Salisbury NHS
NHS Foundation Trust

Adult Inpatient Diabetes Guide

For further advice contact:
Diabetes Inpatient Specialist Nurse – bleep 1223
Diabetes Registrar – bleep 1352
Diabetes Consultant Secretary – ext 4229
Diabetes Inpatient Specialist Nurse – ext 2176
Diabetes Specialist Dietitian – ext 2176

Not for patients admitted under Paediatrics

V2.2 last reviewed July 2018

1 REFERRAL GUIDELINES....1

2 GUIDANCE ON BLOOD GLUCOSE MONITORING....3

2.1 Blood Glucose Monitoring of Patients with Diabetes. 3
2.1.1 Oral agents and non-insulin injectables (`Exenatide,/liraglutide/lixisenatide/bydureon / dulaglutide)....3
2.1.2 Once daily insulin with or without oral hypoglycaemics. 3
2.1.3 Multiple dose insulin regimes....3
2.1.4 Patients On Steroids....3
2.2 Algorithm for Monitoring Blood Glucose in Inpatients with Diabetes....4

3 DIETARY MANAGEMENT OF PATIENTS WITH DIABETES....5

3.1 Menu choices for patients with diabetes 5
3.2 Carbohydrate counting and insulin dose adjustment....7
3.3 Hypoglycaemia management 7
3.4 Downloadable patient information....7
3.5 Special diet information 7
3.6 Information about carbohydrate counting and insulin dose adjustment....7

4 INSULIN: PRESCRIBING ADVICE AND TIPS....9

4.1 Insulin prescribing checklist – Always Apply all of the following: 9
4.2 Insulin 'Do's' 9
4.3 Insulin 'Do Nots'....9

5 ADMINISTRATION OF INSULIN....11

5.1 Administering Insulin 11
5.2 Insulin Types, Profiles and Regimens 12
5.3 Commonly used Insulin Regimens 13
5.4 Which Insulin is the Patient taking?....14
5.5 Guide for Insulin dose adjustment....15

6 HYPERGLYCAEMIA: MANAGEMENT AND CAUSES....17

7 USE OF VARIABLE RATE INTRAVENOUS INSULIN INFUSION (VRIII)....21

7.1 Indications for measurement of capillary blood ketones....22

8 TRANSFER TO INSULIN OR ORAL HYPOGLYCAEMIC AGENTS AFTER USE OF A VARIABLE RATE INTRAVENOUS INSULIN INFUSION....23

8.1 Restarting Oral Agents....23
8.2 Restarting subcutaneous insulin for patients already on insulin 23
8.2.1 Restarting subcutaneous insulin for patients on 'basal-bolus' insulin 23
8.2.2 Restarting subcutaneous insulin for patients on twice daily 'fixed-mix' insulin....23
8.2.3 Restarting subcutaneous insulin for patients on continuous subcutaneous insulin infusion (AKA Insulin Pump)....23
8.3 Calculating insulin dose in insulin naïve patient 24

9 TREATMENT OF HYPOGLYCAEMIA....25

10 GUIDANCE FOR NON INSULIN BASED TREATMENTS FOR TYPE 2 DIABETES....27

10.1 Biguanides....27
10.2 Sulphonylureas 27
10.3 Thiazolidinediones ('Glitazones')....27
10.4 Incretin mimetics....28
10.5 DPP-IV inhibitors 28
10.6 SGLT2 blockers 28
10.7 Combined formulation medications....29

10.8 PRANDIAL GLUCOSE REGULATORS 29
10.9 ALPHA-GLUCOSIDASE INHIBITORS 29
11 DIABETES INPATIENT FOOTCARE PATHWAY 31
12 REFERENCES 33
13 ACKNOWLEDGEMENTS 35

1 Referral Guidelines

The diabetes team will endeavour to review all inpatients with diabetes. Please follow these guidelines for referral /re-referral if patients need to be seen as a priority.

Early referral recommended	• Patient request • Admission for urgent or major elective surgical procedure • Acute coronary syndrome • Diabetic ketoacidosis / hyperosmolar hyperglycaemic states • Severe hypoglycaemia • Sepsis • Vomiting • Impaired conciousness • Parenteral or enteral nutrition • Foot ulceration • Newly diagnosed Type 1 • Intravenous insulin infusion for >48 hrs • Intravenous insulin infusion with glucose outside limits • Previous diabetes problems as inpatient
Referral may be recommended	• Intravenous insulin infusion with good glucose control • Nil by mouth more than 24 hrs post surgery • Significant educational need • Persistent hyper- or hypoglycaemia • Possible type 2 diabetes • Stress hyperglycaemia • Poor wound healing • Steroid therapy
Referral not normally required	• Minor, self treated hypoglycaemia • Transient hyperglycaemia • Simple educational need • Routine dietetic advice • Well controlled diabetes • Good self management skills • Routine diabetic care

All inpatient referrals should be via,
Diabetes Nurse Advisor on bleep 1223.
Diabetes Specialist Registrar on bleep 1352.
Diabetes Consultant Secretary on ext 4229

2 Guidance on blood glucose monitoring

<u>On Admission</u>
ALL patients should have a blood glucose level taken (capillary or serum)

*Serum blood glucose levels MUST be carried out on patients if:

- Patient has known diabetes
- Glycosuria is present on urine test
- Acute confusion/delirium
- Drowsiness / unconsciousness or collapse
- Doubt about capillary level
- Extreme capillary glucose levels (e.g 'High' on meter)
- Potential Diabetic Ketoacidosis (DKA) / Hyperosmolar Hyperglycaemic State (HHS)
- New diagnosis of diabetes
- Patient on high dose steroids >20mg daily prednisolone

**If blood glucose>12mmol/L then test urine for ketones on admission.

2.1 Blood Glucose Monitoring of Patients with Diabetes.

All patients to have pre-meal and pre-bed glucose monitoring for the first 24 hours post admission.

2.1.1 Oral agents and non-insulin injectables (`Exenatide,/liraglutide/lixisenatide/bydureon / dulaglutide)

Glucose levels **4 to 10** mmol/l, for once daily random glucose monitoring.

Glucose levels outside **4 to 10** mmol/l range, continue pre-meal and pre-bed glucose monitoring.

2.1.2 Once daily insulin with or without oral hypoglycaemics.

Glucose levels **4 to 10** mmol/l, for twice daily random glucose monitoring, always testing before breakfast.

Glucose levels outside **4 to 10** mmol/l range, continue pre-meal and pre-bed.

2.1.3 Multiple dose insulin regimes

To be monitored pre-meal and pre-bed.

Frequency of monitoring will need to be reviewed throughout the patients admission, using your professional judgement.

All patients with a single episode of severe hypoglycaemia (glucose < 2.5mmol/l with/without reduced conscious level) should be referred to the diabetes team

All patients having > 1 episode of hypoglycaemia in a 7 day period should be referred to the diabetes team

All patients with > 1 blood glucose reading in any 24 hour period ≥ 11mmol/l should be referred to the diabetes team

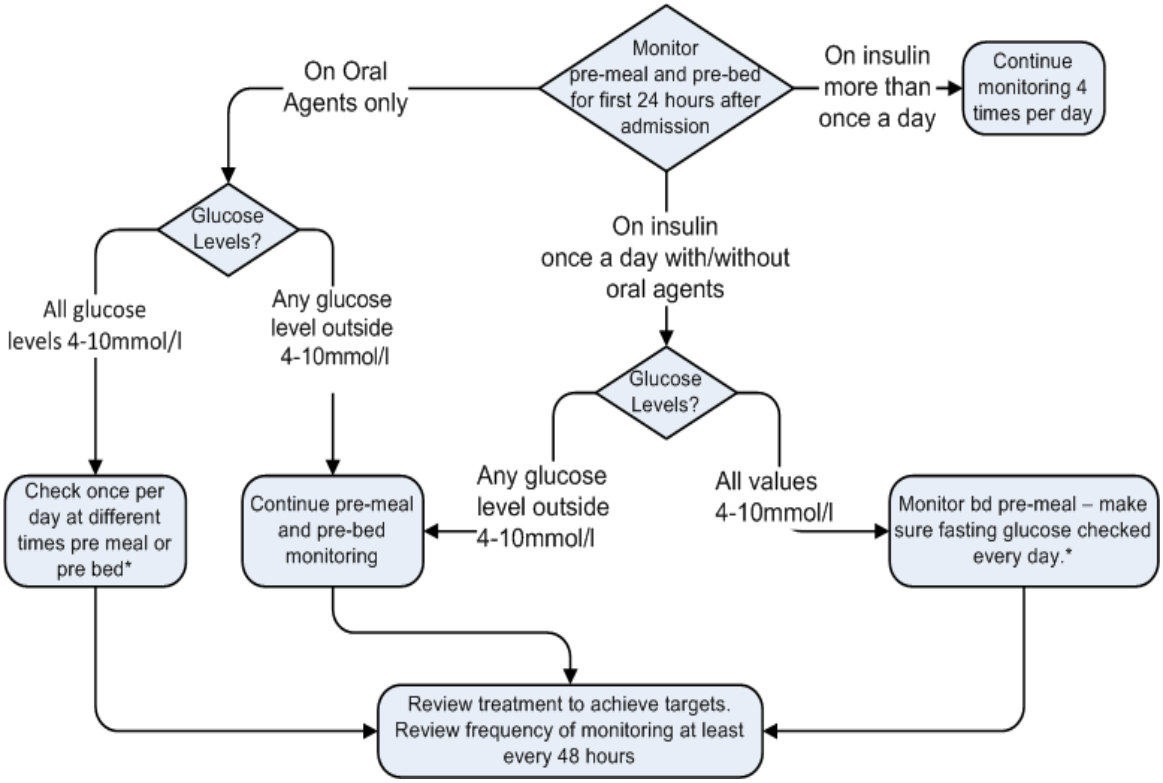
2.1.4 Patients On Steroids.

All patients to have pre-meal and pre bed blood glucose monitoring for the first 24 hours

If glucose levels rise above 12mmol/l, to continue pre meal and pre bed monitoring.

If glucose levels above 15 mmol/l, refer to diabetes team [(Out of hours consider starting insulin with meals in line with guidance on ICID) (Pre Existing Diabetes in Patients on Steroids)]

2.2 Algorithm for Monitoring Blood Glucose in Inpatients with Diabetes



*If patient's clinical condition deteriorates increase monitoring back to pre-meal and pre-bed

All patients with a single episode of severe hypoglycaemia (glucose < 2.5mmol/l with/without reduced conscious level) should be referred to the diabetes team

All patients having > 1 episode of mild hypoglycaemia in a 7 day period should be referred to the diabetes team

All patients with > 1 blood glucose reading in any 24 hour period ≥ 11mmol/l should be referred to the diabetes team

3 Dietary management of patients with diabetes

Dietary management is fundamental for the effective management of diabetes. The aim being to enable people with diabetes to make appropriate food choices to optimise their blood glucose control, achieve a healthy weight and reduce their risk of diabetes related complications. Dietary management has shifted from a prescriptive 'one size fits all' approach to a person-centred approach. The aim being to provide flexibility, promote a healthy diet and lifestyle, improve quality of life, and meet the dietary needs of all people with diabetes, including those with co-morbidities (e.g. coeliac disease, cystic fibrosis, diabetic kidney disease, etc.).

People with diabetes are known to have more frequent admissions to hospital, longer lengths of hospital stay and poorer clinical outcomes. Many are malnourished on admission to hospital, or are at risk of developing malnutrition during their hospital stay and will need nutritional support. Nutritional management should be in partnership with the patient, dietetic and diabetes teams, the aim being to optimise the patient's blood glucose control and nutritional state. It is important that meals and snacks are available at all times, to enable co-ordination with diabetes medication / insulin treatment, and that adjustment of diabetes medication / insulin doses is prioritised over dietary restriction.

3.1 Menu choices for patients with diabetes

Where possible, education and support should be provided so that patients can manage their own food choices. However some patients with diabetes on admission to hospital will lack the mental capacity to be in charge of their own nutrition and will need their food provided to them with varying degrees of choice. Food choices that are suitable for the majority of patients with diabetes are coded as '**D**' on the hospital menu. These have a lower sugar content, however it is important to note that sugar does not affect blood glucose control any differently from other types of carbohydrate. It is the total amount and type of carbohydrate eaten, not sugar consumption that affects post-prandial (after meal) blood glucose levels.

When supporting and educating patients regarding making healthy food choices from the hospital menu:

- Try to ensure patients have some starchy carbohydrate component with each meal (e.g. breakfast cereal, bread, potato, rice or pasta). This is to balance carbohydrate intake with their diabetes medication / insulin treatment.
- Wholegrain carbohydrate food choices (e.g. porridge oats, whole grain breakfast cereals, granary and multigrain bread) are preferable as these foods are broken down into glucose more slowly, raising blood glucose levels more slowly.
- Artificial sweetener can be used instead of sugar to sweeten drinks and to add to breakfast cereals or porridge.
- Tea, coffee, no added sugar drinking squash, low calorie fizzy drinks (e.g. 'diet' coke or lemonade) and water are suitable to drink as they are either sugar free or are very low in sugar. Fruit juice, ordinary drinking squash and fizzy drinks, drinking chocolate, malted milk drinks (e.g. Ovaltine, Horlicks, etc.) including 'lite' / low fat varieties, are very high in carbohydrate, so should be limited.
- Unsaturated spreading fat (e.g. Flora) is available as an alternative to butter for adding to bread, crackers and potatoes.

- Discourage addition of extra salt to food, as eating too much salt can raise blood pressure, increasing risk of cardiovascular disease and other circulation problems, including diabetic kidney disease. Pepper sachets are available as an alternative to salt to flavour food.
- If snacks are needed between meals, fruit, yoghurt, wholegrain cereal and toast are healthier snacks than biscuits, crisps, cake or chocolate, which are high in fat and energy (calories).

Nutrition Support

Patients with Diabetes are at increased risk of malnutrition compared to patients without diabetes, therefore should be screened using the hospital 'nutritional risk assessment' tool and treated appropriately, according to the nutrition support care pathway.

Points to remember:

- Offer and encourage high protein / high energy snacks in between meals (e.g. cheese and biscuits, yoghurt, cereal and milk, etc.).
- Order high protein / high energy food choices (H) from the hospital menu, rather than those coded as being 'suitable for those with diabetes' (D), as the priority is to increase energy intake, not restrict it.
- Build Up milk shakes /soups are available to order from the Catering department and can be offered to patients to sip by ward staff
- If the patient needs enteral feeding or oral sip feeds prescribed, please refer to the ward dietitian and diabetes team for review. This is so that their nutritional needs can be assessed and their diabetes medication / insulin dose(s) can be titrated according to their nutritional needs. This is to ensure that blood glucose levels remain under control.
- Alterations to diabetes medications / insulin doses may be needed due to changes in the patient's clinical condition, appetite, timings of their meals and snacks, oral sip feeds or enteral feed, body weight, physical activity, and the use of other medications that affect blood glucose (e.g. glucocorticoid therapy).

Note

There are no diabetes specific enteral feeds or oral sip feeds currently available in the UK. An increase in blood glucose levels is to be expected as they all contain carbohydrate in a form that is quickly digested and absorbed as glucose into the bloodstream. Fortijuce is **not** generally recommended due to its higher carbohydrate content compared with other oral sip feeds (e.g. Fortisip), however there may be some circumstances when it is indicated. This needs to be assessed on an individual basis by the ward dietitian.

3.2 Carbohydrate counting and insulin dose adjustment

Some patients with type 1 diabetes who are on multiple injection or insulin pump therapy (and some with type 2 on multiple injections) have been taught by their diabetes team to adjust their insulin doses according to their carbohydrate intake, by learning how to carbohydrate count. This allows them greater flexibility to eat what they want and when they want, whilst at the same time improving their blood glucose control and reducing their risk of diabetes related problems. These patients can safely choose from the hospital menu without dietary restriction, provided they have information about the carbohydrate values of their meal and snack choices, to enable them to make an informed choice about adjusting their insulin doses.

3.3 Hypoglycaemia management

Please refer to the hospital clinical management guidelines on treatment of hypoglycaemia.

3.4 Downloadable patient information

This is available on ICID. This includes patient information about ‘healthy eating and diabetes’

3.5 Special diet information

Please contact the Nutrition and Dietetic department (ext. 2333) or bleep the ward dietitian for advice.

3.6 Information about carbohydrate counting and insulin dose adjustment

Please contact Lynne Greenhalgh, Diabetes Specialist Dietitian at The Diabetes Education Centre on ext. 2176.

4 Insulin: Prescribing advice and tips

4.1 Insulin prescribing checklist – Always Apply all of the following:

- Use indelible black ink
- Always prescribe insulin on the diabetes treatment chart
- Use Insulin **brand name**, taking care with dose, route, frequency and timing
- DO NOT WRITE U, IU, / etc ANYWHERE ON DRUG CHARTS OR IN CLERKING NOTES – ALWAYS WRITE THE WORD 'UNITS' IN FULL
- NEVER prescribe insulin on the PRN (as required) side of the drug chart
- Name of prescriber, contact details & prescribing date must be clearly indicated
- Indicate on main drug chart that patient is also taking insulin

4.2 Insulin 'Do's'

- Do **think about** the impact of acute illness on diabetes. The stress of illness or steroid use may worsen hyperglycaemia for instance
- Do **recognise** the need for short term insulin dose adjustment in illness and some tablet controlled patients may need short term insulin
- Do **ensure** that the **right** insulin is prescribed (there are over 60 types) and beware of similar sounding names (e.g. Novorapid vs Novomix 30, Humalog vs Humalog Mix 25, Novomix 30 vs Mixtard 30, Humulin S vs Humulin I vs Humulin M3, or Lantus vs Lente)
- Do recognise that a standard 3ml insulin cartridge contains 300 units of insulin
- Do **ensure** that insulin is prescribed at the **right** time and at **right** dose:
- **Fast/short acting** insulins are given **with food**
- **Mixed insulins** (have a number in the name) are given **with meals**
- **Intermediate acting** insulins can be once or twice daily, before breakfast or at bedtime
- **Once daily long acting** usually given first thing in the morning or at bedtime, but same time daily
- Do **continue** long active insulin in patients on variable rate insulin infusions
- Do **note** that insulin dose reduction should be considered in patients who have poor intake or have renal/hepatic impairment, all of which can increase hypoglycaemia risk

4.3 Insulin 'Do Nots'

- **DO NOT WRITE 'U, IU, /' etc ANYWHERE** ON DRUG CHARTS OR IN CLERKING NOTES – ALWAYS WRITE THE WORD 'UNITS' IN FULL IF NOT PRE-PRINTED
- **Do not ever omit insulin in a patient with type I diabetes** under any circumstance– they will be at high risk of going into DKA
- **Do not ever prescribe any type of insulin on the 'as required/PRN' side of the drug chart** – there is a high risk of patient harm in doing this

- **Do not prescribe a stat dose of short acting insulin without ensuring the previous dose was given or without considering 'why am I really doing this?'** - risk of **both** hypoglycaemia and rebound hyperglycaemia
- **Do not omit insulin** after treating hypoglycaemia, though a 10-20% dose reduction may be necessary
- **Do not** commence intravenous insulin infusions for patients having **hypoglycaemia**
- **Do not give verbal orders for insulin over the phone**
- Do not use Insulin infusions for patients who are eating and drinking **unless for a specific protocol**

5 Administration of Insulin

ALWAYS CHALLENGE UNCLEAR PRESCRIBING!

5.1 Administering Insulin

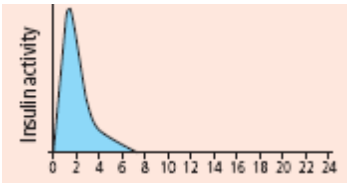
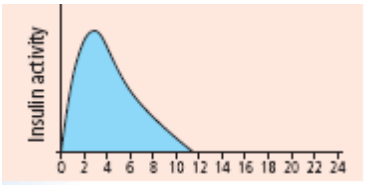
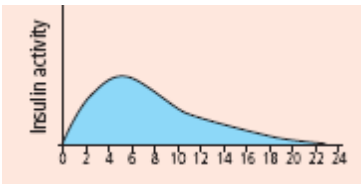
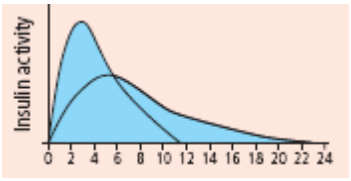
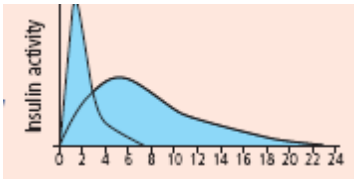
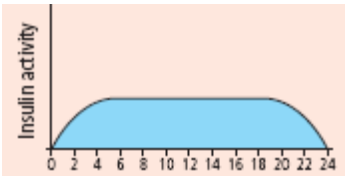
ADMINISTERING INSULIN

- CHECK and DOUBLE CHECK the following:
  - **CORRECT INSULIN TYPE**?
  - **CORRECT DOSE**? – Check dose. Check the numbers carefully.
  - **CORRECT TIME**? – Insulin should always be given **WITH** meals except basal insulin.
  - **CORRECT DEVICE? – ONLY** use an insulin syringe, pen or pump designed solely for insulin.
  - When using insulin to treat **hyperkalaemia**, 50% dextrose must also be administered together

Never use any other syringe to inject insulin!

- Never inject insulin unless you have been trained to do so. If in doubt, ask. Patients on insulin usually know how to inject their own insulin. Listen to the patient; unless they are too ill or confused, the patient is the best person to inject their own insulin.
- DO NOT omit insulin if a patient suffers a hypo. Treat hypo as per guideline, then insulin should be given as usual with the next meal. A 10-20% dose reduction may be needed. (NB. Long acting insulin can be given without a meal)
- **Never** omit insulin in a patient with type I diabetes (risk of ketoacidosis)
- If a patient is on the DKA protocol continue giving basal insulin in parallel.

5.2 Insulin Types, Profiles and Regimens

Rapid Acting Insulin Analogue Novorapid, Humalog, Apidra *Taken **just before/with/just after food***	All insulin times vary with individuals. Onset: 0-15 mins Peak: 1-3 hours Duration: 3-5 hours	
Short Acting/Neutral Insulin Actrapid, Humulin S, Hypurin Porcine/Bovine Neutral, Insuman Rapid *Taken 30 mins **before food***	Onset: 30 mins Peak: 1-5 hours Duration: 6-8 hours	
Intermediate Isophane Insulin Insulatard, Humulin I, Insuman basal Hypurin bovine isophane/PZI/lente Hypurin porcine isophane *Taken 30 mins before food or bed*	Onset: 30-60mins Peak: 2-10 hours Duration: 12-18 hours	
Pre-Mixed Soluble/Isophane Insulin (aka 'fixed mix') Mixtard 30 (withdrawn), Humulin M3, Hypurin Porcine 30/70 Mix Insuman Comb 15/25/50 *Taken 30 mins before food- '**Mixtures with meals'***	Mixture of short-acting insulin and intermediate isophane insulin in one injection	
Pre-Mixed Analogue/Isophane Insulin NovoMix 30, Humalog Mix 25, Humalog Mix 50 *Taken just before/with/just after food – 'Mixtures with meals'*	Mixture of rapid-acting analogue insulin and intermediate isophane insulin in one injection	
Long-Acting Basal Analogues Lantus (Glargine), Levemir (Detemir), Tresiba (Degludec) Taken anytime but at same time of the day	Onset: 30-60 mins Peak: None Duration: 18-24 hours	

5.3 Commonly used Insulin Regimens

Regimen	Number of injections per day	Comment
Basal Insulin	Once *	Can be used in combination with oral hypoglycaemic drugs or GLP1 agonists
Pre-mixed Insulin	Twice **	Given with breakfast and evening meal. Requires fixed meal times, increased risk of hypos with delays, (T1 or T2 DM)
Basal Bolus	Four	3 boluses of rapid or short-acting insulin with meals and once daily basal insulin; most flexible of all regimens (T1 or T2DM)

*May be given twice daily
**May occasionally be given three times daily - under specialist guidance only

5.4 Which Insulin is the Patient taking?

Can GP letter/previous clinic letters/Patient Insulin Passport help?

Is the patient taking

Insulin Once Daily
(+/- OHA*)
Usually T2DM, but check

*Usually first thing in the morning or at bedtime, but **same** time daily*

LONG-ACTING ANALOGUE
lantus (glargine)
levemir (detemir)
tresiba (degludec)

or

INTERMEDIATE ISOPHANE INSULIN
Insulatard (can be bd)
Humulin I (can be bd)
Bovine Isophane, PZI or Lente
Porcine Isophane
Insuman Basal

*OHA = oral hypoglycaemic agents

Insulin Twice Daily
T1DM or T2DM

Before breakfast and before evening meal

MIXED
(must be with meals)
Humulin M3
Hypurin Porcine 30/70
Insuman Comb 15
Insuman Comb 25
Insuman Comb 50

MIXED ANALOGUE
(must be with meals)
Humalog Mix 25
Humalog Mix 50
Novomix 30

or

Before breakfast and bedtime

Insulatard
Humulin I

2 Different Insulins
T1DM (usually) or T2DM
2-4 Injections/day

BOLUS ('fast' insulin with meals)

RAPID-ACTING ANALOGUE
Novorapid
Apidra
Humalog

or

SHORT-ACTING/NEUTRAL
Actrapid
Humulin S
Hypurin Bovine Neutral
Hypurin Porcine Neutral
Insuman Rapid

AND

***BASAL** (long acting background insulin) Usually first thing in the morning or at bedtime, but **same** time daily – (occasionally patients may be on these twice a day)*

LONG-ACTING ANALOGUE
lantus (glargine)
levermir (detemir)
or
INTERMEDIATE ISOPHANE INSULIN
Insulatard (can be bd)
Humulin I (can be bd)
Bovine Isophane, PZI or Lente

5.5 Guide for Insulin dose adjustment

Before considering dose adjustment, please ensure that:

- There is **compliance** with prescribed frequency of injection regimen
- There are no issues around the 'mechanics' of insulin delivery (faulty pen, injection technique, regular needle changes and injection sites rotated, appropriate and not 'lumpy', safety needles being used appropriately)
- Cloudy insulin is gently agitated for at least 30 seconds before administration
- Needles used are of the appropriate size (usually 5,6 or 8mm needles)
- The needle is held in place *subcutaneously* for at least 10 seconds during injection
- **Consider nocturnal hypoglycaemia**
    - Nocturnal Hypoglycaemia is an abnormally low blood glucose (<3.5mmol/L) that occurs overnight during sleep
    - The stress of overnight hypoglycaemia can result in a rebounding high sugar level, driven by the release of stress hormones (e.g epinephrine, cortisol)
    - Pre-breakfast hyperglycaemia may be indicative of nocturnal hypoglycaemia
    - If suspected, **before** increasing night-time or evening insulin doses, ensure pre-bed BGL not < 8mmol/L and consider increased glucose testing overnight to exclude hypoglycaemia

Does your patient take insulin as 'basal bolus' (combination of 'fast' acting mealtime and long acting background insulin) or as a twice daily 'fixed mix'?

Target blood glucose levels for inpatients

Fasting blood glucose	6-10 mmol/L
Pre-meal blood glucose	6-10 mmol/L
2 hour post meal glucose	<10 mmol/L
Bedtime	8-10 mmol/L

Basal bolus

- Only adjust insulin in response to persistent trend of raised blood glucose. If hypoglycaemia occurs, stop up-titration and reassess. Dose reduction may be needed for *recurrent* hypoglycaemia by 4 units or 10%
- Aim to *'FIX FASTING FIRST'*, by adjusting **basal** insulin dose (glargine, levemir, insulatard, humulin I)
- Adjust dose by no more than 2 units or 10% increments of current dose at a time
- After adequate fasting glucose levels are reached, then adjust the pre-meal insulin dose of short acting insulins**. *Only adjust the dose at the time prior to the elevated glucose you are trying to improve*, as in table below**
- Only adjust one dose at a time and reassess after 3 days. Do not adjust more than twice a week

- There will be a need for an increased frequency of blood glucose monitoring during times of dose change
- If unsure, refer to the Inpatient Diabetes Team

Time of high glucose value	**Insulin to be adjusted**
	Basal – bolus regimen
Before breakfast	basal insulin
Before lunch	breakfast insulin
Before dinner	lunch insulin
Bedtime	dinner insulin

Twice daily 'fixed mix'

- Only adjust insulin in response to persistent trend of raised blood glucose levels. If hypoglycaemia occurs, stop up-titration and reassess. Dose reduction may be needed for *recurrent* hypoglycaemia by 4 units or 10%
- Aim to *'FIX FASTING FIRST'*, by adjusting evening dose of a **twice daily regimen** (humulin M3, novomix 30 etc)
- Adjust dose by no more than 2 units or 10% increments of current dose at a time
- After adequate fasting glucose levels are reached, then adjust the breakfast dose of a twice-daily regimen. ***Only adjust the dose at the time prior to the elevated glucose you are trying to improve*, as in table below**
- Only adjust one dose at a time and reassess after 3 days. Do not adjust more than twice a week
- There will be a need for an increased frequency of blood glucose monitoring during times of dose change
- If unsure, refer to the Inpatient Diabetes Team

Time of high glucose value	**Insulin to be adjusted**
	Twice daily 'fixed mix'
Before breakfast	evening insulin
Before lunch	breakfast insulin
Before dinner	breakfast insulin
Bedtime	evening insulin

6 Hyperglycaemia: Management and causes

Hyperglycaemia is a blood glucose of 12mmol/L or more
Although ideal target blood glucose levels are 6-10mmol/l (4-12mmol/l acceptable) these targets must be individualised. Higher targets may be required for patients at high risk of injury from hypos (e.g. elderly, frail and dependant patients) If unexpected, wash patient hands and repeat glucose test Look at blood glucose trend and not single readings when adjusting medication doses. Do not start insulin infusion **without** considering a cause for hyperglycaemia

WHY ARE GLUCOSE LEVELS OUT OF RANGE?	WHEN ARE GLUCOSE LEVELS OUT OF RANGE? **(see guidance on insulin dose adjustment)**
Missed or wrong oral hypoglycaemic drugs or insulin doses **New diagnosis diabetes?** Must Exclude DKA or HHS Infections / Stress / Intercurrent Illness Steroid based treatment Diet (Nil By Mouth, Vomiting, Reduced oral intake, Enteral/Parenteral feeding, Wrong food choices), pancreatic disease	**<u>BD pre-mixed Insulin regimen:</u>** Highs before breakfast or bedtime→ adjust evening insulin Highs before lunch or evening meal→ adjust breakfast insulin **<u>QDS Basal Bolus Insulin regimen:</u>** Highs before breakfast→ adjust basal insulin Highs before lunch→ adjust breakfast insulin Highs before evening meal→ adjust lunch insulin Highs before bed→ adjust dinner insulin Increase dose by 2-4 units (or 10% of usual dose) for hyperglycaemia, provided no hypos

IMPORTANT POINTS ABOUT 'STAT doses' OF INSULIN
• **Do not** give stat rapid or fast acting insulin (e.g. novorapid, actrapid) doses for random high blood glucose readings unless ○ Patient is symptomatic (thirst, polyuria) ○ There is a delay in starting intravenous insulin in patients with confirmed DKA. In the absence of these factors, high blood glucose readings should trigger insulin dose adjustments as above. Be specific in deciding dose to give, go back and <u>check on patient later</u> (risk of hypo with rebound hyperglycaemia). Do not prescribe insulin PRN **Consider early referral to Diabetes Team**

Actions to consid

Actions to consider

- How is the patient? (if drowsy, unwell, vomiting, get help <u>promptly</u>)
- If patient has Type I DM – if BGL>12, check blood for ketones (dip urine if blood ketones not available). Manage as per table below
- If patient has type I diabetes and is vomiting, <u>DKA must be excluded</u>
- If patient has type 2 diabetes and is unwell, <u>hyperglycaemic hyperosmolar state must be excluded.</u> Remember DKA can occur and should be excluded if unwell with hyperglycaemia
- Was the previous insulin injection or diabetes tablets given on time at the right dose?
- Is the patient on an insulin infusion? Is it working properly? has cannula tissued?
- Hyperglycaemia can be aggravated by infections, stress, intercurrent illness, steroids, TPN/feeds
- If sepsis is a possibility, **remove dressings and examine feet** to exclude foot infection

Refer to inpatient Diabetes Outreach Team <u>early</u> if concerns

Testing for blood ketones – Indications and what to do with the results

Who should be tested?

- All patients with urine ketones
- All patients with known Type 1 diabetes who are unwell and have a blood glucose above 11mmols
- Any new or suspected Type 1 diabetes diagnosis
- Any Type 2 diabetes who are unwell with a blood glucose greater than 15mmols/l
- Any Type 2 patient treated with SGLT2 inhibitors (Dapagliflozin, Empagliflozin, Canagliflozin) presenting unwell even if blood glucose levels are normal

Actions

Type 1 patients unwell / newly diagnosed Type 1 **If confirmed DKA please use the DKA pathway** Otherwise action will depend on blood ketone & blood glucose level			
Blood ketones < 1.5mmols/L and blood glucose < 11mmols	**Blood ketones < 1.5 and blood glucose > 11mmols/l**	**Blood ketones 1.5-3.0mmols/L and blood glucose > 11mmols**	**Blood ketones > 3mmols/L and blood glucose > 11mmols**
Monitor blood glucose levels pre meal and pre bed Continue with normal doses of long-acting insulin plus normal doses of mealtime insulin	Monitor blood glucose levels pre meal and pre bed Continue with normal doses of long-acting insulin plus normal doses of mealtime insulin Consider a correction with rapid acting insulin using a ratio of 1 unit of rapid acting insulin reduces the blood glucose level by 3mmols	Give a 10% correction of total daily dose * (TDD) using rapid acting insulin (not Actrapid) every 2 hours **Plus** normal doses of long-acting insulin plus normal doses of mealtime insulin if eating **until** blood glucose and blood ketone levels decrease Monitor 2 hourly blood glucose and ketones	**Check blood gas to eliminate DKA – if confirmed DKA follow DKA pathway (may rarely occur with normal glucose)** Give a 20% correction of total daily dose * (TDD) using rapid acting insulin (not Actrapid) every 2 hours **Plus** normal doses of long-acting and also mealtime insulin if eating **until** blood glucose and blood ketone levels decrease Monitor 2 hourly blood glucose and ketones
*Calculating the TDD- add all the previous days long-acting and rapid acting insulin together **Please note if not resolving request urgent medical review as IV insulin infusion may be required. In prolonged illness doses of long-acting and rapid acting insulin may require adjustment** **Please inform the diabetes team**			

Type 2 patients who appear unwell with blood glucose levels 15 mmols or above Please check blood ketone levels – See below for patients on SGLT2 blockers they are increased of DKAY.	
Blood ketones present and greater than 3mmols/L you must consider DKA and check a blood gas to rule this out. If diagnosed treat according to protocol (LINK) Consider HHS in any patient with type 2 diabetes who is hyperglycaemic and unwell – if this is diagnosed then treat as per protocol (LINK) If the patient is vomiting/nbm/very unwell then consider VRIII to control hyperglycaemia and continue long acting insulin	Negative to Ketones recheck blood glucose in an hour if levels remain elevated give a corrective dose of rapid acting insulin such as Novorapid, Humalog or Apidra NOT Actrapid using the following scale: • 15-18 mmols give 2 unit correction • 18.1-21 mmols give 3 unit correction • 21.1-24 mmols give 4 unit correction • 24.1-27 mmols give 5 unit correction • >27 mmols give 6 unit correction ***6 unit correction is the maximum to be used** Check blood glucose levels in 2 hours repeating corrective dose once more , if patients levels NOT < 15mmols and patient unwell consider VRIII If levels are not reducing request urgent medical review

Type 2 patients treated with SGLT2 inhibitors (Dapagliflozin, Empagliflozin, Canagliflozin) presenting unwell even if blood glucose levels are normal
Check blood ketone levels and if present stop the SGLT2 immediately as at high risk of DKA

7 Use of Variable Rate Intravenous Insulin Infusion (VRIII)

INDICATIONS
• DKA or HHS – **Refer to guidelines** • Emergency surgical procedures complicated by hyperglycaemia (see protocol) • Elective surgical patients with diabetes - **Refer to peri-operative management guideline** • Patients with diabetes and intercurrent illness resulting in hyperglycaemia (especially if vomiting), need to exclude DKA • Patients admitted with a major vascular event e.g. acute coronary syndrome, stroke, with persistently high blood glucose level • Patients with hyperglycaemia complicating acute renal failure, heart failure, or liver failure • Poorly controlled diabetes with wild swings in high blood glucose readings

50 units of Actrapid in 50mls Sodium Chloride 0.9%.
Be aware that amended rates may be prescribed.

Blood Glucose Level	Insulin infusion rate (units/hr) ml/hr
0 – 4	0 (see hypo guidance)
4.1 – 7	1
7.1 – 12	2
12.1 – 17	4
>17.1	6

HOW TO START VRIII	WHEN TO TAKE DOWN VRIII
• Commence VRIII according to protocol • Continue long-acting insulin (Lantus or Levemir or Tresiba or humulin I or insulatard) if patient is already on either • Carry out HOURLY blood glucose measurements	• When the patient is able to eat and drink, <u>mealtimes only</u> • Patients with DKA: refer to guidelines **HOW TO TAKE DOWN VRIII** • At meal times where possible • Remember to STOP the VRIII 30mins **AFTER** sc insulin given

IMPORTANT POINTS
A variable rate insulin infusion is a **temporary** measure to stabilise a patient's overall glycaemic control Use 5% dextrose once glucose levels <12 otherwise sodium chloride 0.9%. Add potassium chloride to IV fluids as pre protocol on ICID See hypo protocol for the management of low blood glucose if this occurs in a variable rate insulin infusion As the half-life of soluble insulin ('actrapid') used intravenously is 3-5 minutes only, do not stop iv insulin for any prolonged period of time – rebound hyperglycaemia and ketosis may occur, resulting in DKA Do not commence a VRIII as a treatment for hypoglycaemia An IV sliding scale should not be used for a patient who is eating and drinking unless for a specific protocol
Essential measures for the safe maintenance of VRII
Hourly monitoring of capillary blood glucose Regular review of insulin infusion rate to achieve target range of glucose At least daily review of patient including fluid status Daily urea and electrolytes

7.1 Indications for measurement of capillary blood ketones

Patients with **type 1** diabetes who are unwell or develop persistent hyperglycaemia whilst in hospital (2 readings >12mmol/l at least 1hr apart) should have a baseline capillary blood ketone measurement with appropriate action taken (see table)

Patients with **type 2** diabetes may also be prone to ketone production if unwell. We recommend ketone testing in this group of patients when presenting with acute illness. We do not recommend the routine use of capillary blood ketone testing in hyperglycaemic patients with type 2 diabetes who are not acutely unwell.

Blood Ketone Results and action to be taken

Blood ketones mmol/l	Action
<0.6	Normal
0.6 – 1.4	Check ketones in 2hr
1.5 – 2.9	Risk of DKA; review patient management, consider reasons for high ketones, e.g. missed insulin dose, inadequate insulin dose and address these. Call diabetes team if in doubt. Check ketones in 1hr and take action depending on the result
>3	Check venous bicarbonate or venous pH, change to DKA guidelines if required. Inform diabetes team

8 Transfer to insulin or oral hypoglycaemic agents after use of a variable rate intravenous insulin infusion

8.1 Restarting Oral Agents

- Assuming that there is no reason to commence alternative therapy (e.g pancreatic disease), recommence treatment at usual dose when patient is ready to eat and drink
- Be prepared to reduce sulphonyurea dose if there is reduced food intake
- Only recommence metformin if eGFR is greater than 30ml/min and/or creatinine < 150micromol/L
- Do not restart pioglitazone if heart failure
- Do not restart GLP 1 agonists if diagnosed with pancreatitis or GFR < 50ml/min – discuss with diabetes team about ongoing management.
- Contact Diabetes Team early for advice

8.2 Restarting subcutaneous insulin for patients already on insulin

- **Only** restart when patient is eating and drinking **without** nausea or vomiting
- Commence usual dose pre-insulin infusion but recognise need to adjust dose in response to infection, post-operative stress, steroid use, altered food intake, renal or hepatic function
- Refer patient to Diabetes Team early if appropriate glucose control not achieved within 24 hours of s/c insulin commencement.

8.2.1 Restarting subcutaneous insulin for patients on 'basal-bolus' insulin

- There must be an overlap: The fast acting insulin should be given with a meal and the IV insulin and fluids should be discontinued 30-60 minutes later
- The long acting background analogue insulin (e.g. Levemir, Lantus, Tresiba) should have been used concurrently with the IV insulin infusion. **If this was not given, the insulin infusion must be continued until some background insulin has been given.** If the background insulin is usually given in the evening and the plan is to restart subcutaneous insulin in the morning, then give half of the usual dose in the morning continue the usual dose in the evening – contact diabetes team if nsure.
- Contact Diabetes Team early for advice

8.2.2 Restarting subcutaneous insulin for patients on twice daily 'fixed-mix' insulin

- There must be an overlap: Re-introduce insulin before breakfast or evening meal **only**. The IV insulin and fluids should be discontinued 30-60 minutes after injection is given

8.2.3 Restarting subcutaneous insulin for patients on continuous subcutaneous insulin infusion (AKA Insulin Pump)

- **Only** restart when patient is eating and drinking **without** nausea or vomiting
- The subcutaneous Pump infusion should be recommenced at the usual basal rate. The IV insulin infusion and fluids should be continued until the next meal bolus has been given

- Do not recommence at bedtime
- Contact Diabetes Team early for advice

8.3 Calculating insulin dose in insulin naïve patient

- Begin with between 0.3 and 0.5 units per kg per day as the total daily dose (TDD)
- If desire is to commence **'basal bolus'** (combination of mealtime fast acting and once daily long acting insulin) regimen, then give 40% of TDD as the background insulin in the evening and 20% of the TDD before each meal as short acting insulin
- If desire is to commence a **twice daily** 'fixed mix' regimen, then give two thirds of total daily dose before breakfast and the remaining one third with the evening meal

9 Treatment of Hypoglycaemia

Algorithm for the Treatment of Hypoglycaemia in Adults with diabetes in Hospital

Hypoglycaemia is defined as blood glucose of less than 4mmol/L (if symptomatic but blood glucose is above 4mmol/L then give a small carbohydrate snack for symptom relief)

Mild	Moderate	Severe
Patient conscious, orientated and able to swallow	Patient conscious but confused/ disorientated or aggressive and able to swallow	Patient unconscious/having a fit or very aggressive or nil by mouth (NBM)
Give 15-20g of quick acting carbohydrate 4-5 glucotabs or 1 glucojuice Test blood glucose level after 10-15 minutes If still less than 4mmol/L repeat up to 3 times If this has been repeated 3 times consider 50-100 ml of 20% dextrose or 150-200 ml of 10% dextrose over 15 minutes or 1mg glucagon IM (once daily only) Phone doctor for review if treated 3 times and glucose level below 4	If capable and cooperative, treat as for mild hypoglycaemia If not capable and cooperative but can swallow give either 1.5-2 tubes of GlcoseGel®/Dextrogel® Test BGL after 10-15 minutes. If still less than 4mmol/L repeat above up to 3 times or if ineffective use 1 mg glucagen IM (once daily only) If still hypoglycaemic or deteriorating at any stage, call doctor and consider IV glucose (as for severe)	Check ABC, Stop any IV insulin, fast bleep a doctor If IV access give 50-100 ml of 20 % dextrose or 150-200 ml of 10% dextrose over 15 minutes. Repeat up to 3 times If no IV access can give glucagon 1mg IM (once daily) – if BGL is below 4 after 15 minutes will need IV dextrose as above
Blood glucose level should now be above 4mmol/L. Give 20 g of long acting carbohydrate e.g. 2 biscuits or a slice of bread or next meal if due. If IM glucagon has been used give 40g of long acting carbohydrate in order to replenish glycogen stores ***For enterally fed patients ONLY:*** Restart feed or give bolus feed as per guideline or IV 10% glucose at 100ml/h		Recheck glucose level after 10-15 minutes, it should now be above 4mmol/L. Follow up treatment as described on the left: **If nil by mouth (NBM) give 10% glucose infusion at 100ml/h until no longer NBM or reviewed by doctor**

DO NOT OMIT SUBSEQUENT DOSES OF INSULIN, CONTINUE REGULAR CAPILLARY BLOOD GLUCOSE MONITORING FOR 24 TO 48 HOURS AND GIVE HYPO EDUCATION OR REFER TO DIABETES INPATIENT SPECIALIST NURSES FOR ADVICE

BGL – Blood Glucose Level

If hypoglycaemic on IV insulin stop IV insulin, treat as protocol. Once blood glucose greater than 4mmol/L restart insulin.
Review insulin rate and/or fluids. Consider changing fluids to 10% dextrose

20% Dextrose infusion bag is in the treatment room on all wards

Medical First Responders
• In patients who are unconscious +/-having seizures+/-very aggressive • Airway, Breathing,(give O2), Circulation, Disability (including GCS & blood glucose) and Exposure (including temperature), Consider critical care review • IV access: pink cannula or larger • Give **100ml of 20% dextrose or 200mls of 10% dextrose** • Give IM 1mg Glucagon if unable to gain IV access promptly • Check capillary glucose at 10-15 mins to ensure it rises to at least 4mmol/l • If not above 4mmol/l at 15 minutes give further bolus of IV dextrose – a second dose of glucagon is unlikely to work if the first produces no effect – if glucagon has been used with no benefit IV access must be secured and IV dextrose must be given. • Once glucose >4mmol/l and patient recovered, give a starchy carbohydrate (see above) • Look for cause of hypo • Occasionally may need iv dextrose infusion (5% or 10% dextrose) if cause of hypo is due to intermediate or long-acting insulin or oral hypoglycaemic drugs

Post-Hypo Event Prevention and Management
• **CAUSE?** Look for cause so that future events can be avoided • **MONITORING:** QDS at minimum for next 48 hours • **DIABETES TEAM REFERRAL** - Especially if moderate/severe hypoglycaemia or if unsure of cause of hypo • **REVIEW TREATMENT** and glucose targets May need dose reduction of oral hypoglycaemic drugs or insulin (Reduce doses of insulin 10-20% of usual dose) Patient may need a change of insulin regimen or treatment For the frail, elderly and dependant patient, avoid tight glucose control

Potential Causes of Hypoglycaemia	
Oral Intake • Missed or delayed meals • Smaller meal than usual • Lack of access to usual between meal or pre-bed snacks • 'Nil by mouth' • Nausea/vomiting • Reduced appetite	**Medical Issues** • Inappropriate 'stat' or 'PRN' quick acting insulin not given with meal with subsequent risk of hypoglycaemia and rebound hyperglycaemia • Acute discontinuation of long term steroid therapy • Wrongly timed diabetes medication for meal/enteral feed • Incorrect insulin prescribed and administered • Regular insulin doses being given in hospital when these are not routinely taken at home • Renal failure, severe hepatic dysfunction or adrenal insufficiency • Recovery from acute illness

10 Guidance for Non insulin based treatments for type 2 diabetes

10.1 Biguanides

Metformin (aka Glucophage)

Actions: Reduces hepatic glucose output

Improves peripheral insulin sensitivity

Does not cause hypoglycaemia

Directions: Given with or after food 1-3 times daily

Risks:

GI side effects and reduced vitamin B12 absorption reported

Stop in acutely ill patients at risk of poor tissue perfusion or with raised lactate (lactic acidosis risk)

Suspend/stop if creatinine >150micromol/L or eGFR<30ml/min

Stop before and 48 hours after radiocontrast administration in anyone with GFR < 60ml/min. Check U and E 48 hours after contrast administration. Metformin should only be restarted if the creatinine is < 150micromol/l and/or the creatinine is not more than 30% worse than baseline if < 150micromol on the 48 hour post angiogram blood test

If metformin not restarted at 48 hours the urea and electrolytes should be rechecked at 7-10 days post angiography to assess whether metformin can be restarted.

10.2 Sulphonylureas

Glibenclamide

Gliclazide (aka Diamicron)

Glimiperide (aka Amaryl)

Glipizide (aka Minodiab)

Tolbutamide

Actions: Increase insulin secretion

Directions: Given with meals 1-3 times daily DEPENDING ON PREPARATION (CHECK IN BNF)

Risks:

Can cause hypoglycaemia – dose review advised when clinically indicated

Dose review advised in renal and hepatic impairment

Avoid in pregnancy except for glibenclamide

10.3 Thiazolidinediones ('Glitazones')

Pioglitazone (Actos)

Actions: Increases peripheral tissue sensitivity to insulin

Directions: Given once daily with or without food

Risks:

Can cause weight gain, oedema, anaemia and hypoglycaemia

Not to be used in patients with history of heart failure, bladder cancer or with high fracture risk

Stop in all patients with osteoporotic fracture

Stop in any patient with current bladder cancer or a history of bladder cancer as may be associated with increased risk

Dose review advised in renal and hepatic impairment

10.4 Incretin mimetics

Exenatide (Byetta, Bydureon))

Liraglutide (Victoza)

Lixisenatide

Dulaglutide

Actions: Increase insulin secretion, with weight loss in responding patients

Directions: Given twice daily 60 minutes prior to main meals (exenatide), once daily anytime, around same time daily (liraglutide, lixisenatide). Once per week (bydureon, Dulaglutide)

Risks:

Hold if GFR < 50ml/min + d/W diabetes team re continued use as drugs vary in guidance

GI side effects and pancreatitis reported with these agents – stop if patient admitted with pancreatitis

Not to be used in pregnancy, history of pancreatitis or other pancreatic disease

Stop in hepatic impairment

10.5 DPP-IV inhibitors

Sitagliptin (Januvia)

Saxagliptin (Onglyza)

Vildagliptin (Galvus)

Linagliptin (Tradjenta)

Alogliptin

Actions: Indirectly reduce clearance of endogenous insulin

Directions: Given once or twice daily (depending on preparation) at any time of day, with or without food

Risks:

Low risk of hypoglycaemia

Avoid in pregnancy

Dose review/omission advised in renal and hepatic impairment – suggest discussion with diabetes team for any patient with GFR < 50ml/min as guidance on individual agents varies

Avoid if history of pancreatitis

10.6 SGLT2 blockers

Dapagliflozin (Forxiga)

Canagliflozin (Invokana)

Empagliflozin (Jardiance)

Actions: Inhibits glucose up take in the renal tubule

Risks

Stop If patient on or starting diuretics particularly frusemide

Stop if eGFR <60 – discuss continued use with diabetes team if on canagliflozin/empagliflozin as may continue to eGFR of 45 in some patients

Stop if patient unwell with deteriorating renal function (discuss with diabetes team as may need alternative treatment for diabetes)

May cause postural hypotension, especially in the elderly – review use in patients with postural dizziness and in the elderly with a history of falls where postural hypotension is thought to be a contributor.

Avoid in pregnancy.

10.7 Combined formulation medications

Pioglitazone + Metformin (aka Competact)

Sitagliptin + Metformin (aka Janumet)

Vildagliptin + Metformin (aka Eucreas)

Actions: As for individual agents

Directions: Given twice daily with or just after food

Risks:

As for individual agents

10.8 Prandial glucose regulators

Nateglinide (aka Starlix)

Repaglinide (aka Prandin)

Actions: Increase insulin secretion

Directions: Given 30 minutes before meals up to 3 times (Nateglinide) or 4 times (Repaglinide) daily

Risks:

Can cause hypoglycaemia – dose review advised when clinically indicated

Dose review advised in renal and hepatic impairment

10.9 Alpha-glucosidase inhibitors

Acarbose (aka Glucobay)

Actions: Reduce carbohydrate absorption from small intestine

Directions: Given with meals 3 times daily

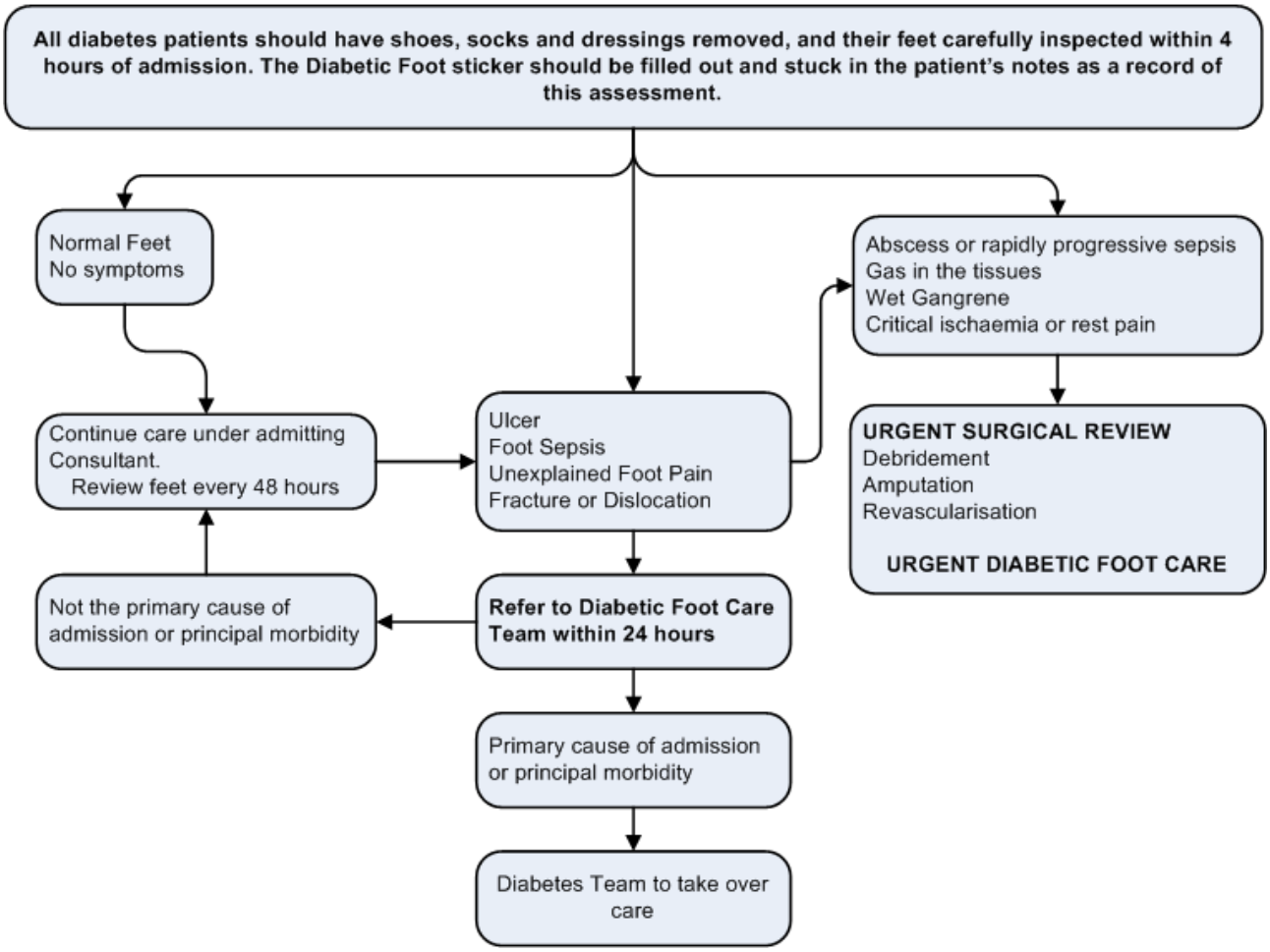
Risks:

GI side effects widely reported

Can cause hypoglycaemia – dose review advised when clinically indicated

Dose review advised in renal and hepatic impairment

11 DIABETES INPATIENT FOOTCARE PATHWAY



DIABETIC FOOT CARE TEAM

REFERRALS
BLEEP 1223 (Monday to Friday)
or
contact Dr Smith or Dr Lawrence or Dr Zarif direct

DIABETIC FOOT CLINIC – Daily in the Vascular and Diabetes Unit.

ALL PATIENTS WITH A DIABETIC FOOT ULCER SHOULD HAVE

- ✓ XRAY of the foot and consideration of MRI to assess for osteomyelitis.
- ✓ ORTHOTICS referral for pressure off-loading footwear (**extension 4175**). Until footwear fitted patients should be minimal weight bearing.
- ✓ ARTERIAL DUPLEX. Refer to vascular surgeons if significant stenoses or monophasic waveforms
- ✓ WOUND SWAB if infected
- ✓ WOUND DRESSING – Inadine and Allevyn until diabetic foot team review
- ✓ ANTIBIOTICS if signs of infection (see diabetic foot sepsis guidelines on ICID)

12 References

1. NHS Diabetes: Safe and Effective use of Insulin in Hospitalised Patients
2. NHS Diabetes: The Hospital Management of Hypoglycaemia in Adults with Diabetes Mellitus
3. http://www.diabetes.nhs.uk/safe_use_of_insulin/
4. Diabetes UK: The Balance Guide to Testing & Treating Diabetes 2010
5. NHS Institute for Innovation and Improvement: ThinkGlucose Toolkit

13 Acknowledgements

Dr Mayank Patel and the Southampton Inpatient Diabetes Team for sharing their inpatient handbook with us
Insulin Activity Profile Graphs Page
Taken with permission from http://www.leicestershirediabetes.org.uk/