Teaching patients with type 2 diabetes to self-administer insulin

CPD

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Background
Type 2 diabetes mellitus (T2DM) is a progressive chronic condition. Glucose-lowering medications are initiated, maximised and combined throughout the patient journey. Prescribing insulin is an integral part of managing T2DM.

Objective
The aim of this article is to provide practical guidance to assist commencement of insulin.

Discussion
Access to specialist diabetes care for insulin commencement varies considerably according to disease complexity, service type, setting and location. Delays in commencing insulin can result in the patient experiencing further glycaemic deterioration, increasing the risk of developing or worsening diabetes-related complications. Initiation of insulin in primary care can involve more than determining the type and dose of insulin in order to achieve optimal patient outcomes. The key to successfully teaching patients to self-administer insulin, and allowing them to master the steps involved, is to focus on 'why' rather than 'what' to do.

IT IS ESTIMATED that the commencement of insulin therapy can be delayed for up to eight years after a patient's glycaemic control fails to achieve the target range on the maximum dose of non-insulin glucose-lowering medications (GLMs).[1] Starting insulin is a shared decision between general practitioners (GPs), patients, family and/or carers. Decision making pertaining to the type of insulin, frequency and dose also takes into consideration issues such as the individual's comorbidities, changes to non-insulin GLMs, physical and cognitive capacity, type of employment, care support and potential level of adherence.

In addition to addressing the concerns patients have about insulin, which can be wide-ranging, the most important message to convey is that the need for insulin is not their fault, nor have they failed in their management. Fear of needles, self-administration, hypoglycaemia and weight gain can be overcome with empathy and appropriate education. Promoting insulin as a normal part of the diabetes continuum and a beneficial change for long-term health will further improve patients' experience during the commencement of insulin.

Credentialled diabetes educators

The role of credentialled diabetes educators (CDEs) is not limited to patient education during insulin commencement. Patient education provided by CDEs after a diagnosis of type 2 diabetes mellitus (T2DM) often highlights the progressive nature of this condition, and periodic review, in collaboration with their GPs, provides an opportunity to prepare patients for their eventual transition to insulin therapy. Services provided by CDEs are funded for patients with a Medicare Benefits Schedule (MBS) GP Management Plan and Team Care Arrangement. A limited number of private health funds offer rebates for CDE services.

Choosing the device

It is important to distinguish disposable devices from 3 mL cartridges suitable for non-disposable pen devices when issuing an insulin prescription. While the latter have the advantage of being less bulky when travelling with a large quantity of medications, a non-disposable pen device is less accessible to patients and pharmacies alike. Advising patients to travel with a spare non-disposable pen is recommended.

National Diabetes Services Scheme Medication Change form

Patients can receive' insulin pen needles free of charge from the National Diabetes Services Scheme (NDSS) by either of two methods:

- a completed *NDSS Medication Change* form signed by a GP, endocrinologist, CDE or nurse practitioner
- a completed *NDSS Medication Change* form certified by community

pharmacists and attached to the patient's insulin prescription to be forwarded to the NDSS.

The *NDSS Medication Change* form can be downloaded from the NDDS website (www.ndss.com.au/forms).

Self-monitoring of blood glucose

As a direct consequence of restrictions imposed in July 2017 on subsidised blood glucose test strips for people not treated with injectable GLMs, self-monitoring of blood glucose (SMBG) may need to be learned as a new skill by some patients.

While some patients may need their blood glucose meter updated, it is important not to assume they are already cognisant of the crucial components of appropriate SMBG. Emphasise that the purpose of SMBG is to obtain meaningful clinical information such as glucose variability, rather than it being a task with little or no interpretation of results.

Hypoglycaemia

From 2012 to 2016 there was a reduction in the prescription of sulfonylurea agents.[2] As a result, for many people with T2DM, insulin is the first treatment that is associated with a risk of hypoglycaemia. Nevertheless, the initiation of insulin should always be preceded by education or revision on the management of hypoglycaemia.

The American Diabetes Association's *2018 Standards of Medical Care in Diabetes* recommends 15–20 g of glucose as the preferred treatment for conscious individuals with a blood glucose level (BGL) ≤3.9 mmol/L.[2] Associating the 'sweetness' of a food with its effectiveness in reversing hypoglycemia is common. Chocolate, for example, contains a significant amount of saturated fat, which slows the rise in BGLs. Similarly, orange and apple juice contain fructose that is slow to break down into glucose. Distinguishing between slow-acting and fast-acting treatment options will assist patients to choose the most appropriate food or drinks available to reverse dropping BGLs.

Treatment choices such as jelly beans are convenient to carry inside patients' blood glucose meter storage bags and introduce the concept of having a 'hypo kit' readily available. Glucose-containing rather than sucrose-containing soft drinks are an option for people who prefer a liquid alternative. Commercially available glucose sachets and glucose gel tubes are ideal when there is an issue with chewing or swallowing thin fluids.

Driving and insulin therapy

T2DM has been identified as a medical condition that can affect a person's ability to drive. People with insulin-treated diabetes cannot hold an unconditional private driver's licence due the risk of an unexpected occurrence of hypoglycaemia.

A conditional licence can be issued subject to a two-yearly review (at a minimum) by a GP. Commercial licences (heavy vehicles, public passenger vehicles or requiring a dangerous goods driver licence) are subject to an annual review (at a minimum) by an endocrinologist or consultant physician specialising in diabetes. The Austroads Assessing Fitness to Drive for commercial and private vehicle drivers can be found online (https://austroads.com.au/drivers-and-vehicles/assessing-fitness-to-drive).

It is important to reinforce to patients that there are a number of precautionary steps that should be implemented, including testing BGLs prior to driving and not driving if BGLs are <5.0 mmol/L. The NDSS provides useful information to support people treated with insulin to minimise their driving risk from hypoglycaemia (https://static.diabetesaustralia.com.au/s/fileassets/diabetes-australia/a668b54a-15e1-4692-aa15-b47122572139.pdf).

Insulin regimens

Insulin is indicated when patients taking maximum doses of non-insulin GLMs have sub-optimal glycaemic control; or when one or more of their existing non-insulin GLMs are either no longer tolerated or contraindicated for further use, with their dose reduction or discontinuance resulting in hyperglycaemia. The Royal Australian College of General Practitioners (RACGP) notes that 'all insulins work effectively and there is no wrong choice when commencing insulin'.[3]

The main two strategies recommended include:

- basal insulin once daily
- premixed insulin once daily with the largest carbohydrate meal of the day.

A glycated haemoglobin (HbA1c) result above target is only one parameter to consider when initiating insulin. Fasting BGLs, BGLs throughout the day (both pre-prandial and post-prandial) and glucose variability should influence decision making. Requesting patients to test their BGLs at times throughout the day can provide not only important information on the type of insulin to start, but present a clear picture of the individual's blood glucose profile, identifying where improvements can be made with insulin.

Recently, two new formulations have been added to the Pharmaceutical Benefits Scheme (PBS) list: insulin glargine U300, available only in the disposable pen, and the co-formulated insulin degludec and insulin aspart. The RACGP provides guidance for commencing (including initial dosing) basal or premixed insulin.[3] The guides clearly outline how (and how often) to titrate insulin. They also include directions for patients to self-titrate insulin. Manufacturers of insulin produce similar guides, especially if intensification of insulin is required, such as increasing the number of injections.

Non-insulin GLMs

Reasons to continue or cease non-insulin GLMs when insulin is commenced can vary. Some classes such as thiazolidinediones and glucagon-like peptide 1 (GLP-1) receptor agonists are not compliant with PBS subsidy when insulin is prescribed. For people with chronic kidney disease (CKD), many GLMs are not recommended at an estimated glomerular filtration rate (eGFR) of 30–45 mL/min. Some exceptions include gliclazide, linagliptin and a low dose of sitagliptin. The recently released American Diabetes Association/European Association for the Study of Diabetes consensus report into the management of hyperglycaemia in

T2DM promotes the use of sodium-glucose cotransporter 2 inhibitors (SGLT2i), if not contraindicated, when atherosclerotic cardiovascular disease, heart failure or CKD are present.[4] Many studies identify a benefit in weight loss and a reduction in the total daily insulin dose when SGLT2i are added to insulin.[5]

Insulin administration technique

Each of the three pharmaceutical companies that distribute insulin in Australia has a number of excellent consumer information booklets and starter kits for people with T2DM commencing insulin. In addition, insulin pen needle manufacturers also provide pictorials on correct injection technique. Increasingly, this information is available in several languages, and the inclusion of pictures and diagrams can assist people with low literacy levels. Several online insulin self-administration demonstrations are also available. Teaching insulin self-administration should focus on injecting into the right tissue space, at the right time, in the right way, every time.

Insulin must be administered into subcutaneous tissue to ensure optimal absorption. The abdomen is the preferred site for insulin administration within the boundaries of 1 cm above the symphysis pubis, 1 cm below the lowest rib, 1 cm away from the umbilicus and laterally at the flanks.[3] International clinical guidelines recommend using short 4 mm and 5 mm pen needles (regardless of body size) to reduce accidental intramuscular administration that can alter insulin action and blood glucose variability and increase the risk of hypoglycaemia. Slimmer people may need to use a skin fold to further reduce the risk of intramuscular administration.[6] The safety and efficacy of 4 mm insulin pen needles has been demonstrated without additional skin leakage in adults of all sizes.[7] When using 4 mm needles, insulin should be delivered at a 90 degree angle to reduce the risk of dermal administration.

Cloudy or premixed insulin must be resuspended correctly prior to every injection. A two-unit air shot must be made prior to dialling up the intended dose to ensure free and unobstructed flow.

It is important to educate patients on the insulin time–action profile regardless of the type of insulin used to initiate or intensify therapy. This promotes their understanding of the 'why' and elevates their confidence in the 'how' to self-titrate. The benefit of patient empowerment achieved in this area should not be underestimated.

Lipohypertrophy

Lipohypertrophy can develop when injection sites are not rotated correctly and pen needles are reused. Education about the importance of rotation and strategies to assist systematic rotation should be provided at the time insulin is started and also as part of ongoing education, especially when injection sites are inspected and the patient's technique is assessed by healthcare professionals.[8,9] Insulin injected into tissue affected by lipohypertrophy can result in a higher incidence of hyperglycaemia, unexplained hypoglycaemia, greater variability in BGLs, and a higher HbA1c and total daily insulin dose.[7]

In terms of injection technique, it is easier to grip the end of the pen when inserting the needle to enable the thumb to press the plunger down fully. Once the dose is delivered, the pen must be kept in situ for a minimum of 10 seconds to ensure the entire dose has been administered. Pen needles are single-use only. Reusing needles can increase the risk of lipohypertrophy.[10]

Disposal

Dispose all sharps into approved containers and return to the local council for exchange.

Storage

Insulin in use can be kept at room temperature (under 30°C) for up to 30 days. Note that administering refrigerated insulin may feel uncomfortable for the patient.

Follow-up

Follow-up dose titration via email/SMS/telephone or in clinic rooms can be undertaken according to recommended intervals. Self-titration may be appropriate after careful patient selection. Pharmaceutical companies also provide resources to assist patients with dose adjustment.

CASE

Background

Mrs HJ is a retired schoolteacher aged 78 years. She is independent in activities of daily living and has adequate self-efficacy. Her medication adherence is regular.

History

Mrs HJ has T2DM (12-year duration), dyslipidaemia, hypertension and microalbuminuria.

Medications

Mrs HJ's medications are: perindopril/amlodipine 5 mg/5 mg daily, atorvastatin 40 mg daily, sitagliptin/metformin 50 mg/1 g twice a day and gliclazide 60 mg MR 2 in the morning.

Recent pathology results

Mrs HJ's recent pathology results are: HbA1c 8.5% (for the past two quarters), creatinine 107 mmol/L, eGFR 47 mL/min/1.73 m^2, urine albumin/creatinine ratio 7.7 mg/mmol, low-density lipoprotein cholesterol 1.9 mmol/L, triglycerides 2.5 mmol/L, blood pressure 133/80 mmHg, heart rate 75 bpm, height 165 cm and weight 76 kg.

Mrs HJ's decline in eGFR means her metformin needs to be reduced to 1 g per day. Her sitagliptin can remain at 100 mg per day unless the eGFR falls to below 45 mL/min. Mrs HJ previously developed recurrent urinary tract infections while taking an SGLT2i. She is also intolerant of the severe nausea she developed while using a GLP-1 agonist. Therefore, her GP's discussion with her focuses on the rationalisation of using insulin. Mrs HJ acknowledges she is ready to commence therapy.

Mrs HJ previously stopped self-monitoring her glucose after finding it did not help her achieve a better glycaemic outcome. Her GP explains to her that self-monitoring will be essential

from now on. The *NDSS Medication Change* form is completed in anticipation of insulin commencement. This allows Mrs HJ to access blood glucose test strips without restriction.

Mrs HJ returns the following week with her seven-point profile for three days. Table 1 shows Mrs HJ's BGLs.

During the analysis of Mrs HJ's glucose pattern, she confirms having three regular meals a day with the midday meal typically containing the lowest carbohydrate content. Skipping lunch on 8 August was an unusual occurrence. Her GP takes this opportunity to reinforce the importance of having regular meals and review the features of hypoglycaemia and its management.

Once-daily co-formulated insulin is most appropriate as Mrs HJ's glucose excursions are more significant after breakfast. The recently PBS-listed coformulated insulin degludec/aspart has the advantage of containing an ultra–long acting basal component (degludec) with a half-life of 24 hours. Its rapid-acting component (aspart) will be useful in addressing Mrs HJ's post-breakfast glucose rise. There is no need to resuspend the insulin pen prior to administration as this formulation does not contain a protaminated basal component. Mrs HJ chooses a disposable pen to avoid having to refill a reusable pen with a cartridge periodically. Her GP prescribes a starting dose of 10 units with breakfast and a planned clinic follow-up in four days, giving the long-acting component of coformulated insulin degludec/aspart time to reach steady state.

Thorough education on injection technique and hypoglycaemia management is provided prior to Mrs HJ leaving the consultation. Her GP also completes the Assessing Fitness to Drive form. Mrs HJ will self-monitor her BGL four times a day prior to each of her meals as well as at bed time. While all four readings can help to up-titrate the basal component degludec, pre-lunch readings are important to confirm the rapid-acting component aspart is matching Mrs HJ's breakfast carbohydrate intake. Frequency of SMBG can be reduced later to as low as once a day, in a staggered pattern after her glucose profile is stabilised.

Depending on convenience and clinic availability, Mrs HJ is subsequently reviewed every four to seven days until her fasting BGLs reach the target range, provided she does not experience hypoglycaemia in the interim. A second dose of coformulated insulin degludec/aspart, or a dose of rapid-acting insulin, may be introduced with either the midday or evening meal if glucose excursions remain outside her individually determined target range.

Conclusion

Timely intensification of diabetes management helps to minimise adverse health outcomes. Insulin initiation in a GP setting provides important support to people with T2DM.

Table 1. Blood glucose levels – Mrs HJ

	Blood glucose levels (mmol/L)							
Date	**BB**	**AB**	**BL**	**AL**	**BD**	**AD**	**BS**	**Comments**
7 August	7.6	13.4	10.3	13.0	9.9	11.4	9.0	
8 August	8.9	15.1	11.5	–	8.5	9.9	9.6	Skipped lunch because of a large breakfast
9 August	8.1	14.3	11.4	12.1	9.0	12.3	9.7	

AB, two hours after breakfast; AD, two hours after dinner; AL, two hours after lunch; BB, before breakfast; BD, before dinner; BL, before lunch; BS, before sleep; –, no result recorded

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