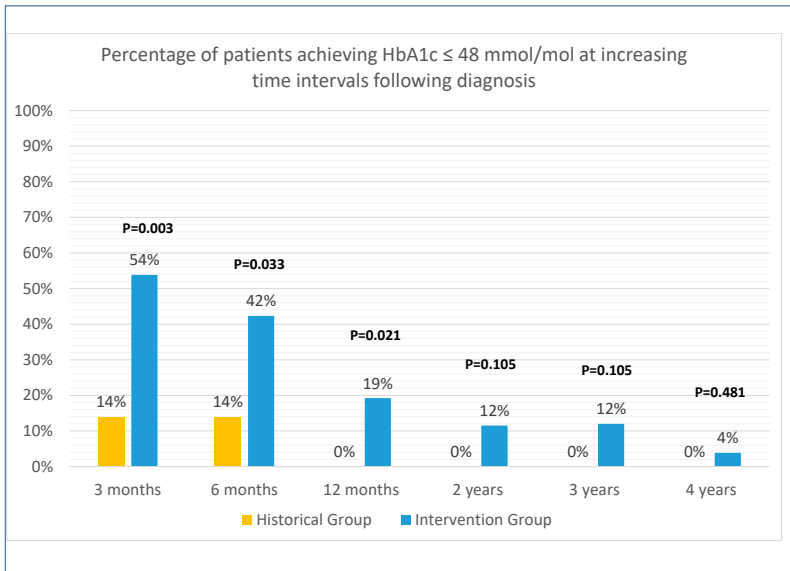


Figure 3. Percentage of participants achieving HbA_{1c} ≤ 48 mmol/mol.

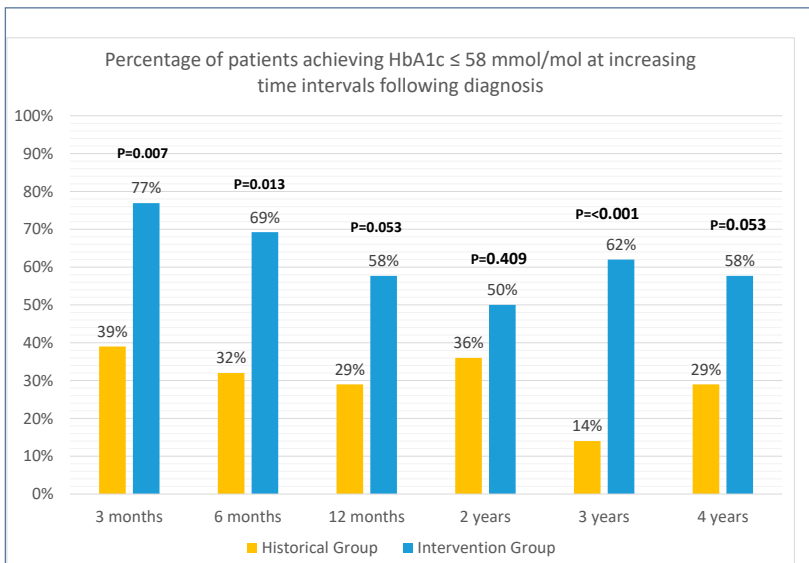


Figure 4. Percentage of participants achieving HbA_{1c} ≤ 58 mmol/mol.

increase in CYP achieving HbA_{1c} levels of ≤ 58 mmol/mol in the intervention group at 3 and 6 months. Following the intervention, the number of contacts received by CYP in the first 60 days increased on average from two to five appointments. The majority of appointments were made by consultants in both groups and the proportion of consultant appointments increased in the intervention group. It is not known whether increasing the contact with nurses or dietitians would have the same effect, and further investigation is needed.

When feedback was sought from the diabetes MDT, it was observed that knowledge levels were improved and this improvement was achieved at a faster rate than had previously been seen. It was also observed that CYP were more confident in self-managing their condition sooner.

Both the historical and intervention groups had similar baseline characteristics in terms of age, initial inpatient stay, gender, initial HbA_{1c} and occurrence of diabetic ketoacidosis (DKA) at diagnosis. This helps minimise bias affecting the results. Unfortunately, some CYP did not have a HbA_{1c} recorded at diagnosis. This may have been due to lack of understanding of the importance of an initial HbA_{1c} within the admitting teams. The unavailability of these data may skew results as, if the missing HbA_{1c} data were high, we may not know if some CYP were more unwell at diagnosis.

Unfortunately, we were not able to include data on socioeconomic status as it is not routine to ask families their income or occupation. However, there was no reason to believe that there was a difference between the historical and intervention group.

There was slight variance in insulin usage between the two groups, with three more children (14% more) using insulin pump therapy in the intervention group, compared with the historical group. While the NPDA data (NPDA, 2020) suggest a trend that CYP who use insulin pump therapy achieve lower HbA_{1c} targets versus those who use multiple daily injections (MDI), the data do not account for confounding variables. The SCIP trial (Blair et al, 2019) also shows no clinical benefit in outcomes in the first year after diagnosis when comparing insulin pump therapy with an MDI regimen. Actual numbers for variance within this study are low and we do not feel this impacts the overall strength of the intervention results.

Looking at a subanalysis of those presenting in DKA or not in DKA, an improvement in percentage of CYP achieving a target HbA_{1c} of both ≤ 48 mmol/mol and ≤ 58 mmol/mol can be seen in both groups at almost all time points (Figure 5 and Figure 6, overleaf). This further highlights the importance of the good education and training that has been achieved through increased initial follow up. It is, therefore, reasonable to conclude that CYP achieving an improvement in HbA_{1c} did so as a result of the intervention.

Initially, the team had planned for the intervention group to have even more contacts in the first 60 days. Ideally, CYP would have had weekly consultant appointments for the first six weeks. Due to lack of diabetes MDT resources and clinic slot availability, this was scaled back to the intervention described. Further work has been done to try and achieve weekly consultant follow-up for the first six weeks. A “hidden slot” in the consultant clinic timetable has been added to allow any newly diagnosed CYP to be seen. This might explain why the majority of the increase in contact appears to be with consultants.

Future work could look at whether the improvement in HbA_{1c} seen in this study continues with further increases in early face-to-face contact, as we had previously planned. This would be difficult to compare with the current cohort of individuals as there have been a number of further quality improvement measures and clinical practice changes. As part of the Royal College of Paediatrics and Child Health Quality Improvement Collaborative for CYP with Diabetes, several interventions have been implemented to improve the clinic experience and enable better self-management. Examples of this include a clinic goals sheet, downloading data at home or in clinic ahead of the appointment, nurse- and dietitian-led download clinics, and an alternative clinic layout.

After diagnosis with type 1 diabetes, residual beta-cell production of insulin makes optimal diabetes control more achievable. As the “honeymoon period” ends and the ongoing psychosocial demands of a chronic health condition manifest, maintaining good control becomes harder to attain (Ye et al, 2017; Tang et al, 2019). Therefore, as expected, in both the historical and intervention groups, the number of CYP who achieved an HbA_{1c} of ≤48 mmol/mol decreased over time. Following our intervention, however, more CYP were achieving this target and more were sustaining it for longer.

In this study, we have shown that increased early contact improves glycaemic control. There are currently no guidelines for frequency of initial follow-up in CYP with newly diagnosed type 1 diabetes. Other diabetes centres that do not have as many early contacts may find this intervention

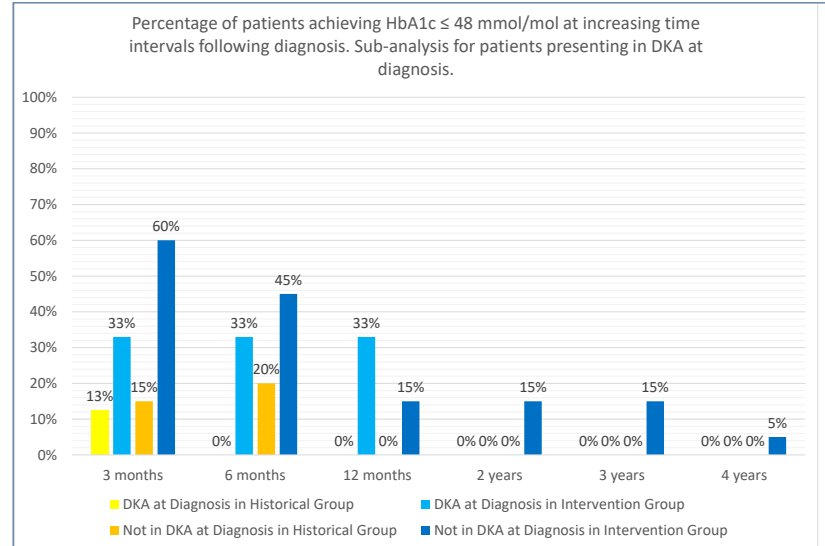


Figure 5. Percentage of participants achieving HbA_{1c} ≤ 48 mmol/mol in those presenting with DKA at diagnosis.

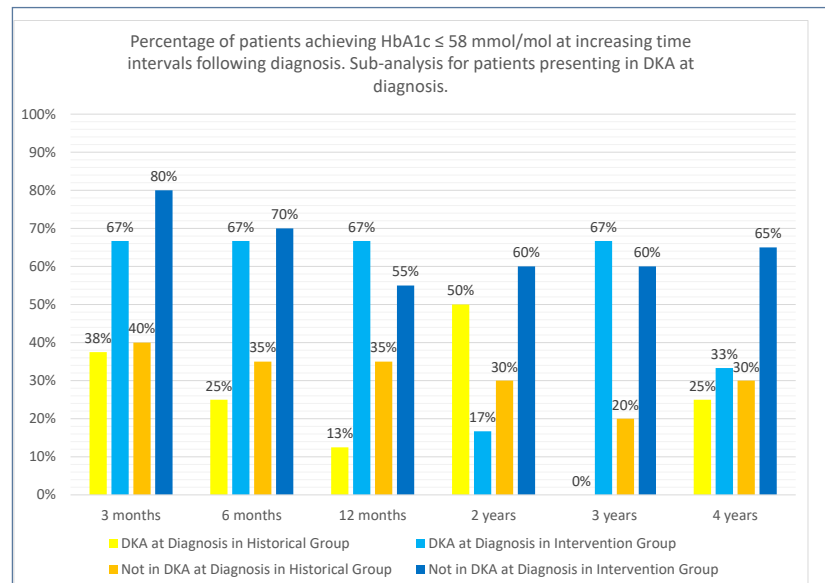


Figure 6. Percentage of participants achieving HbA_{1c} ≤ 58 mmol/mol in those presenting with DKA at diagnosis.

useful to help improve early glycaemic control. This approach may also be applicable to the management of other chronic conditions and may be investigated further. Not all chronic conditions, however, have a good measure of long-term control such as HbA_{1c}, and so this may make it harder to interpret.

Conclusion

Increasing the frequency of initial follow-up by consultants after diagnosis of type 1 diabetes in CYP

Authors

Rebecca Mander is an ST1 in Paediatrics in South Yorkshire; Vellore Abitha Kujambal is a Paediatric Consultant, Special Interest in Diabetes and Endocrinology, Gloucestershire Royal Hospital; Mihirani Balapatabendi is a Paediatric Consultant, Special Interest in Diabetes, Gloucestershire Royal Hospital; Susan Matthai is a Paediatric Consultant, Special Interest in Diabetes and Endocrinology, Gloucestershire Royal Hospital; Sarah Cheney is a Paediatric Consultant, Special Interest in Diabetes, Gloucestershire Royal Hospital.

helps improve the long-term glycaemic control up to 4 years following diagnosis. Further investigation may show that increased contact beyond what we have looked at may be of additional benefit. ■

Acknowledgements

The authors thank Chris Foy for his help as statistician in the preparation and revision of this manuscript, and the Gloucester Diabetes MDT.

Blair J, McKay A, Ridyard C et al (2019) Continuous subcutaneous insulin infusion versus multiple daily injection regimens in children and young people at diagnosis of type 1 diabetes: pragmatic randomised controlled trial and economic evaluation. *BMJ* **365**: 11226

Dalton J, Edge J, Wales J et al (2015) NICE guideline for the management of diabetes in children and young people – comments from the Guideline Development Group. *Diabetes Care for Children & Young People* **4**: 94–101

Herman WH, Braffett BH, Kuo S et al (2018) What are the clinical, quality-of-life, and cost consequences of 30 years of excellent vs. poor glycemic control in type 1 diabetes? *J Diabetes Complications* **32**: 911–5

Hopkins D, Lawrence I, Mansell P et al (2012) Improved biomedical and psychological outcomes 1 year after structured education in flexible insulin therapy for people with type 1 diabetes: the U.K. DAFNE experience. *Diabetes Care* **35**:1638–42

Nathan DM (2014) The diabetes control and complications trial/epidemiology of diabetes interventions and complications study at 30 years: Overview. *Diabetes Care* **37**: 9–16

National Paediatric Diabetes Audit (2020). Annual Report 2018–2019. Available at: <https://bit.ly/3ya575x> (accessed 27.07.21)

NICE (2004) *Type 1 diabetes: Diagnosis and management of type 1 diabetes in children, young people and adults* [CG15]. NICE, London. Available at: <http://www.nice.org.uk/guidance/cg15> (accessed 27.07.21)

NICE (2016) *Diabetes (type 1 and type 2) in children and young people* [NG18]. NICE, London. Available at: www.nice.org.uk/guidance/ng18 (accessed 27.07.21)

Tang R, Zhong T, Wu C et al (2019) The remission phase in type 1 diabetes: Role of hyperglycemia rectification in immune modulation. *Front Endocrinol* **10**: 824

Testa R, Bonfigli AR, Praticchizzo F et al (2017) The “Metabolic Memory” theory and the early treatment of hyperglycemia in prevention of diabetic complications. *Nutrients* **9**: 437

Ye CY, Jeppson TC, Kleinmaus EM et al (2017) Outcomes that matter to teens with type 1 diabetes. *Diabetes Educ* **43**: 251–9