Introduction

Type 2 diabetes in young people is an aggressive disease with greater risk of complications leading to increased morbidity and mortality during the most productive years of life (1). Prevalence in the UK and globally is rising yet experience in managing this condition is limited (2).

Data for morbidity and mortality is largely derived from adult studies. Glycaemic control improves microvascular risk. However, the increased risk of a major cardiovascular event (MACE) in adults with type 2 diabetes is not reduced by improved glycaemic control. Additional measures including reduction in excess adiposity, smoking prevention, increased physical activity and reduction of hypertension and dyslipidaemia are essential to reduce MACE risk.

The cornerstones paediatric and adult type 2 management have diverged with recent data in adults supporting caloric-restricted meal replacement regimens (3), new drug classes targeting GLP1 and SGLT2 which improve glycaemic control, weight and MACE risk, and bariatric surgery.

The evidence base in CYP is relatively limited and largely derives from observational data and the TODAY randomised control study (4). TODAY showed improved glyaemic control with the addition of rosiglitazone to the standard baseline treatment of metformin and/or insulin. However, rosiglitazone has been removed from the market due to increased cardiovascular risk. Importantly, intensive lifestyle support improved weight but did not improve glycaemic control.

Little safety data exists to support the use of newer treatments in CYP except for recent RCT data supporting the use of the daily GLP1-agonist liraglutide in CYP aged 10 and over (5). Good observation evidence exists for bariatric surgery in CYP yet few have access to it in the UK.

These guidelines aim to improve the care of CYP in the UK with type 2 diabetes. CYP with type 2 diabetes are likely to have complex needs including obesity and other co-morbidities, deprivation, and high physical and mental health burden within the family. The majority of experience in type 2

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diabetes management is in primary care and specialist adult clinics, neither of which has expertise supporting CYP with complex needs. Most paediatric diabetes multi-disciplinary teams have good experience in managing type 1 diabetes and complex conditions yet relatively little experience managing type 2 diabetes and associated co-morbidities. Strong relationships and joint working between primary care, adult diabetes specialists and paediatric diabetes teams are likely to be needed to support this challenging population effectively.

Key recommendations:

- Diabetes subtype is frequently misdiagnosed and careful consideration of subtype should be given to all patients at diagnosis, particularly those with excess adiposity, strong family history of type 2 diabetes, high-risk ethnicity or with evidence of insulin resistance. Diabetes antibodies can help identify those with type 1 diabetes and those likely to have rapid deterioration in glycaemic control.
- HbA1c should be measured at diagnosis and every three months with a target below 6.5% for most individuals. Intensification of treatment should be commenced after 3 months if target HbA1c has not been attained.
- Blood glucose measurement should be taught to all and equipment provided. Individualised monitoring frequency should be based on treatment type, dose intensification and concurrent illness whilst noting that adherence to testing is low and causes additional burden.
- FGM/CGM should be considered on an individual basis, including needle phobia, learning difficulties or intermittent use during treatment intensification.
- All families should receive individualised structured education at diagnosis. No single education programme is recommended and could include iCAN or TODAY materials.
- All children and young people should be managed in a multi-disciplinary secondary-care diabetes service with close liaison with primary care, adult diabetologists and multi-agency organisations.
- Glycaemic control improves microvascular but not macrovascular risk. Careful consideration of smoking status, exercise and fitness, blood pressure and lipids reduces CVD and CKD risk.

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- Weight reduction is an important treatment modality, with target loss of 5% at 3-6 months and 10% at 1 year. No single lifestyle intervention is recommended and interventions should be individualised.
- All CYP should be encouraged to adhere to UK guidelines of 60 minutes moderate-severe exercise each day
- Mental health co-morbidities are high, especially depression and disordered eating. Questionnaires such as PedsQL for type 2 diabetes and PHQ-2 should be used for screening and appropriate treatments offered.
- All CYP should be treated with metformin at diagnosis unless contra-indicated. Basal insulin should be added immediately if HbA1c >8.5%, if symptomatic and/or ketosis is present and subsequently weaned when possible.
- Liraglutide is the second line treatment for CYP aged 10 years and over where insulin is not indicated. No other agents are routinely recommended however SGLT2 inhibitors could be considered in those who have completed puberty in association with an adult diabetologist.
- Bariatric surgery is the only evidence-based intervention with good weight loss outcomes and high frequency of type 2 diabetes remission. Bariatric surgery should be considered at 12-18 months where there is excess adiposity and inadequate response to lifestyle support and pharmacological treatments.
- Treatment of hypertension reduces CVD risk. Blood pressure should be regularly measured using appropriately sized cuffs and age- and height-appropriate centile charts. Treatment with ACE-inhibitors should be initiated where hypertension is not improved by lifestyle measures over 6 months.
- Treatment of dyslipidaemia reduces CVD risk. Initial treatment is by dietary modification and improvement in glycaemic control, followed by the use of statins for raised non-HDL (over 10 years of age).
- All girls should receive pregnancy-prevention support to minimise increased risks of fetal malformation and premature birth associated with dysglycaemia, and teratogenic effects of ACE-inhibitors and statins.

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- Screen for NAFLD at diagnosis and then yearly using ALT. Undertake further investigations if ALT is greater than twice the upper limit of normal. NALFD should be treated with improved glycaemia, weight reduction and treatment of obstructive sleep apnoea.
- Screen for diabetes retinopathy yearly from 12 years of age. Good glycaemic control minimises retinopathy risk and reduces disease progression however sudden improvement in glycaemia may lead to rapid progression.
- Albuminurea is strongly correlated to progression of chronic kidney disease (CKD) and CVD risk. Screening with early morning urine ACR (albumin to creatinine ratio) should be undertaken at diagnosis and yearly. Persistently raised ACR over 3-6 months should be treated with reduction of risk factors (dysglycaemia, smoking, obesity, hypertension) followed by initiation of ACE-inhibitor where there is lack of progress.
- Clinicians should screen for sleep apnoea, noting non-specific signs and symptoms and lack of good screening questionnaire. Formal diagnosis should be made by overnight polysomnography by a specialist sleep service.

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ssociation of Children's Diabetes Clinicians

First presentation

NEW PRESENTATION OF DIABETES:

Undertake holistic assessment, including:
-Assess for DKA/HSS (including blood gas and blood ketones) and treat if present.
-Symptoms (thirst, polyurea, weight loss)
-Blood glucose, **validated** HbA1c.
-Weight (BMI and fat distribution) and puberty status
-Co-morbidities associated with type 1 (coeliac, autoimmune thyroid disease)
-Co-morbidities associated with type 2 diabetes (signs of insulin resistance, NAFLD, hypertension)
-Co-morbidity screen (including mental health, sleep apnoea, NAFLD)
-Complication screen (urine proteinurea, peripheral neuropathy, retinopathy)
-Family history (type 1 and type 2)

If diabetes type unclear, send diabetes antibodies (GAD, IA2 and ZnT8), c-peptide (urine or plasma) and discuss with adult/paediatric type 2 specialists.

Type 2 diabetes initial management
(after resolution of DKA/HSS)

All:
Education including diabetes management and healthy lifestyle
Initiate treatment plan for co-morbidities & complications
Initiate metformin 500mg BD and titrate over next 4 weeks

If HBA1c >8.5% or symptomatic:
add basal insulin

Type 1 diabetes or MODY

Treat as per guidelines

4 week review

All:
Holistic review of progress since diagnosis
Continue education
Reconsider diagnosis type, including antibody/c-peptide results (if performed) and response to treatment. Consider MODY screen if antibody negative and family history of atypical diabetes
Review all results including co-morbidities + complications

Optimise metformin usage – discuss strategies to maximise concordance and minimise side-effects.

If glucose in target:
-Wean insulin (if on insulin)
-Do not stop metformin unless not tolerated

If glucose raised:
-Start/increase insulin

3 moth review

All:
Holistic review, as at 4 weeks
Continue education
Reconsider diabetes type, as at 4 weeks

If glucose range in target
-wean insulin (if on insulin)
-do not stop metformin unless not tolerated

HbA1c >6.5%:
-start liraglutide if over 10 years