

Clinical Support Guide | Injectable treatments for adults with diabetes

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1. Using this guide

This publication is intended as a resource for CHSA staff who provide care and education to people with diabetes. The guide includes an overview of the underlying principles for starting insulin and GLP1 agents along with practical tips on initial patient education. A glossary of terms associated with diabetes and its treatment is also provided.

The sharing of responsibility for the routine management of diabetes brings exciting new opportunities and challenges for staff in the inpatient, outpatient, community and aged care setting. It is recommended that the advice of a credentialed diabetes educator be sought to support the appropriate level of care for patients.

Educating people with diabetes about their condition and how to self-manage aspects of their care such as self-injecting is vitally important for managing blood glucose levels. This in turn will assist in minimising risks of hospital admission and future complications.

The person's medical practitioner or nurse practitioner is also responsible for explaining the options and will prescribe the appropriate injectable treatment (eg insulin or GLP1). Nurses and midwives have an important role in providing the applicable education to support safe self-injection and self-management.

This guide is not a complete or definitive resource but is designed to be used in conjunction with SA Health and SA Government regulatory documents regarding scope of practice, competencies and professional development frameworks.

2. Glucose/insulin metabolism

The body needs glucose all the time. Glucose is supplied by carbohydrate (CHO) foods and via the liver, (in the absence of CHO intake eg overnight). Glucose needs to be available at a relatively constant rate all the time (known as basal blood glucose).

Insulin is the hormone produced in the pancreas. Insulin enables glucose in the blood to be taken up by the body cells and also suppress liver glucose production. A steady release of insulin (known as basal insulin) is therefore needed to maintain normal blood glucose (BG) levels. There is also a burst of insulin released in response to meals (known as bolus insulin). Whenever glucose is released into the bloodstream from carbohydrate (CHO) digestion, insulin is released to move the glucose into the cells and maintain homeostasis.

Figure 1: Example of normal basal insulin profile

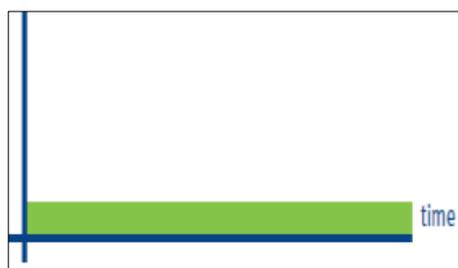
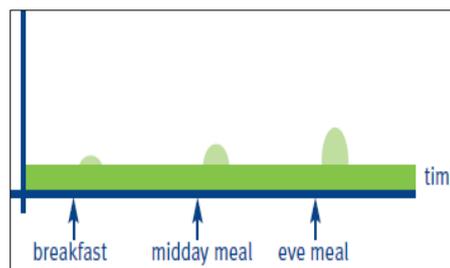


Figure 2: Example of normal mealtime insulin profile



People with type 1 diabetes don't produce any insulin and require multiple doses of injected insulin every day or an insulin pump. People with type 2 diabetes will need injected insulin/GLP1 analogues, when nutritional modification, physical activity and oral hypoglycaemic agents (OHAs) are no longer sufficiently effective in maintaining their individual blood glucose targets.

3. Choosing the right therapy for the person

There will be a range of possible treatments and no one choice is suitable for everyone. Whichever option is chosen, there must always be a clear rationale behind the decision.

4. Insulin therapy

Patients with any type of diabetes (eg type 1 diabetes, type 2 diabetes and gestational diabetes mellitus (GDM)) can benefit from insulin treatment.

Indications for insulin therapy include;

- > unsatisfactory glycaemic control such as blood glucose out of target range
- > oral hypoglycaemic treatments not tolerated/contraindicated (in type 2 diabetes).

Modern insulin aims to mimic the natural pattern of insulin production and is available in five main categories;

- > rapid acting (preferred mealtime bolus insulin) eg NovoRapid[®], Humalog[®], Apidra[®]
- > short acting eg Actrapid[®] and Humulin R[®] are limited to IV insulin infusions only
- > long acting (most commonly used basal insulin eg Glargine (Lantus[®]U100 and Toujeo[®]U300) Determir (Levemir[®])
- > intermediate acting eg Protaphane[®] is used less commonly as basal insulin
- > premixed (rapid or short acting mixed with intermediate acting insulin) eg NovoMix[®] 30, Mixtard[®] 30/70, Humalog[®] Mix 25, Humalog[®] Mix50
- > co-formulation (rapid mixed with long acting analogue) eg Ryzodeg 70/30.

Long acting basal insulin therapy

Basal insulin therapy alone is inadequate for people with type 1 diabetes. In type 2 diabetes, basal insulin can be used alone or used in combination with OHA's or mealtime insulin;

- > who have a blood glucose profile that would respond to the addition of basal insulin
- > who are unable to inject themselves thus requiring supportive care
- > whom optimising control is not vital, such as an older person with history of severe hypoglycaemia, limited life expectancy, advanced complications or extensive comorbid conditions.

Lantus[®] is the most commonly prescribed long acting basal insulin.

Toujeo[®] is a new HIGH STRENGTH long acting basal insulin. Toujeo[®] is U300 meaning it is 300 units per ml as compared to Lantus[®] which is U100 (100 units per ml). Toujeo[®] is three (3) times the strength of Lantus.

Toujeo[®] may be considered in people on large doses of Lantus[®]. Toujeo[®] is only available in a pre-filled disposable insulin pen device. It is not available in a 3ml pen fill.

Toujeo[®] MUST NOT be administered via insulin syringe. Drawing up with an insulin syringe will result in an INCORRECT insulin dose.

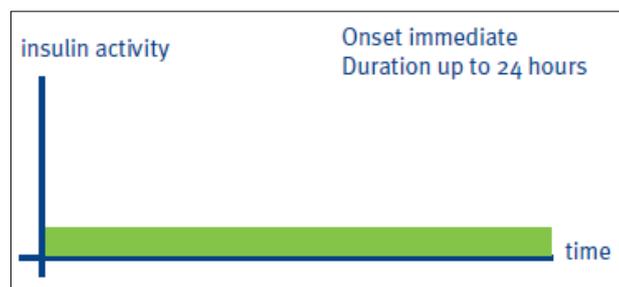
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It is common to combine basal insulin with OHA's in type 2 diabetes. The advantages include;

- > long acting basal insulin is generally a once daily injection (in some cases twice daily injections may be needed)
- > long acting insulin provides 24 hour basal coverage (most people) with no pronounced peak thus reducing the risk of hypoglycaemia and hyperglycaemia
- > improved glycaemic control while insulin is being introduced and the dosage adjusted
- > less risk of weight gain.

In GDM, basal insulin can be used alone.

Figure 3: Long acting basal insulin profile bolus insulin profile



Case study: Gerry

'I've been dreading this day for the past 10 years', said Gerry as he came into the office. His GP's referral spelled it out: 'Gerry has a strong aversion to injections. Knowing that I might be suggesting insulin therapy, he has had at least two sleepless nights.' His HbA1c was 80mmol/mol (9.5%), and the results of his home blood glucose tests were consistently between 10 and 14mmol/Ls. He was diagnosed with type 2 diabetes in 2004 and on maximum doses of his oral medication for the past 4 years.

The nurse explained (and showed him) that insulin needles are tiny. The nurse persuaded him to do a 'dry' injection. Gerry was amazed – not only did it not hurt, but he could hardly feel it at all. Gerry decided to start once-daily long acting insulin (Lantus®U100) in combination with his tablets. The nurse also referred Gerry to the local credentialled diabetes educator for an update of his blood glucose monitoring, sick day action plan and hypo action plan. Within two months his HbA1c had fallen by 11mmol/mol (1.5%) to 69mmol/mol (8.0%). Because he felt so much better, Gerry was able to exercise more and started taking more notice of his carbohydrate intake and distribution. As a result, he lost 3kgs of unwanted weight and is closer to achieving his healthy weight.

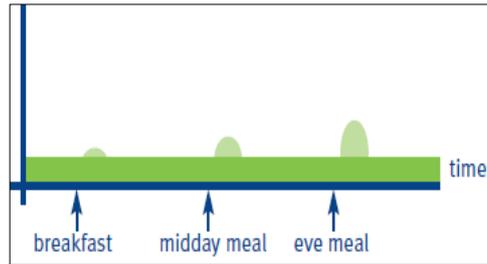
Basal bolus insulin therapy (also known as multi-daily injection/MDI)

Basal bolus insulin therapy is highly recommended in people with type 1 diabetes. For people with type 2 diabetes, it is recommended in those who have had diabetes for many years and;

- > produce little endogenous insulin themselves
- > have a blood glucose profile that would respond best to multiple injections
- > have an elevated HbA1c that is unlikely to respond to basal insulin alone
- > need to optimise blood glucose control because of complications, illness or an infection
- > who need flexibility because of an irregular routine (eg meal times, shift work, regular travelling, regular/spasmodic sport).

In GDM, basal bolus insulin may be used.

Figure 4: Basal bolus insulin profile



Case study: Nicole

Nicole is 14 years old and was diagnosed with type 1 diabetes at the age of 7. At diagnosis, Nicole was prescribed twice daily short acting insulin (Actrapid®) and intermediate acting insulin (Protaphane®). Her parents would give her insulin injections using a syringe and 'auto injector' as she hated needles. Nicole enjoys netball and was recently accepted in the SAPSASA Talent Squad. She has just started training 3 nights per week and is finding her twice daily injections too restrictive. She is also worried that she might hypo, be embarrassed, and miss out on playing a game.

Nicole was recommended to change to basal bolus insulin therapy to allow her more flexibility to adjust her insulin around her training and meals. Nicole found her new regimen of once-daily long acting insulin (Lantus®U100) and rapid acting insulin (NovoRapid®) with her main meals, new injection devices (disposable insulin pens), CHO counting and adjusting her doses for exercise a bit challenging at first but is more confident now and is happy she has minimised her risk of hypos for netball.

Case study: Barry

Barry is 38 years old and has had type 2 diabetes for 15 years. He is on maximum OHAs, and his HbA1c is 92mmol/mol (10.6%). Barry works shifts in a bakery and rises early most mornings during the week. When on roster, he returns home to sleep during the afternoon. Barry has been on a basal insulin for 2 years and knows it is not enough to control his blood glucose levels after eating.

Barry's GP offers a switch to pre-mixed insulin twice daily but Barry's working hours do not offer a stable meal, physical activity or sleep pattern this was agreed that this was not a good fit. His GP then offers to retain his basal insulin but prescribe extra rapid acting insulin with his breakfast as a start. If his blood glucose levels remain out of target during the afternoon and/or evening when he eats CHO, Barry understands that additional rapid acting insulin with those meals/times may be needed. Barry is happy and agrees with the 'stepped approach'.

Pre-mixed insulin therapy

Twice daily premixed insulin is an option in people with type 1 diabetes but is not recommended as 'best practice'. As an alternative to basal bolus insulin therapy, twice daily premixed insulin may be prescribed if the person declines basal bolus insulin or requires assistance to administer insulin. In people with type 2 diabetes, once or twice daily premixed insulin may be a suitable choice;

- > with very regular lifestyles, who eat similar amounts of CHO at similar times every day
- > who have a blood glucose profile that would respond to a predetermined ratio of basal insulin and rapid acting insulin.

The advantages include:

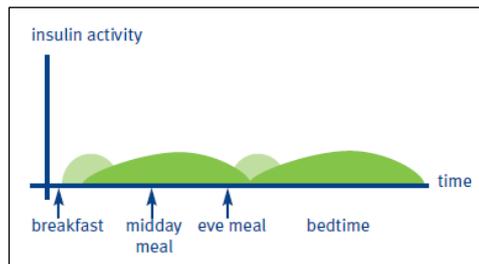
- > a prepared mixture of rapid/short acting insulin and intermediate acting basal insulin at a prescribed ratio

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- > four (4) choices of prescribed ratio
 - NovoMix® 30 - 30% rapid acting insulin with 70% intermediate acting basal insulin
 - Humalog® Mix 25 - 25% rapid acting insulin with 75% intermediate acting basal insulin
 - Humalog® Mix 50 - 50% rapid acting insulin with 50% intermediate acting basal insulin and
 - Mixtard® 30/70 - 30% short acting insulin with 70% intermediate acting basal insulin
- > the rapid acting insulin covers the meal, while the intermediate acting insulin provides basal insulin coverage
- > can be prescribed daily (breakfast or evening meal) or twice daily.

In GDM, pre-mixed insulin is not used.

Figure 5: Premixed insulin profile



Common side effects of insulin

The common side effects of insulin include:

- > hypoglycaemia – the risk is increased the young and the old, those who have had diabetes for many years, those using rapid acting insulin and those that are unable to recognise the symptoms of low blood glucose levels
- > local reaction at injection site
- > weight gain.

Case study: Peter

Peter is 16 years old and was diagnosed with type 1 diabetes at the age of 6. At diagnosis, he was prescribed twice daily short acting insulin (Actrapid®) and intermediate acting insulin (Protaphane®) and at 13 years old, he was transferred to basal bolus insulin using once-daily long acting insulin (Lantus®U100) and rapid acting insulin (NovoRapid®) with his main meals. Due to recent events, Peter has not been managing his diabetes well and feels like he needs 'time out' from it all.

Peter's diabetes specialist offered a 'rest from basal bolus insulin' until his home life settles down and is prescribed premixed insulin (NovoMix30®) twice daily. He is encouraged to recommence blood glucose monitoring and asked to ring the credentialled diabetes educator each week with his blood glucose results. Peter knows that 'it is not the best way to give insulin', but will concentrate on 'not missing doses' and will consider returning to basal bolus insulin therapy in 3 months at his next diabetes specialist review.

Case study: Rosemary

Rosemary is 66yrs old and has had type 2 diabetes for 12 years. She is overweight, with a BMI of 29. She has coronary heart disease and stage 3 renal impairment. Her HbA1c is 75mmol/mol (9.0%). She takes Gliclazide 120mg daily, and has had her Metformin ceased due to her progressive renal disease. Rosemary is trying hard to keep her weight steady, and as she has just retired from her shift work job, she is now able to have regular meals with equal carbohydrate amounts and has started walking with a friend in the afternoons.

Having a regular routine enables Rosemary to manage premixed insulin (Humalog®Mix25) twice daily injections well. The dietitian has reviewed her knowledge of carbohydrate exchanges and the credentialed diabetes educator has modified her action plans for hypo and hyperglycaemia/sick days. This has been reviewed and updated since she retired. She has had no 'hypos' and her HbA1c is the lowest it's been for a long time at 56mmol/mol (7.3%).

Co-formulation insulin therapy

Ryzodeg is a co-formulation insulin consisting of 70% insulin degludec and 30% insulin aspart. Degludec is an ultra-long acting basal insulin whereas aspart is a very rapid acting meal related insulin.

The actions of these individual insulins act independently. Unlike pre-mixed insulins, they exist separately in the solution and in the subcutaneous tissue which allows them to retain their individual clinical activity while being administered together. Premixed insulins interact with one another and in doing so, compromise their clinical activity.

Ryzodeg is indicated in both type 1 and type 2 diabetes and is available in insulin cartridges and disposal pens. It does not require resuspension.

Ryzodeg, due to the large basal component, is administered once daily with the largest carbohydrate meal of the day.

In type 1 diabetes, it has been demonstrated to:

- > reduce variability of the glucose-lowering effect.
- > reduce the risk of nocturnal hypoglycaemia.

In type 2 diabetes, studies have identified lower rates of hypoglycaemia, a lower total daily dose and a reduction in fasting blood glucose levels.

5. Choosing an insulin delivery device

Insulin can be administered via insulin syringe, injection device or by continuous subcutaneous insulin infusion (commonly called insulin pumps). The choice of insulin can also be influenced by the type of injection delivery device the person prefers.

The current SA Health benchmark and recommended method of insulin administration by nurses in an inpatient setting is with an insulin syringe. Insulin syringes vary in size (eg 100 unit, 50 unit or 30 unit) and are identifiable by an orange cap and needle insitu. **Using any other syringe will result in an INCORRECT insulin dose.**



Figure 6: Example of insulin syringe

There are two main types of injection devices for insulin and both are for 'individual' use only.

An insulin pen is a convenient way to administer insulin and is available in two basic types: disposable and reusable. Disposable insulin pens come already filled with insulin. When a pen is empty or expired, it is simply discarded. Re-useable insulin pens have a replaceable cartridge of insulin. The cartridge is replaced when the insulin is used or expired.

Examples of disposable and reusable insulin pens

	Novo Nordisk		SANOFI		Lilly	
Disposable Insulin Pens	FlexPen® 	FlexTouch® 	Solostar® 	Toujeo® 	KwikPen® 	
Reusable Insulin Pens	NovoPen® 4 	NovoPen Echo® 	Allstar PRO® 		Luxura® HD 	Savvio® 

A delivery device is larger and easier to handle than insulin pens. They have clear, readable dials and easy-to grip shapes that are designed for people with vision problems and poor hand control. A delivery device works like a disposal pen, it comes already filled with insulin and when it is empty or expired, it is simply discarded.

	Novo Nordisk
Disposable Delivery Device	InnoLet® 

Figure 7: Example of disposable delivery devices

All insulin cartridges and prefilled pens are available on prescription.

Insulin pens and delivery devices are used by the patients and/or carers to administer insulin. It is recommended that safety pen needles be used by patients and/or carers while supported/supervised by nursing staff.



Figure 8: Example of BD AutoShield Duo Safety Pen Needle

Continuous subcutaneous insulin injections (Insulin pump therapy)

Insulin pump therapy is a continuous subcutaneous insulin infusion (CSII). The aim of CSII is to mimic normal endogenous insulin production. At present, insulin pump consumables are only subsidised for people with type 1 diabetes.

Rapid acting insulin (NovoRapid®) is infused 24 hours a day by a device called an insulin pump. The pump is connected by tubing to a catheter which is inserted into the subcutaneous (fat) layer of the skin. The tubing, catheter and site need to be replaced every 3 days.

Basal insulin requirements can be programmed for each hour or at a temporary rate and bolus insulin doses can be administered when eating carbohydrates at meals/snacks or periodically, to correct hyperglycaemia.

Insulin pump therapy offers flexibility with insulin administration however, as only rapid acting insulin is used, diabetic ketoacidosis can develop within 3-4 hours if the insulin is not administered correctly (eg pump removed for showering and not reconnected, catheter blocked, tubing kinked, pump dropped and damaged).

Figure 9: Examples of insulin pumps



Case study: Madeline

Madeline has type 1 diabetes and is quite sensitive to insulin requiring very small doses. She is at significant risk to hypoglycaemia and is keen to use an insulin pump as it will allow her to program her basal insulin rates for each hour of the day and night. She is also really looking forward to feeling more in control with regards to her bolus insulin doses at meal times.

To prepare for insulin pump therapy, Madeline is reviewed by the diabetes specialist. After a number of appointments with the credentialed diabetes educator and dietitian, her 'insulin pump start' admission is booked. Her initial rates are:

Basal rate:	1.2 units/hour
Carbohydrate to insulin ratio (CHO: insulin):	12.5gms
Target blood glucose levels:	6.0mmol/L
Insulin sensitivity factor (ISF):	2.5mmol/L
Insulin action (IOB):	4 hours

Madeline is also provided with information on reducing her current insulin prior to the 'insulin pump start' admission and what follow up with the diabetes team is required following discharge.

6. In hospital insulin administration

In hospital, insulin will be administered via an insulin syringe by a nurse as outlined in the Medication Management and Administration – Roles and Responsibilities of Nurses, Midwives and student nurses / midwives in CHSALHN sites procedure (Country Health SA Local Health Network 2018).

An insulin injection device (pen or pump) may be self-managed under certain circumstances. Self-managing an insulin device will require assessment that the person is competent to prepare the insulin delivery device, administer the prescribed dose and dispose of the used sharp (eg pen needle) immediately.

HIGH STRENGTH insulin (Toujeo®) is 300 units/mL and **MUST NOT** be administered via insulin syringe. Toujeo® is available **ONLY** in an insulin pen. **Using an insulin syringe will result in an INCORRECT insulin dose.**

Key Points

- > If a person with diabetes brings their own insulin delivery device into hospital, assessment of their self-administration is needed to ensure safe and appropriate practice.
- > The person with diabetes who is deemed capable of 'self-injection' must continue to administer the prescribed dose under the supervision of a nurse.
- > If the person with diabetes is unable to safely administer insulin via the insulin delivery device (eg deterioration in mental or physical status), the nurse should administer subcutaneous insulin via an insulin syringe.

- > **HIGH STRENGTH** insulin (Toujeo®) can be continued if the patient can self-administer.

If the person is unable to self-administer, the prescribing medical officer will cease Toujeo® and order Lantus® 100 units/mL which will be administered by a nursing staff using an insulin syringe. A 20% dose reduction in dose may be considered.

In the event the person regains the ability to self-administer, the prescribing medical officer will cease Lantus® and recommence Toujeo® at a 1 to 1 unit dose ratio.

- > Consult with the credentialled diabetes educator or diabetes link nurse for advice and/or assessment.

Timing of insulin injections

- > Long acting basal insulin (Lantus® U100) is usually administered once a day, most commonly at 2100hrs. It is important to administer long acting basal as close to the same time every day.
- > In some cases, long acting insulin will be administered twice a day. Rapid acting mealtime bolus insulin (NovoRapid®) is best administered immediately before the meal. There should be no delay between administration of the insulin and the person eating.
- > Rapid acting insulin may also be given immediately after a meal and is often used in this way to identify the amount of carbohydrate they have actually eaten and then what dose is required for the carbohydrate consumed. It is also used in acute illness (eg patient feels anorexic or nauseated and unsure what they might be able to tolerate).

Insulin dose titration or adjustment

Before the adjustment of any insulin is made, it is important to consider all influences on blood glucose levels (eg carbohydrate intake, mealtimes, eating late or overnight), activity level changes, other medication changes and concurrent illness. Always consult the prescribing medical practitioner if any concerns regarding dosage.

The treatment aim is for an improvement in blood glucose levels by matching the insulin to the person's requirements, not matching the person to a specific insulin dose. Dose titration is undertaken by assessing blood glucose levels and then titrating the insulin that is responsible for blood glucose at that time of the day:

All blood glucose levels consistently higher than target:

- > indicates not enough basal insulin, suggest increasing the basal insulin dose.

Fasting (before breakfast) blood glucose is not in target:

- > the only insulin impacting on fasting blood glucose is the basal insulin. There will be no impact from the rapid acting insulin administered at teatime the night before. Suggest increasing the basal insulin dose.
- > high fasting blood glucose - increase evening basal insulin dose
- > low fasting blood glucose - decrease evening basal insulin dose.

Lunchtime (before lunch) blood glucose is not in target:

- > mainly influenced by the breakfast rapid acting insulin dose
- > high blood glucose before lunch - increase breakfast rapid acting insulin
- > low blood glucose before lunch - decrease breakfast rapid acting insulin.

Teatime (before evening meal) blood glucose is not in target:

- > mainly influenced by the lunch time rapid acting insulin dose
- > high blood glucose before tea - increase lunch rapid acting insulin
- > low blood glucose before tea - decrease lunch rapid acting insulin.

2100 hours (eg before bed) blood glucose is not in target:

- > mainly influenced by the teatime rapid acting insulin dose
- > high blood glucose at 2100 - increase teatime rapid acting insulin
- > low blood glucose at 2100 - decrease teatime rapid acting insulin.

7. GLP1 therapy

Glucagon like peptide 1 (GLP1) and glucose dependent insulintrophic polypeptide (GIP) are incretin hormones normally produced by the gastrointestinal tract in response to carbohydrate digestion and are necessary for the maintenance of glucose homeostasis.

Synthetic GLP1 mimics the action of naturally secreted GLP1. GLP1 should not be used in people with type 1 diabetes. GLP1 is not recommended for use in children.

GLP1 may be used in people with type 2 diabetes to improve blood glucose control in combination with diet and exercise who:

- > have unsatisfactory glycaemic control despite use of metformin, sulphonylureas or the combination, particularly elevated post prandial blood glucose levels

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- > have a HbA1c which exceeds 53mmol/mol (7.0%). GLP1 analogues are not PBS subsidised for use in combination with basal insulin.

GLP1 treatment is an additional option to oral medication and can also be used in combination with oral medication.¹

The advantages of GLP1 therapy include;

- > increase insulin secretion from the pancreas in a glucose dependent manner (eg no risk of hypoglycaemia unless combined with a sulphonylurea)
- > decrease glucagon secretion from the pancreas
- > slow gastric emptying, and increase satiety.

GLP1 does not induce hypoglycaemia when prescribed alone but when used in combination with sulphonylureas, the risk of hypoglycaemia is increased. The common side effects of GLP1 include:

- > nausea and sometimes vomiting - this usually resolves within 7-10 days but can be minimised by starting on a lower dose for 2-4 weeks and injecting immediately before food.
- > diarrhoea, dyspepsia, gastric oesophageal reflux disorder, abdominal pain, headaches and dizziness
- > small lumps at the injection site that do not disperse should be discussed and monitored.

The delivery device

All GLP1 therapies are dispensed in prefilled disposable devices. The weekly preparations (Figure 10) and the BD and once daily preparations (Figure 11) are in disposable pen devices which contain 4 weeks treatment. Demonstration packs are available to facilitate education.

Figure 10: Examples of weekly GLP1 therapies



Bydureon® (exenatide XR)

Trulicity® (dulaglutide)

Figure 11: Examples of daily GLP1 therapies



Byetta® (exenatide)

The GLP1 injectable pen is commonly used by the patients to self-administer insulin. It is recommended that safety pen needles be used by patients self-injecting whilst supervised and/or assisted by nursing staff. (Figure 12)



Figure 12: Example of BD AutoShield Duo Safety Pen Needle

Timing of GLP1 injections

- > Once a day (Byetta®) should be administered at the same time each day within the hour preceding a main meal.
- > Twice a day (Byetta®) should be administered within the hour preceding the 2 chosen meals with a minimum of six hours between injections (eg before breakfast and the evening meal).
- > Once a week (Bydureon®) and (Trulicity®) should be administered on the same day each week (can be a day or so either side, but not within 2 days of the next dose).

Dose titration or adjustment

- > Byetta® (once or twice a day) – initiate at 5micrograms BD for a minimum of one month. Titrate to a maximum of 10 micrograms BD.
- > Bydureon® 2mg and Trulicity® 1.5mg are pre-determined standard doses.

Case study: Lucy

Lucy's weight has always been an issue. She tells you that people she knows who have gone onto insulin have said they have put on lots of weight. Lucy's BMI had always been greater than 35; her HbA1c was 74mmol/mol (8.9%) on Metformin 1g BD and Gliclazide MR 120mgs daily. Lucy's blood glucose monitoring, hypo action plan and sick day action plan were reviewed and updated as part of the commencement of a new medication.

Lucy's GP suggested a six month trial with Exenatide BD in addition to her current medication was agreed. Lucy agreed and an initial dose of 5mcg BD was commenced which was increased to 10mcg BD after four weeks. Lucy did experience some mild nausea for the first 10 days but the problem resolved without treatment. After six months, Lucy's HbA1c had fallen to 61mmol/mol (7.7%), her weight had reduced (BMI33) and she reported that she had managed to reduce her portion sizes without feeling hungry. Lucy asked to continue the 'trial' indefinitely.

8. In hospital GLP1 administration

A GLP1 prefilled delivery device can be discussed and demonstrated with the person with type 2 diabetes where appropriate by a credentialed diabetes educator. Only following education and assessment should the person prepare the GLP1 delivery device, administer the prescribed dose and dispose of the used pen needle appropriately.

Periodic assessment to determine if the person can independently 'self-inject' and use the GLP1 delivery device is essential following discharge.

Key points

- > If a person with type 2 diabetes brings their own GLP1 delivery device into hospital, staff can contact the diabetes link nurse, or credentialed diabetes educator for advice and/or assessment.
- > During admission, the person with type 2 diabetes who is deemed capable of 'self-injection' can continue to administer the prescribed GLP1 dose under the supervision of the nurse.
- > If the person with type 2 diabetes is unable to independently self-administer GLP1 via the GLP1 delivery device (eg deterioration in mental or physical status), the registered nurse, diabetes link nurse or credentialed diabetes educator will need to contact the prescriber for alternate medication order. This is the current SA Health benchmark.

9. Getting the patient started on insulin and/or GLP1 injectable therapy

Some key considerations: ^{2,3,4,5,6}

- > **Does the person fully understand and agree with the injectable therapy that has been chosen?** If they are still reluctant to start injectable therapy, suggest a three month trial period; experience shows that very few people want to stop insulin once they have started but the idea of using it 'for life' can be daunting. If they refuse outright, you must respect their choice. It may be worth encouraging them to talk to someone who has already started insulin or GLP1 and is doing well.
- > **Have you done a dry injection?** Many people think they will have to use a large needle, and inject into a vein. It's important to allay their fears, and show them how easy and painless injecting can be with the short pen needles. They may well be able to concentrate on the rest of the discussion if you get the needle fear out of the way early.
- > **Has the person's personal choice and manual dexterity been considered?** It is recommended that the choice of device takes into account the person personal choice and physical capabilities (eg how heavy the pen may be and how easy it is to dial a dose and push the plunger). The size of the dose may also impact on the type of device. Some devices will deliver a bigger maximum dose than others.
- > **Is the person visually impaired?** If the person with diabetes is visually impaired, consideration should also be given to whether the pen has an audible click on dialling; the size of the numbers on the dial; whether appropriate magnifiers are available.
- > **Is the person needle phobic?** People with a fear of needles may prefer to use needles such as the auto shield safety needle, where the needle is not exposed during the injection.
- > **What size pen needle should be used?** Choosing the correct pen needle is also extremely important. Incorrect needle length can contribute to variability in insulin absorption thus causing unstable blood glucose readings. Most people will do best with a pen needle 6mm or shorter. The needle only needs to be long enough to pass through the skin into the fatty (subcutaneous) layer. Obese people do not need longer needles.
- > In hospital, insulin administration by nurses is by an insulin syringes with 8mm needles and 3ml pen fill insulin cartridges.

Choosing an injection site ^{5,6}

- > The abdomen is the recommended site for routine subcutaneous insulin or GLP1 as it offers the most even absorption rate, has adequate subcutaneous fat, and makes it easy to raise a skin fold. It is important to avoid any scars that may be present. If the abdomen is contra-indicated due to abdominal injury or wound, alternative sites include;
- > Thighs – slower absorption, can be used for alternate site for long acting insulin; very little subcutaneous fat thus higher risk of intramuscular injection.
- > Back of arms – medium to fast absorption, not recommended for self-injection.
- > Buttocks – slowest absorption, can be used for alternate site for long acting insulin.

Rotating injection sites ^{5,6}

Repeatedly injecting into the same spot will cause lumps (lipohypertrophy) which hinder insulin absorption resulting in unstable blood glucose levels. Lipohypertrophy is also unsightly and distressing to the person. Encourage the person to continuously rotate injection sites around the abdomen.



Figure 13: Lipohypertrophy

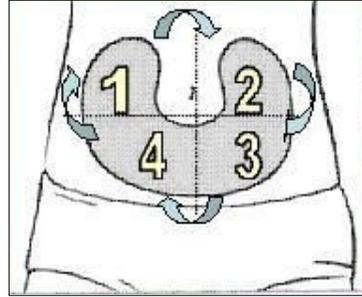


Figure 14: Rotation of sites

Each injection should be at least a finger's breadth away from the last one. Examine the abdomen with the flat of the finger and encourage the person to check for lumps on a regular basis at home. If lipohypertrophy is found, that area should not be used for injecting until it has become soft again. This may take weeks or even months, depending on the severity of the lipohypertrophy. Any sign of lipohypertrophy should be discussed with the person's medical practitioner and credentialed diabetes educator.

Injection technique ⁷

Injectable therapy (eg insulin and/or GLP1) is not to be given without a written or phone order. In the hospital environment, injectable therapy is to be checked by two nurses to ensure:

- > right client (eg using three nationally recognised identifiers)
- > right medication
- > right dose
- > right route
- > right time & date.

Pen needles come in 4mm, 5mm, 6mm and 8mm lengths. Shorter needles reduce risk of intramuscular injection and can also reduce the fear of injections.

For further information, refer to the CHSA Subcutaneous Insulin Administration in Hospital and Aged Care and CHSA Protocol Subcutaneous Insulin Administration in Community Care Setting.

Disposing of sharps disposal ²

Immediately discard syringe into sharps container. Do not re-sheath the needle. Remove personal protective equipment and attend hand hygiene.

For patients injecting using the safety pen needle, a red indicator band confirms the shield is locked in place and the needle has been used. Patients should hold by white sleeve when removing and discard into sharps container.

Used syringes, pen needles and lancets must be disposed of in an Australian Safety Standards approved sharps container which is puncture proof and has a secure lid.

Needle reuse

Needles and syringes are designed for single use only. Patients with diabetes should be informed that after use;

- > the needle will no longer be sterile
- > insulin/GLP1 may block the needle
- > the needle may be blunt or damaged and that damaged needles can bend or break under the skin, cause scarring and eventually reduce insulin absorption within the skin
- > extremes of temperature can cause insulin to leak from the needle if it is not removed from the pen; this could change the relative concentrations of pre-mixed insulin
- > air may enter the device through the needle, which can lower the dose and contaminate the insulin.²

It is important that the person is informed of the risk of sharps injury to family members, household visitors and refuse collectors. Careful and appropriate handling and disposal of sharps is of paramount importance.

10. Hypoglycaemia

Simply providing information is not enough. Understanding hypoglycaemia and knowing how to deal with it is an essential part of self-management. You may need to repeat the information several times and reinforce it in writing. A written 'hypo action plan' with details about the contents of their hypo kit will be needed. Ask the person with diabetes to repeat key facts and instructions back to you to check their understanding.

In severe hypoglycaemia, the person with diabetes may not be able to treat themselves or they may become unconscious, so their carer, partner, family or friends will need to know what to do. Include family in the discussion where possible. Discussion about having access to a glucagon injection kit at home should also occur for all people with type 1 diabetes, especially for those with a history of severe or unconscious hypoglycaemia. Any loss of consciousness will require the usual emergency response and an ambulance.

Figure 15: Example Glucagen Hypo Kit



For further information pertaining to hypoglycaemia, refer to the CHSA Hypo Protocol [on SharePoint](#).

11. Hyperglycaemia and sick days

Every person with diabetes no matter what type of diabetes or what treatment should have an individualised sick day action plan.

For further information pertaining to hyperglycaemia, refer to the CHSA Diabetic Ketoacidosis and Hyperglycaemia Hyperosmolar State Protocol [on SharePoint](#).

Documentation

It is important to record the BGL and sign the dose of insulin administered on the appropriate chart (eg National Inpatient Medication Chart, Basal-Bolus Insulin Chart: Adult MR62A).

When rotating sites, record the area in which the injection was given and skin condition in progress notes. If soreness, bruising, welts, redness, swelling, rash or lumps occur at injection site, document and report to the medical practitioner.

Document any unplanned effect (medication allergy and any Adverse Drug Reaction (ADR)). In the event that the medication is not administered (eg missed dose, drug unavailable, patient refuses), document reason in progress note and notify medical practitioner.

Document any education provided. Writing everything down can be helpful for the person, especially when new to insulin and/or GLP1. Ensure the person has a blood glucose monitoring diary and has their injectable doses recorded.

Discharge from hospital

Arrange an urgent follow up appointment with the credentialed diabetes educator for those patients admitted with either hypoglycaemia or a hyperglycaemic emergency (Diabetic Ketoacidosis or Hyperglycaemic Hyperosmolar State). Other non-urgent referrals include;

- > newly commenced/changes to insulin - needs medication self-management action plan
- > blood glucose/ketone monitoring hyperglycaemia/sick day action plan (or review and update)
- > hypoglycaemia action plan (or review and update).

Provide both a routine contact and an out of hours emergency number. For example, in hours, the patient can contact their usual medical practitioner and after hours contact their local hospital.

National Diabetes Services Scheme (NDSS)

NDSS products, such as insulin syringes and insulin pen are available free of charge to all Australian residents from NDSS Access Points, mostly community pharmacies.

Blood glucose monitoring strips, blood ketone monitoring strips and insulin pump consumables are also available from Access Points at a subsidised price.

Where an Access Point does not stock the product, products can be ordered by and delivered to the Access Point, usually within 24 hours.

Disposal of sharps

Procedures for disposing of sharps containers may vary. The patient should be advised to contact their local diabetes service or local council for information. Sharps must never be disposed of in household or industrial waste.

Additional information

- > Blood glucose monitoring – initial timing and frequency of tests. Discuss this with the credentialed diabetes educator or medical practitioner.
- > Weight gain/loss – many people put on weight when they start insulin. They will need a strategy to maintain their current weight. Weight loss has been seen in the studies using GLP1 however, weight loss only happens if their calorie intake is reduced in response to effects on their appetite.

- > Carbohydrates – appropriate quantities and regular intake of carbohydrates will help stabilise blood glucose levels. People may need to be reminded which food groups these are. Refer to the credentialled diabetes educator or dietitian for education.

Conclusions

All patients with diabetes should be encouraged to actively participate in their diabetes management as much as possible. Promote a joint responsibility where by the patient commits to the self-management actions and your responsibility is to provide the most appropriate education and support to do so. Educating people with diabetes, their carer's, partners and families is therefore a vitally important part of every nurse's role.

We hope that this resource in conjunction with local support via the CHSA Diabetes Service staff will lead to increased knowledge and expertise for both nurses and patients, and improved health and wellbeing for people with diabetes requiring injectable diabetes treatments in our CHSA hospitals.

12. Glossary

Basal bolus insulin Basal bolus insulin regimen involves taking a longer acting form of insulin to keep blood glucose levels stable through periods of fasting as well as separate injections of shorter acting insulin to prevent rises in blood glucose levels resulting from meals.

Continuous subcutaneous insulin infusion Also known as an 'insulin pump', refers to the constant, continuous infusion of a short acting insulin driven by mechanical force (a pump) and delivered via a needle or soft cannula under the skin.

Glucagon A hormone produced by the alpha cells in the islets of Langerhans in the pancreas. Glucagon stimulates the production of glucose from the liver (the conversion of liver glycogen to glucose). Injecting a manufactured preparation of glucagon (Glucagon hypo kit) is used to treat severe or unconscious hypoglycaemia.

HbA1c (Glycated haemoglobin) An indicator of glycaemic control during the previous six to eight weeks. The lowest risk of long term diabetic complications is in people whose HbA1c is closest to the normal range (below 42mmol/ 6.0 percent). HbA1c targets will be modified to a high level for those at risk of hypoglycaemia.

GLP1 Glucagon like peptide 1 is a hormone produced in the gut following the ingestion of food. GLP1 enhances glucose dependent insulin production.

Insulin analogue A modern insulin preparation genetically engineered so that its action more closely resembles the normal physiological action of insulin in a person without diabetes.

Ketosis A state of severe insulin deficiency. Untreated, ketosis can lead to diabetic ketoacidosis, coma and death.

Metformin First line oral treatment for type 2 diabetes, especially for overweight people. It works by decreasing insulin resistance and the reducing the amount of stored glucose released by the liver.

Sulphonylurea A class of common oral medication for type 2 diabetes derived from sulphonamides. Drugs in this group stimulate insulin secretion. Hypoglycaemia is a side effect.

Type 1 diabetes Is an autoimmune disorder characterised by raised blood glucose levels caused by absolute insulin deficiency. People with type 1 diabetes require multiple dose insulin therapy or insulin pump therapy to survive.

Type 2 diabetes Raised blood glucose due to a combination of impaired insulin secretion and insulin resistance to the action of insulin at the cell level. Type 2 diabetes is a progressive disease, which frequently requires treatment with insulin to achieve glucose targets.

Gestational diabetes mellitus Is diagnosed when higher than normal blood glucose levels first appear during pregnancy when the amount of insulin needed for both the woman and her unborn child's requirements is increased. Hormones produced by the placenta that support the baby to grow and develop, reduces the effectiveness of insulin at the cellular receptor site.

13. CHSA Diabetes Service resources on [SharePoint](#)

CHSA Hypoglycaemia Protocol (2016)

CHSA Hyperglycaemia Protocol (2018)

CHSA Diabetic Ketoacidosis Protocol (2016)

CHSA Hyperglycaemia Hyperosmolar State Protocol (2016)

CHSA Fact Sheets

- > Insulin in type 1 diabetes - Basal bolus
- > Insulin pump therapy in type 1 diabetes
- > High blood glucose (includes sick day plan)
- > Low blood glucose
- > Starting insulin in type 2 diabetes
- > Starting insulin in gestational diabetes

CHSA Diabetes Service website: www.chsa-diabetes.org.au

14. Useful links

Australian Diabetes Educators Association: <http://www.adea.com.au/>

Diabetes Australia: <http://www.diabetesaustralia.com.au/>

National Prescribing Service: <http://www.nps.org.au/>

Motor Vehicle Registration: <http://www.sa.gov.au/topics/transport-travel-and-motoring/motoring/drivers-and-licences/medical-fitness-to-drive>

Linked Documents

Document Name
CHSA Subcutaneous Insulin Administration in Hospital and Aged Care Protocol (2018)
CHSA Subcutaneous Insulin Administration in the Community Setting Protocol (2018)
CHSA Inpatient Blood Glucose Monitoring Chart (MR59H) (2014)
CHSA Inpatient Blood Glucose & Ketone Monitoring Protocol (2016)

References

Document Name
1. Griesdale DE, de Souza RJ, van Dam RM, Heyland DK, Cook DJ, Malhotra A, Dhaliwa R, Henderson WR, Chittock DR, Finfer S, and Talmor D, 2009, <i>Intensive insulin therapy and mortality among critically ill patients: A meta-analysis including NICE-SUGAR study data</i> . Canadian Medical Association. 180(8): p. 821-827.
2. American Society of Health-System Pharmacists, 2005, <i>Professional Practice Recommendations for Safe Use of Insulin in Hospital</i> . USA, American Society of Health-System Pharmacists.
3. Rosenstock J, Racciah D, Korányi L, Maffei L, Boka G, Miossec P, and Gerich J, 2013, Efficacy and Safety of Lixisenatide Once Daily Versus Exenatide Twice Daily in Type 2 Diabetes Inadequately Controlled on Metformin; A 24-week, randomized, open-label, active-controlled study (GetGoal-X). <i>Diabetes Care</i> . 36(10): p. 2945-2951.
4. National Institute for Health and Clinical Excellence, 2014, <i>Type 2 diabetes: The management of type 2 diabetes</i> . (cited 20th October, 2014); Available from: http://www.nice.org.uk/guidance/cg87/chapter/1-guidance .
5. Australian Diabetes Educators Association, 2017, <i>Clinical Guiding Principles for Subcutaneous Injection Technique</i> ; Technical Guidelines. Canberra.
6. Hicks, D, Adams, D, Diggle, J and Gelder, C, 2015, <i>The UK Injection Technique Recommendations</i> . United Kingdom, Forum for Injection Technique UK: 1-40.
7. Country Health SA Local Health Network, 2018, <i>Medication Management and Administration – Roles and Responsibilities of Nurses, Midwives and student nurses / midwives in CHSALHN sites</i> . Country Health SA, Adelaide.

Accreditation Standards

National Safety and Quality Health Service Standards (NSQHSS)

1	2	3	4	5	6	7	8	9	10
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Governance for Safety and Quality in Healthcare	Partnering with Consumers	Preventing & Controlling Healthcare Associated Infections	Medication Safety	Patient Identification & Procedure Matching	Clinical Handover	Blood & Blood Products	Preventing & Managing Pressure Injuries	Recognising & Responding to Clinical Deterioration	Preventing Falls & Harm from Falls

Evaluation and Quality Improvement Program (EQUIP)

11	12	13	14	15
<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Service Delivery	Provision of Care	Workforce Planning and Management	Information Management	Corporate Systems and Safety

Australian Aged Care and Quality Agency (AACQA) – Home Care Common Standards

1	2	3	Specific criteria: (e.g. 1.5, 3.1)
<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
Effective Management	Appropriate Access and Service Delivery	Service User Rights and Responsibilities	

Country Health SA Local Health Network

Australian Aged Care and Quality Agency (AACQA) – [Residential Aged Care Standards](#)

1 <input type="checkbox"/>	2 <input checked="" type="checkbox"/>	3 <input type="checkbox"/>	4 <input checked="" type="checkbox"/>	<i>Specific criteria: (e.g. 1.1, 4.5)</i>
Management Systems, Staffing and Organisational Development	Health and Personal Care	Care Recipient Lifestyle	Physical Environment and Safe Systems	

Consultation

Version	Consultation
1.0	SA Health Metropolitan Diabetes Services, NP-Diabetes - Mt Gambier, CHSA Diabetes Specialist Nurse Network, Director of Endocrinology.
2.0	SA Health Metropolitan Diabetes Services, Flinders University SA, NP-Diabetes - Mt Gambier, CHSA Diabetes Specialist Nurse Network, Clinical Pharmacists, CHSA Director of Endocrinology.