Managing diabetes as an acute and long term condition

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Aims of the session

1. Describe the different metabolic disorders of glucose metabolism, the pathogenesis of these & their clinical characteristics
2. Discuss the differences between type 1 diabetes and type 2 diabetes in terms of clinical presentation, patient characteristics and diagnostic criteria.
3. Discuss treatment pathways for type 1 and type 2 diabetes.
4. Discuss acute complications and emergencies.
5. Discuss chronic complications of diabetes.
7. Explore principles of patient centred care and self-management.
Key Knowledge Sources used in this session

- NICE:
  - Type 1 diabetes in adults: diagnosis and management (NG17) (Last update 2016)
    https://www.nice.org.uk/guidance/ng17
  - Type 2 diabetes in adults: management (NG28) (Last Update May 2017)
    https://www.nice.org.uk/guidance/ng28
Knowledge Sources continued...

- **National Diabetes Audit**
  
  [http://content.digital.nhs.uk/nda](http://content.digital.nhs.uk/nda)

- **Research @Hudd**


What is this?
Control of blood glucose

Glucagon stimulates the conversion of stored glycogen in the liver into glucose.

Insulin stimulates the liver to remove glucose from the blood and stores it as glycogen.

Insulin released by beta cells of pancreas.

Glucagon released by alpha cells of pancreas.

Tissue cells take up glucose from blood.

Lowers blood sugar.

High blood glucose.

Low blood glucose.
The Effect of Insulin

Cell

Insulin

Glucose

Insulin receptors

Glut-4

Glucose transporters

Fat/muscle cells
Normal Blood Insulin
What is diabetes?

- Diabetes is a chronic disease that occurs when the pancreas does not produce enough insulin, or when the body cannot effectively use the insulin it produces. Hyperglycaemia, or raised blood sugar, is a common effect of uncontrolled diabetes and over time leads to serious damage to many of the body's systems, especially the nerves and blood vessels.

Incidence and Prevalence

Globally: The estimated diabetes prevalence worldwide for 2011 was 366 million and it is expected to affect 552 million people by 2030.

United Kingdom

- Prevalence % = England 5.5%; NI 3.8%; Scotland 4.3%; Wales 5.0%
- It is estimated that there are around 850,000 people in the UK who have diabetes but have not been diagnosed.
- 10% Type 1 – adults. (15% if include children)
- 90% Type 2 – adults. (85% including children)

Source - Diabetes in the UK (2018)
Local prevalence

In 2009/10 there were 8886 people aged 17 years and older diagnosed with diabetes in Calderdale PCT. There is also an estimated 3379 adults with undiagnosed diabetes. The chart below compares the prevalence of diabetes in Calderdale PCT with the cluster group and England as a whole.

Wakefield

In 2009/10 there were 18148 people aged 17 years and older diagnosed with diabetes in Wakefield District PCT. There is also an estimated 3646 adults with undiagnosed diabetes. The chart below compares the prevalence of diabetes in Wakefield District PCT with the cluster group and England as a whole.

Kirklees

In 2009/10 there were 18059 people aged 17 years and older diagnosed with diabetes in Kirklees PCT. There is also an estimated 7292 adults with undiagnosed diabetes. The chart below compares the prevalence of diabetes in Kirklees PCT with the cluster group and England as a whole.

North Yorkshire

In 2009/10 there were 30350 people aged 17 years and older diagnosed with diabetes in North Yorkshire & York PCT. There is also an estimated 16744 adults with undiagnosed diabetes. The chart below compares the prevalence of diabetes in North Yorkshire & York PCT with the cluster group and England as a whole.
Pathology & Classification of Diabetes
Ben is 15 years old, complaining of increased urination, weakness and weight loss over 3 months.

Looks dehydrated and his random plasma glucose is 13.8mmol/L.

What is his diagnosis?

What leads you to suspect this?

Are there any tests or investigations you might carry out?
Case Study Two

Mrs Sarah Palin is a 56 year old lady with a BMI of 31.
She presents with a UTI.
Her fasting glucose is 6.9mmol/L.
She has a sister with diabetes.

What is her likely diagnosis?
What would you do with her?
Why?
Type 1 diabetes

- Auto-immune elimination of beta-cells (beta-cell antibodies)
- Genetic

- Clinical picture:
  - Absolute requirement for insulin
  - (without it: hyperglycaemia wasting, ketoacidosis)
  - Otherwise healthy

- Incidence
  - Two peaks:
    a) infancy (1-4y)
    b) early adolescence (8-12y)
  - May present at any time in life (if ~ type 2: LADA)
Development of type 1 diabetes

Causes - multifactorial

- Genetic predisposition
- Diabetogenic trigger (environment)
- Immune response (islet cell antibodies)
- Destruction of beta cells
Type 2 Diabetes

- Decline in insulin production
- Insulin resistance

Environment/Lifestyle factors:
- Weight – central (50-70%)
- Calorie dense diet
- Inactivity
- Thrifty gene
- Drug induced

- Key study UKPDS

Age: peak 60 yrs
Prevalence: 85% PWD have type 2
Genetic susceptibility:
- Family history = 40% patients
- Twin = 60-90% concordance

Lifetime risk first degree relative with diabetes = five-fold

In-utero/infant malnutrition

Black (9%) & Asian (11%) compared to 1-3% UK white population
Model of underlying factors in type 2 diabetes: insulin resistance and β-cell dysfunction

Adapted from DeFronzo RA. *Med Clin N Am* 2004; 88:787–835.
Underlying causes of Type 2 Diabetes

- Obesity
- Insulin resistance
- Hyperinsulinaemia
- Impaired glucose tolerance
- Early diabetes
- Decreased insulin secretion
- β-cell defect
- β-cell failure
- Late diabetes

Underlying factors in type 2 diabetes are insulin resistance and β-cell dysfunction.
Type 2 Diabetes: A Complex Disease

- Impaired glucose tolerance
- Hyperinsulinaemia
- Clotting disorders
- Hypertension
- Dyslipidaemia
- Central obesity
- Macrovascular complications

Type 2 diabetes

Other types of diabetes

- **Genetic defects**: effect on beta cell function or insulin action – MODY, type A insulin resistance, leprechaunism, LADA

- **Diseases of the pancreas**: pancreatitis, trauma & infection, cancer, pancreatectomy

- **Endocrinopathies**: e.g. Cushing Syndrome (adrenal tumour)/Acromegaly antagonist effect of hormones - GH, glucagon, cortisol, adrenaline. Above syndromes may cause diabetes but typically when hormone levels reduced return to normoglycaemia

- **Polycystic Ovarian Syndrome**: ovary secretes high levels of oestregens and testosterone contributing to insulin resistance & weight gain (central) which may contribute to risk of type 2 DM

- **Gestational Diabetes**: type 2 diabetes in pregnancy – carbohydrate intolerance leading to hyperglycaemia – OGTT @ 24-28 weeks (third trimester) - classification to type 2 diabetes 6 weeks after delivery with OGTT. Screen for those with higher risk

- **Drug induced**: 
# DRUGS CAUSING DIABETES

## Drugs That Affect Insulin Secretion

<table>
<thead>
<tr>
<th>Drugs that Affect Insulin Secretion</th>
<th>Cations</th>
<th>Hormones</th>
<th>Antihelminthics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anticonvulsant</td>
<td>Cations</td>
<td>Hormones</td>
<td>Antihelminthics</td>
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<tr>
<td>Phenytoin</td>
<td>Barium</td>
<td>Somatostatin</td>
<td>Pentamidine</td>
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<tr>
<td>Diuretics</td>
<td>Cadmium</td>
<td>Pesticides</td>
<td>Antineoplastics</td>
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<tr>
<td>Thiazides</td>
<td>Lithium</td>
<td>DDT</td>
<td>L-Asparaginase</td>
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<tr>
<td>Furosemide</td>
<td>Potassium</td>
<td>Fluoride</td>
<td>Mithramycin</td>
</tr>
<tr>
<td>Ethacrynic acid</td>
<td>Zinc</td>
<td>Pyriminil (Vacor)</td>
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</tr>
</tbody>
</table>

## Drugs that affect insulin action

- Hormones
- Growth hormone

## Drugs that affect both insulin secretion and insulin action

<table>
<thead>
<tr>
<th>Drugs that affect both insulin secretion and insulin action</th>
<th>Antihypertensive</th>
<th>Blocking agents</th>
<th>Psychopharmacologic agents</th>
</tr>
</thead>
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<tr>
<td>Hormones/Hormone Antagonists</td>
<td>Antihypertensive</td>
<td>Blocking agents</td>
<td>Psychopharmacologic agents</td>
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<tr>
<td>Glucagon</td>
<td>Clonidine</td>
<td>(\beta)-Adrenergic blockers</td>
<td>Benzodiazepines</td>
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<td>Glucocorticoids</td>
<td>Diazoxide</td>
<td>Calcium-channel blockers</td>
<td>Ethanol</td>
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<tr>
<td>Octreotide</td>
<td>Prazosin</td>
<td>Histaminergic blockers</td>
<td>Opiates</td>
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<tr>
<td>Adrenergic compounds</td>
<td></td>
<td></td>
<td>Phenothiazines</td>
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<tr>
<td>Epinephrine</td>
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<td></td>
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<tr>
<td>Norepinephrine</td>
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</tbody>
</table>
What are the likely presenting symptoms of diabetes?
Presenting symptoms of type 1 and type 2 diabetes

- Thirst
- Hunger
- Fatigue
- Polyuria (type 1)
- Weight loss (type 1)
- Blurred Vision
- Candidal infections
- Sores (ulcers) fail to heal or delayed
- May be no symptoms with type 2
- May present with complication related to diabetes e.g. retinopathy, CVD, foot problems
Methods and criteria for diagnosing diabetes

1. Diabetes symptoms (e.g. polyuria, polydipsia and unexplained weight loss for Type 1) plus:
   1. a random venous plasma glucose concentration ≥ 11.1 mmol/l or
   2. a fasting plasma glucose concentration ≥ 7.0 mmol/l (whole blood ≥ 6.1 mmol/l) or
   3. two hour plasma glucose concentration ≥ 11.1 mmol/l two hours after 75g anhydrous glucose in an oral glucose tolerance test (OGTT).

2. With no symptoms diagnosis should not be based on a single glucose determination but requires confirmatory plasma venous determination. At least one additional glucose test result on another day with a value in the diabetic range is essential, either fasting, from a random sample or from the two hour post glucose load. If the fasting random values are not diagnostic the two hour value should be used.

Consider further investigation in adults that involves measurement of C-peptide and/or diabetes-specific autoantibody titres (Type 1).
Diagnosis of diabetes

For type 1 diagnosis likely to be based on presence of ketones and presenting symptoms especially in child. For type 2 tests on separate days if no symptoms.

Diagnostic Guidelines
Symptoms eg thirst, polyuria, weight loss, fatigue, visual disturbances

Diagnostic tests
• HbA1c > 48 mmol/mol (6.5%)
• Plasma Glucose (Laboratory Test)
  • Random ≥ 11.1 mmol/l
  • Fasting ≥ 7.0 mmol/l

If asymptomatic, confirm diagnosis with repeat test on another day

TEST URINE FOR KETONES
Impaired Fasting Glucose & Impaired Glucose Tolerance

- IFG = elevated fasting glucose levels
  6.1-6.9 mmol/L
- IGT = Impaired Glucose tolerance
  7.8 mmol/L – 11.1 mmol/L

In an adult with both tests abnormal the risk of developing diabetes after 10 years is 50%
Type 1 vs. type 2 diabetes
Nolan JJ. Medicine 2006; 34(2): 52-56

Features of type 1 diabetes
- Onset in childhood/adolescence
- Lean body habitus
- Acute onset of osmotic symptoms
- Ketosis-prone
- High levels of islet autoantibodies
- High prevalence of genetic susceptibility
- Diagnosis on symptoms, history and presence of hyperglycaemia & ketones

Features of type 2 diabetes
- Usually presents in over-30s (but also seen increasingly in younger people)
- Associated with overweight/obesity
- Onset is gradual and diagnosis often missed (up to 50% of cases)
- Not associated with ketoacidosis, though ketosis can occur
- Immune markers in only 10%
- Family history is often positive with almost 100% concordance in identical twins
- Diagnosis typically HbA1c, FPG or OGTT with one or more symptoms
Treatment of Adults with type 1 diabetes

• At the time of diagnosis (or if necessary after the management of critically decompensated metabolism), the diabetes professional team should develop with and explain to the adult with type 1 diabetes a plan for their early care.

• Offer all adults with type 1 diabetes a structured education programme of proven benefit, for example the DAFNE (dose-adjustment for normal eating) programme. Offer this programme 6–12 months after diagnosis.

• **Dietary management**

• **Physical activity**

• **Blood glucose management**
  • 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
  • Advise routine self-monitoring of blood glucose levels for all adults with type 1 diabetes, and recommend testing at least 4 times a day, including before each meal and before bed
  • Consider real-time continuous glucose monitoring for adults with type 1 diabetes who are willing to commit to using it at least 70% of the time and to calibrate it as needed,
Treatment of Adults with type 1 diabetes

- Insulin therapy
- Insulin regimens

Offer multiple daily injection basal–bolus insulin regimens, rather than twice-daily mixed insulin regimens, as the insulin injection regimen of choice for all adults with type 1 diabetes. Provide the person with guidance on using multiple daily injection basal–bolus insulin regimens. [new 2015]

Do not offer adults newly diagnosed with type 1 diabetes non-basal–bolus insulin regimens (that is, twice-daily mixed, basal only or bolus only). [new 2015]

<table>
<thead>
<tr>
<th>Type of Insulin</th>
<th>Brand Name</th>
<th>Generic Name</th>
<th>Onset</th>
<th>Peak</th>
<th>Duration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rapid-acting</td>
<td>NovoLog</td>
<td>Insulin aspart</td>
<td>15 minutes</td>
<td>30 to 90 minutes</td>
<td>3 to 5 hours</td>
</tr>
<tr>
<td></td>
<td>Apria</td>
<td>Insulin glulisine</td>
<td>15 minutes</td>
<td>30 to 90 minutes</td>
<td>3 to 5 hours</td>
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<tr>
<td></td>
<td>Humalog</td>
<td>Insulin lispro</td>
<td>15 minutes</td>
<td>30 to 90 minutes</td>
<td>3 to 5 hours</td>
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<tr>
<td>Short-acting</td>
<td>Humulin R</td>
<td>Regular (R)</td>
<td>30 to 60 minutes</td>
<td>2 to 4 hours</td>
<td>5 to 8 hours</td>
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<td></td>
<td>Novolin R</td>
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<td></td>
<td></td>
<td></td>
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<tr>
<td>Intermediate-acting</td>
<td>Humulin N</td>
<td>NPH (N)</td>
<td>1 to 3 hours</td>
<td>8 hours</td>
<td>12 to 16 hours</td>
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<tr>
<td></td>
<td>Novolin N</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Long-acting</td>
<td>Levemir</td>
<td>Insulin detemir</td>
<td>1 hour</td>
<td>Peakless</td>
<td>20 to 25 hours</td>
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<tr>
<td></td>
<td>Lantus</td>
<td>Insulin glargine</td>
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<tr>
<td>Pre-mixed NPH</td>
<td>Humulin 70/30</td>
<td>70% NPH and 30% regular</td>
<td>30 to 60 minutes</td>
<td>Varies</td>
<td>10 to 15 hours</td>
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<tr>
<td>(intermediate-acting)</td>
<td>Novolin 70/30</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Humulin 50/50</td>
<td>50% NPH and 50% regular</td>
<td>30 to 60 minutes</td>
<td>Varies</td>
<td>10 to 16 hours</td>
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<tr>
<td>Pre-mixed insulin lispro protamine suspension (intermediate-acting) and insulin lispro (rapid-acting)</td>
<td>Humalog Mix 75/25</td>
<td>75% insulin lispro protamine and 25% insulin lispro</td>
<td>10 to 15 minutes</td>
<td>Varies</td>
<td>10 to 15 hours</td>
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<tr>
<td></td>
<td>Humalog Mix 50/50</td>
<td>50% insulin lispro protamine and 50% insulin lispro</td>
<td>10 to 15 minutes</td>
<td>Varies</td>
<td>10 to 15 hours</td>
</tr>
<tr>
<td>Pre-mixed Insulin aspart protamine suspension (intermediate-acting) and insulin aspart (rapid-acting)</td>
<td>NovoLog Mix 70/30</td>
<td>70% insulin aspart protamine and 30% insulin aspart</td>
<td>6 to 15 minutes</td>
<td>Varies</td>
<td>10 to 16 hours</td>
</tr>
</tbody>
</table>
Insulin Action

The Physiologic Insulin Profile

- Short-lived, rapidly generated prandial insulin peaks
- Normal, free, insulin levels from genuine data (mean)
- Low, steady, basal insulin profile

Adapted with permission from Polonsky KS. N Engl J Med. 1988;318:1231-1239.
Basal-Bolus principle
Treatment of adults with type 2 diabetes

Algorithm for blood glucose lowering therapy in adults with type 2 diabetes

- If HbA1c is 48 mmol/mol (6.5%) on lifestyle interventions, offer metformin.
- If standard-released metformin is tolerated, consider a trial of modified-release metformin.
- If triple therapy is not effective, consider combination therapy with pioglitazone or an SU.
- If HbA1c is 48 mmol/mol (6.5%) on lifestyle interventions, offer metformin.

First intensification:
- Consider dual therapy with: metformin and a DPP-4i
- Support the person to aim for an HbA1c level of 53 mmol/mol (7.0%)
- Support the person to aim for an HbA1c level of 53 mmol/mol (7.0%)

Second intensification:
- Consider: triple therapy with metformin, a DPP-4i, and a SU
- Consider: triple therapy with metformin, a DPP-4i, and a SU
- Support the person to aim for an HbA1c level of 53 mmol/mol (7.0%)
- Support the person to aim for an HbA1c level of 53 mmol/mol (7.0%)

Insulin-based treatment:
- Offer NPH insulin once or twice daily according to need.
- Consider starting both NPH and short-acting insulin either separately or in combination (biphasic) human insulin (particularly if HbA1c is 75 mmol/mol (9.0%) or higher.
- Consider, as an alternative to NPH insulin, using insulin detemir or glargine if the person needs basal insulin for the day and is not recommended for the type of hypoglycaemia that results in recurrent symptoms.

Other antidiabetic agents as an option:
- Consider pre-mixed (biphasic) preparations that include short-acting insulin analogues, rather than pre-mixed (biphasic) preparations that include intermediate acting human insulin preparations if the person prefers injecting insulin immediately before a meal.
- Consider insulin-based treatment with or without other antidiabetic drug classes as an option.

Abbreviations: DPP-4: Dipeptidyl peptidase-4 inhibitor, GLP-1: Glucagon-like peptide-1, SGLT-2: Sodium-glucose cotransporter 2 inhibitors, SU: Sulfonylurea. Recommendations cover DPP-4 inhibitors, GLP-1 mimetics and sulfonylureas refer to these groups of drugs at a class level.

* When prescribing pioglitazone, exercise particular caution if the person is at high risk of the adverse effects of the drug. Pioglitazone is associated with an increased risk of heart failure, bladder cancer and bone fracture. Known risk factors for these conditions, including increased age, should be carefully evaluated before treatment. See the manufacturers’ summaries of product characteristics for details. Medicines and Healthcare Products Regulatory Agency (MHRA) guidance (2011) advises that ‘prescribers should review the safety and efficacy of pioglitazone in elderly patients.’

* See NICE technology appraisal guidance 288 & 418, 315 and 336 on dapagliflozin and empagliflozin, respectively. All three SGLT-2 inhibitors are recommended as options in dual therapy regimens with metformin under certain circumstances. In combination with insulin, these agents are also options for monotherapy in certain situations.

* Be aware that the drugs in dual therapy should be introduced in a stepwise manner, checking for tolerability and effectiveness of each drug.

* Incretin mimetics are often prescribed in combination with insulin, especially in patients with risk factors for the development of cardiac failure. It advises that if the combination is used, people should be observed for signs and symptoms of heart failure, weight gain, and oedema. Pioglitazone should be discontinued if any deterioration in cardiac status occurs.

* The recommendations given in this guideline also apply to any current and future indications of sulfonylureas that have an appropriate Marketing Authorisation that allows the use of the biosimilar(s) in the same indication.

* A Consultant-led multidisciplinary team may include a wide range of staff based in primary, secondary and community care.
Type 2 Diabetes Treatment

Pharmacological targets of current drugs used in the treatment of T2DM

- **Incretin mimetics (exenatide Injectable)**: Improves glucose-dependent insulin secretion, suppresses glucagon secretion, slows gastric emptying.
- **Liraglutide (injectable)**: is the first human GLP-1 analogue. Stimulates insulin secretion, inhibits glucagon secretion.
- **DPP-4 inhibitors**: Increase endogenous GLP-1, stimulate insulin secretion, suppress glucagon release in a glucose dependent manner.
- **Biguanide (metformin)**: Decreases insulin resistance.
- **Sulphonylurea**: Increase insulin secretion from pancreatic β-cells.
- **Meglitinides**: Increase insulin secretion from pancreatic β-cells.
- **Glitazones**: Decrease insulin resistance.
- **α-glucosidase inhibitors**: Delay intestinal carbohydrate absorption.

Adapted from Cheng AY, Fantus IG. CMAJ. 2005; 172: 213-228.
Initial Management

- History - FBC – lipids, FPG, U & E’s
- Examination - complications
- Explanation
- Explore current lifestyle
- Diet
- Activity
- ? Medications – oral/injectable
- ? Monitoring – glucose/ketones
- ? Follow up
- Education for self-management
Diabetes Emergencies (Acute Complications)

- **Hypoglycaemia**
  - "Low blood glucose level: <3.5 mmols/l"
  - Can affect people treated with insulin (type 1 and 2) and those taking sulphonylureas

Hospital management:
[https://diabetes-resources-production.s3-eu-west-1.amazonaws.com/diabetes-storage/migration/pdf/JBDS%2520hypoglycaemia%2520position%2520%282013%29.pdf](https://diabetes-resources-production.s3-eu-west-1.amazonaws.com/diabetes-storage/migration/pdf/JBDS%2520hypoglycaemia%2520position%2520%282013%29.pdf)

1. Oral Glucose (short acting CHO)
2. Glugagon IM
3. IV Glucose
Diabetes Emergencies

- Hyperglycaemia
  - Polydypsia (excessive thirst)/ dry mouth
  - Polyuria (passing urine frequently)/ incontinence
  - Tiredness
  - Blurred vision

- Diabetic Ketoacidosis
  - Usually type 1
  - ? Infection
  - Rapid onset (hours to a few days)
  - Polydypsia
  - Weakness/lethargy
  - Urine output high or low
  - Deep and rapid respirations
  - Ketonuria
  - Ketone smell to breath
  - Nausea, vomiting, abdo pain

  Dehydrated – Tachycardia, hypotensive, flushed, dry mucous membranes)
  Alert or unconscious
  Weight loss
  Electrolyte imbalance
Diabetic Ketoacidosis

- **Ketone self-monitoring for prevention of DKA**
  - 1.11.1 Consider ketone monitoring (blood or urine) as part of 'sick-day rules' for adults with type 1 diabetes, to facilitate self-management of an episode of hyperglycaemia. [new 2015]

- **Ketone monitoring in hospital**
  - 1.11.2 In adults with type 1 diabetes presenting to emergency services, consider capillary blood ketone testing if:
    - DKA is suspected or
    - the person has uncontrolled diabetes with a period of illness, and urine ketone testing is positive. [new 2015]
  - 1.11.3 Consider capillary blood ketone testing for inpatient management of DKA in adults with type 1 diabetes that is incorporated into a formal protocol. [new 2015]
Management of DKA

1.11.4 Professionals managing DKA in adults should be adequately trained, including regular updating, and be familiar with all aspects of its management which are associated with mortality and morbidity. These topics should include:

- fluid balance
- acidosis
- cerebral oedema
- electrolyte imbalance
- disturbed interpretation of familiar diagnostic tests (white cell count, body temperature, ECG)
- respiratory distress syndrome
- cardiac abnormalities
- precipitating causes
- infection management, including opportunistic infections
- gastroparesis
- use of high dependency and intensive care units
DKA treatment

• For primary fluid replacement in adults with DKA, use isotonic saline, not given too rapidly except in cases of circulatory collapse. [2004]
• 1.11.6 Do not generally use bicarbonate in the management of DKA in adults. [2004, amended 2015]
• 1.11.7 Give intravenous insulin by infusion to adults with DKA. [2004]
• 1.11.8 In the management of DKA in adults, once the plasma glucose concentration has fallen to 10–15 mmol/litre, give glucose-containing fluids (not more than 2 litres in 24 hours) in order to allow continued infusion of insulin at a sufficient rate to clear ketones (for example, 6 units/hour monitored for effect). [2004, amended 2015]
• 1.11.9 Begin potassium replacement early in DKA in adults, with frequent monitoring for the development of hypokalaemia. [2004]
• 1.11.10 Do not generally use phosphate replacement in the management of DKA in adults. [2004, amended 2015]
• 1.11.11 In adults with DKA whose conscious level is impaired, consideration should be given to inserting a nasogastric tube, monitoring urine production using a urinary catheter and giving heparin. [2004]
• 1.11.12 To reduce the risk of catastrophic outcomes in adults with DKA, ensure that monitoring is continuous and that review covers all aspects of clinical management at frequent intervals. [2004, amended 2015]
Diabetes as a long term condition

- Principle - Individualised Shared Care Plan
- Self - management/ self care.
- Service level interventions.
- Surveillance.
- Screening.
- Education
  Via- Primary Care Led Services.

**Education**

**Self-management**
Self-management education programmes by lay leaders for people with chronic conditions

**Service Interventions:**
Interventions to improve the management of diabetes mellitus in primary care, outpatient and community settings
Cochrane Library 2017
Care Plan Mutual Goals

- Height and weight (BMI = kg/m²)
- Blood pressure
- Blood glucose control
- HbA1c and cholesterol levels
- Discuss any issues
- Advise any change in regime, lifestyle or medication - including any side effects
- People who take insulin should also have their injection or infusion sites checked.
- Depression and sexual dysfunction questionnaire.
Care Plan Mutual Goals

- **HbA1c targets**
  - People with diabetes are generally advised to keep their **HbA1c values below 48 mmol/mol (6.5%)**
  - However, an individualised target should be set to take into account factors such as your daily activities, likelihood of developing complications and risks presented by hypoglycemia.
  - Ideally, the lower the HbA1c value you can achieve without increasing instances or severity of hypoglycemia, the better.
  - For comparison purposes, people without diabetes tend to get HbA1c readings in the 15 to 37 mmol/mol (3.5 to 5.5%) range.
- **Blood pressure (hypertension) guidelines**
  - Blood pressure targets for type 1 diabetes:
    - **Below 135/85 mmHg**
    - Or below **130/80 mmHg** if abnormal presence of albumin in the urine (a sign of diabetic kidney disease) or if there are signs of metabolic syndrome
  - Blood pressure targets for type 2 diabetes:
    - **Below 140/80 mmHg**
    - Or below **130/80 mmHg** if you have kidney disease, retinopathy or have cerebrovascular disease (including stroke)
- **Total cholesterol:** under 4.0 mmol/l
- **LDL levels:** below 2.0 mmol/l
- **HDL levels:** at least 1.0 mmol/l (men) or 1.2 mmol/l (women)
- **Triglyceride levels:** less than (or equal to) 1.7 mmol/l
- Kidney function guidelines for diabetic patients are as follows:
  - **Albumin/creatinine ratio:** less than or equal to 2.5 mg/mmol (men) or 3.5 mg/mmol (women)
Self-Management

- Physical Activity/ Exercise.
- Dietary management.
- Mediation compliance.
- Psychological well-being.
- Control- (Blood Glucose Monitoring/ Dose adjustment/ Nutritional adjustment).
- Education
  - Dose Adjustment for Normal Eating (DAFNE)- Type 1 [http://www.dafne.uk.com/]
  - Diabetes Education and Self Management for Ongoing and Diagnosed (DESMOND)- Type 2
  - [http://www.desmond-project.org.uk/index.php]
UKPDS: 1% (16 mmol/mol) decrease in HbA\textsubscript{1c} is associated with a reduction in complications


- Microvascular complications e.g. kidney disease and blindness * 37%
- Amputation or fatal peripheral blood vessel disease* 43%
- Deaths related to diabetes* 21%
- Heart attack* 14%
- Stroke** 12%

* p<0.0001
** p=0.035
Macro-vascular complications of diabetes
Micro-vascular complications

- Diabetic Retinopathy

https://www.youtube.com/watch?v=mHBRxQD4ef4
Micro-vascular complications

Kidney disease
Diabetic Nephropathy
Micro-vascular complications

Diabetic Neuropathy
Other complications

Diabetic autonomic neuropathy:

**Pupillary**
- Decreased diameter of dark adapted pupil
- Argyll-Robertson type pupil

**Metabolic**
- Hypoglycemia unawareness
- Hypoglycemia unresponsiveness

**Cardiovascular**
- Tachycardia, exercise intolerance
- Cardiac denervation
- Orthostatic hypotension
- Heat intolerance

**Neurovascular**
- Areas of symmetrical anhidrosis
- Gustatory sweating
- Hyperhidrosis
- Alterations in skin blood flow

**Gastrointestinal**
- Constipation
- Gastroparesis diabeticorum
- Diarrhea and fecal incontinence
- Esophageal dysfunction

**Genitourinary**
- Erectile dysfunction
- Retrograde ejaculation
- Cystopathy
- Neurogenic bladder
- Defective vaginal lubrication