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Practical Aspects of Insulin Therapy

Making Education Easy 2020

About the expert

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RESEARCH REVIEW™
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For individuals with diabetes who require insulin as a treatment option, coping with the complexities of insulin therapy is often challenging. The number of newer insulin formulations, combination insulin therapies, and insulin delivery devices have made this process increasingly complex. This review will discuss the practical aspects and common complications associated with insulin use and provide advice for insulin management during specific situations such as during exercising, sick days, eating out, Ramadan, travel, driving and the COVID-19 pandemic. This review is intended as an educational resource for healthcare professionals and has been created with an educational grant from Sanofi and BD.

Practical insulin usage

Insulin therapy is essential for individuals with type 1 diabetes mellitus (T1DM). Given the progressive nature of type 2 diabetes mellitus (T2DM), insulin may also be required over time if target glycosolated haemoglobin (HbA1c) levels are not achieved with healthy eating, physical activity and recommended oral antihyperglycaemic agents.[1, 2] Compared with other agents, insulin if correctly administered has the most potential to lower HbA1c levels in a dose-dependent manner.[3]

Insulin delivery devices

The devices available to deliver insulin include insulin pens, insulin syringes and insulin pumps, with the individual's preference, capability and commitment determining the final choice.

Insulin pens are generally the most common and convenient way of administering insulin.[4,5] Both reusable and disposable insulin pens are available in New Zealand from three manufacturers, Novo Nordisk, Lilly and Sanofi.[6-8] Reusable insulin pens hold the insulin in a replaceable cartridge and administer the required dose.[6] Each branded insulin device must be matched with their complementary brand of insulin cartridge to ensure the injection and dosing is accurate.[8] Disposable pens have a pre-fitted cartridge that cannot be removed, and so when the insulin runs out, the entire pen is discarded.[6] Insulin syringes with needles can be used for administration to young children, for insulin not available in cartridge form and when mixing two insulins together.[4]

A 10 mL vial is used if injecting using a syringe, and 3 mL cartridges are available for use with reusable insulin pens.

Insulin Pens

Insulin from the 3 mL cartridge is given using an insulin pen. There are two types of insulin pens:

- **Reusable pen** which allows pen users to replace the insulin cartridge when it is empty or expired.
- **Disposable pen** in which a cartridge is pre-fitted into the pen and cannot be removed.

Sanofi	Lilly	Novo Nordisk
Lantus® SoloStar® Disposable 	**HumaPen® Luxura™** Reusable 	**Novopen® 4®** Reusable 
Lantus® AllStar®Pro Reusable 	**HumaPen® Savvio®** Reusable 	**NovoRapid® FlexPen®** Disposable 
Apidra® SoloStar® Disposable 		**NovoMix® 30 FlexPen®** Disposable 
Apidra® AllStar ®Pro Reusable 		**NovoPen Echo®** Reusable 
JuniorSTAR® Reusable 		

Insulin pumps used in the management of T1DM. Insulin pumps and consumables, e.g. insulin cartridges/reservoirs and infusion sets, are fully subsidised for people who meet PHARMAC criteria for Special Authority approval.[9] Insulin pumps replace the need for multiple daily injections, but intensive patient education on carbohydrate counting, correctional insulin dosing based on insulin sensitivity factor, regular measurement of blood glucose and engagement with their specialist diabetes team is essential if they are to be successful in the management of diabetes.[10]

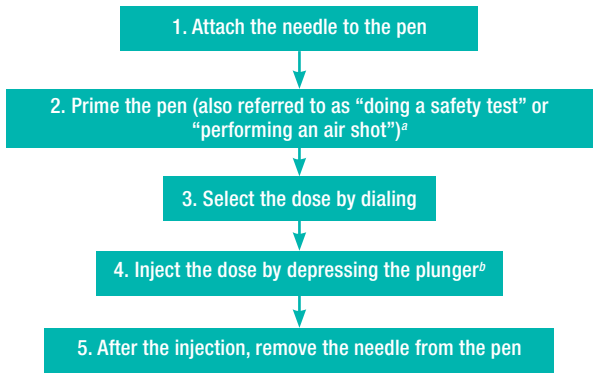
Insulin safety

Safety must always be a priority when using insulin.[11] Various checks should be in place to ensure that the correct insulin is delivered at the correct dose and at the correct time.

Insulin pens

Errors that may occur when pens are used include the wrong type of needle, injecting without removing the inner cap, and dialling the pen back down instead of pushing the plunger, dialling the incorrect dose or not inverting the insulin cartridge when necessary.[12] Additional errors may occur if the priming step is missed (see **Figure 1**).[13] Priming the device after attaching a new pen needle ensures that the pen is working correctly, that air bubbles have been removed, and the correct dose of insulin is being delivered.[4, 5]

It is important when replacing a cartridge in a reusable pen, that the correct brand of insulin is used in the correct pen.[6] For example, a Lilly pen will use Lilly insulin cartridges, a Novo-Nordisk pen will use Novo-Nordisk insulin cartridges, a Sanofi pen will use Sanofi cartridges.



[a] The pen can be primed by dialling 2 units following insertion of an insulin cartridge, before each injection is administered. These units are injected into the air and the priming repeated until a stream of insulin is seen.

[b] The plunger needs to be pressed and the needle held in the skin for 10 seconds (or according to the manufacturer's instructions) to ensure complete delivery of the insulin dose.

Figure 1. Steps for insulin pen use[4, 5]

Pharmacists

Pharmacists must always be vigilant when dispensing insulin, and must always double-check the insulin against the person's script and history.[14] Pharmacists should ensure the safe storage of high-risk medicines such as insulin and separate any that look similar, have similar names, or are a similar type. 'Safety alerts' should be in place to prompt staff to double check the correct insulin is being dispensed.[14]

Prescribers

Errors have occurred when short- or intermediate-acting insulin preparations and similarly named biphasic insulin mix preparations have been confused and when similarly packaged and presented insulin pens have been confused.[4] The full brand name should be specified when insulin is prescribed to avoid confusion. When prescribing insulin, the word 'unit' should not be abbreviated to avoid errors in the interpretation of the prescription.[15]

People with diabetes

People with diabetes must feel free to question their healthcare professional(s) so that they have a clear understanding about the impact of the insulin they are being prescribed.[14] Care must always be taken when preparing and administering insulin to ensure that the intended medicine is given.

Insulin storage

Insulin must be stored in a refrigerator between 2—8°C.[16] It must not be stored in the deep freeze. All insulin has an expiry date, and any unused insulin should be discarded after that date whether or not it has been kept in the refrigerator. Once opened, insulin vials, cartridges or pre-filled pens can be kept at room temperature for up to 28 days (check the package insert), but must be discarded after this time.[4, 16] When keeping insulin in use at room temperature, it should not be exposed to sunlight or heat.[4, 17]

Injection technique

People with diabetes requiring insulin can struggle with injections and may require support and assistance to develop the skills required for diabetes management.[18] Healthcare professionals play an essential role in the education of people with diabetes especially in regard to the appropriate techniques to be used when injecting insulin, as well as providing reassurance and support in helping the person explore their worries and barriers to this form of treatment.[18-21]

Injection sites

Injections of insulin should be made into the subcutaneous (SC) fatty tissue, not into intramuscular (IM) tissue.[21, 22] The SC tissue has relatively poor blood supply, prolonging the absorption time of injected medicines, resulting in a more consistent absorption rate. Intramuscular deposition of insulin, especially into working muscle, can lead to unpredictable (largely faster) absorption of insulin, and result in poor glycaemic control, including excessive glycaemic variability.[18] Clinical studies indicate that IM injections can result in frequent and unexplained hypoglycaemia.[23, 24] Intramuscular injections of insulin are associated with a greater risk of bleeding, bruising, and pain.[18] Inadvertent IM injections occur more frequently with longer needles, in slimmer and younger individuals, in males and in those who use limbs rather than truncal injection sites.[18]

The injection site should be examined before administering an insulin injection.[8, 18] Injections should only be into clean sites, using clean hands. Injections should never occur into sites of lipohypertrophy, inflammation, oedema, ulceration or infection.[18]

A number of factors may also affect the absorption of insulin from the SC tissue.[25] Exercise, a hot bath, sauna and massage of the injection site dramatically increase serum insulin levels after injection, while a cold bath delays insulin absorption.[25, 26] Smoking also decreases the rate of absorption of insulin from the SC tissue.[27] Hot showers or baths should be avoided within 30 minutes of an injection to decrease the risk of a sudden drop in blood glucose level leading to hypoglycaemia.[4]

The abdomen is the most commonly used and recommended site due to its convenience, and for the more rapid and reproducible uptake of the insulin from this site.[18, 21, 22, 28] When injecting into the abdominal SC tissue in adults, injections should be given at least 1 cm above the symphysis pubis, 1 cm below the lowest rib and 1 cm away from the umbilicus.[18] Injection into the antero-lateral upper thigh and buttocks (typically upper outer quadrant) may also be considered, but the rate of absorption of insulin is slower from these sites and there is an increased risk of IM injection. Injection into the arms (triceps area) is not generally recommended due to limited SC tissue and high risk of IM insulin delivery.

Modern insulin analogues (both rapid-acting and long-acting) can be administered subcutaneously at any site as absorption rates do not appear to be site-specific.[18, 28]

The absorption of soluble human insulin at an injection site is more variable.[18] The abdomen is the preferred injection site for soluble human insulin (regular) and for the morning doses of mixed human insulin, due to the faster absorption from this area. Isophane insulin (NPH insulin), when given alone, should be administered at bedtime rather than earlier in the evening so that the risk of nocturnal hypoglycaemia is reduced.[18, 28] Given the slower absorption from the thigh and buttocks, NPH (or mixed insulin containing NPH) should be administered into these sites if there is risk of nocturnal hypoglycaemia.[18, 28]

Injection rotation

Rotation of the injection site is important to prevent lipohypertrophy or lipoatrophy.[18, 22] Rotation within one area is recommended (e.g. rotating injections systematically within the abdomen), with each new injection into a different site (**Figure 2**).[18]

One evidence-based method involves dividing injection areas into quadrants (abdomen) or halves (thighs or buttocks), using one quadrant/half per week and rotating from quadrant/half to quadrant/half in a consistent direction.[18] Each injection should be at least 1 cm (or approximately the width of an adult finger) from previous injections.

A recent worldwide survey reported that individuals with diabetes were more likely to use the correct rotation methods if they had received injection instructions from their healthcare professional within the past 6 months;[29] therefore, regular review is important.

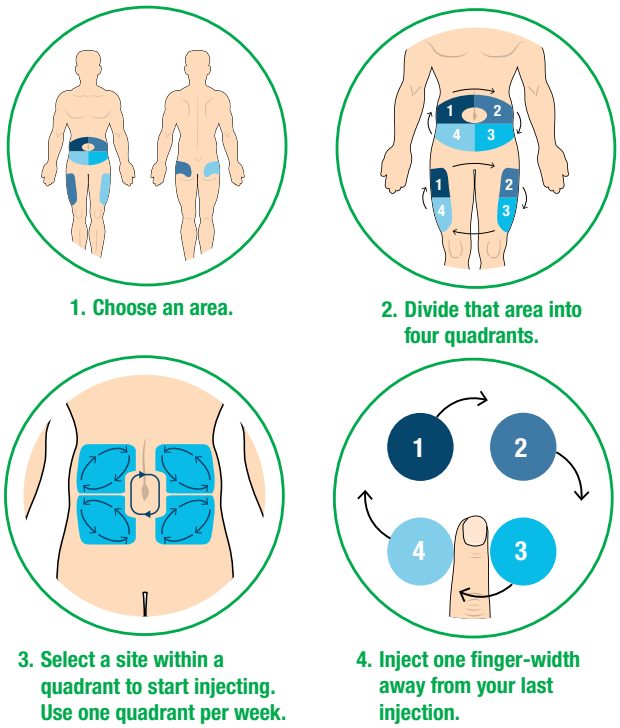


Figure 2. Rotation for insulin injections

Needles

The appropriate needle length should be one which reliably delivers insulin into the SC space, without leakage or discomfort, and not into the IM region.[18] Studies investigating the effect of needle length show that glycaemic targets are achieved, without increased leakage, and with less pain, when a shorter needle length is used.[30-36] The shortest needles currently available (4 mm pen needles and 6 mm insulin syringes) are safe, effective, and less painful and should be the first-line choice in all patient categories.[18]

In New Zealand, pen needles from 4 mm to 12.7 mm in length are currently available (**Figure 3**).[37] Current guidelines recommend 4 mm pen needles in adults and children regardless of age, sex, ethnicity, or BMI, since they are long enough to traverse the skin and enter the SC tissue, with little risk of IM (or intradermal) injection.[8, 18, 38] In obese individuals, the preferred choice of a 4 mm pen needle is less likely to inadvertently result in an IM injection and effective; a 5 mm pen needle may also be acceptable.

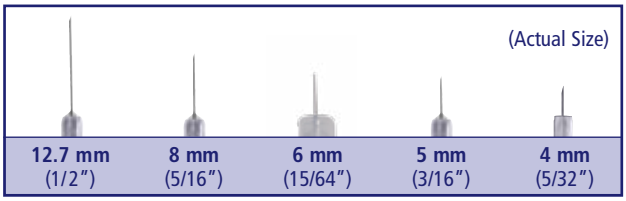


Figure 3. Pen needle length

A 4 mm needle can be injected at 90 degrees without a skin fold in most people with diabetes (**Figure 4**).[18] However, guidelines recommend that very young children aged ≤6 years old and very slim adults using the 4 mm needle should lift a skinfold and insert the needle perpendicularly into it.[18] Children using a 5 mm pen needle should inject using a lifted skinfold, however, they should be switched to a 4 mm pen needles if possible.

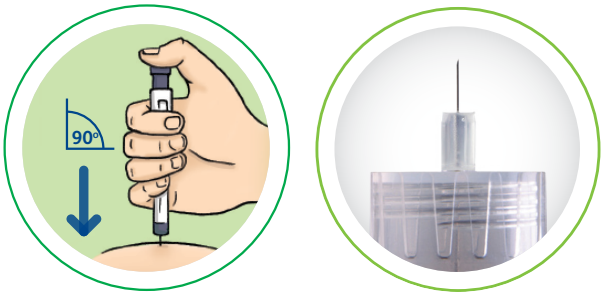


Figure 4. A 4 mm pen needle inserted at 90 degrees is recommended for adults and children. A new needle should be used with each injection

Insulin syringes funded in New Zealand vary in needle length from 8 mm to 12.7 mm.[37] However, needles greater than 6 mm are no longer recommended due to the high risk associated with IM injections.[18] Longer syringe needles may be the better option for some individuals with higher BMIs and coordination challenges resulting from co-morbid health conditions, such as arthritis. If a syringe needle is used in children (≥6 years old), adolescents, or slim to normal weight adults (BMI of 19-25 kg/m^2), injections should be given into a lifted skinfold.[8, 18] The use of syringe needles in children aged <6 years and extremely thin adults (BMI <19 kg/m^2) is not recommended, even if using a raised skinfold, because of the excessively high risk of IM injections.[18] Needles 8 mm long should be injected at a 90 degree angle. Needles that are 12.7 mm long should be inserted at 45 degrees, particularly if there is minimal SC tissue, with a skinfold to reduce the risk of IM injection.

A new needle should be used with every injection,[18] with important changes by PHARMAC encouraging this recommendation.[39] PHARMAC has increased the quantities for prescribing and dispensing quantities for free insulin pen needles and syringes from 100 to 200 needles.[39] In people requiring two or more insulin injections per day, the changes now cover a full three months needle supply. For people who need more than 200 needles in a three-month period, an additional prescription will be required. There is no maximum on the number of prescriptions and the additional quantities of needles are fully funded.[39]

https://www.pharmac.govt.nz/news/notification-2019-07-11-various/#needles

While not funded in New Zealand, pen needles with additional safety aspects, such as BD AutoShield Duo™ Pen Needle,[40] are available to facilitate safer insulin injections. The 5-mm BD AutoShield Duo™ Pen Needle features automatic dual-protection shields on both ends of the needle which help prevent needlestick exposure and injury during injection and disposal (**Figure 5**).[40]

Figure 5. BD AutoShield Duo™ Pen Needle[40]

Disposal of sharps

The correct disposal of sharps after use is not always optimal.[28] A recent worldwide study indicated that almost 15% of people using insulin reported that there were others in their immediate surroundings who might get accidentally stuck with sharps.[28] Nearly, 40% of people placed their sharps in the publically disposed rubbish, and only 21% used a container specially made for used sharps.[28]

It is vital that people using insulin are educated about the correct disposal of their used sharps. People using insulin should be made aware that syringes and pen needles need to be disposed of in approved sharp disposal containers. These may be available through local diabetes services, regional diabetes societies or local pharmacies. Disposal practices vary across regions, and individuals should check with their local diabetes services to determine how to best dispose of used needles.[41]

Common complication associated with insulin use

Injection complications

The most common local cutaneous complication of injecting insulin is lipodystrophy, which may present as either lipoatrophy or lipohypertrophy (**Figure 6**).[18, 42] Lipoatrophy involves the loss of adipocytes, and it manifests clinically as indenting and cratering. Lipohypertrophy involves the enlargement of adipocytes, and it manifests as swelling or induration of fat tissue.[18, 42]

Lipohypertrophy is common, with rates between 29–64% reported in clinical studies.[29, 43-46] A meta-analysis of 26 studies involving nearly 12,500 people with diabetes using insulin reported the pooled prevalence of lipohypertrophy to be 38%.[43]

Figure 6. Individual with lipohypertrophy

The absorption of insulin injected into regions of lipohypertrophy may be erratic and unpredictable, and can lead to hyperglycaemia, unexpected hypoglycaemia, or increased glucose variability.[47-49] Factors impacting the development of lipohypertrophy include repeated injection into the same sites, poor site rotation, the reuse of needles, the duration of insulin use and the number of daily injections.[43-44, 50]

Injection sites should be examined for lipohypertrophy by the healthcare professional at least once a year (more frequently if lipohypertrophy is already present) both visually and by palpation.[18] In order to reduce the risk of developing lipodystrophy, people with diabetes and/or their family member or carers should be shown how to inspect their own injection sites and know how to detect lipohypertrophy, to use proper injection technique (including the rotation of injection sites) and to avoid the reuse of needles.[18]

People with diabetes should be encouraged to avoid injecting into areas of lipohypertrophy until their health-care professional advises that it is safe to do so. Switching the insulin injection from an area of lipohypertrophy to an unaffected area may necessitate the reduction of the insulin dose and should be guided by the individual's blood glucose measurements. Dose reductions commonly exceed 20% of the original dose.[18]

Further details relating to the detection, treatment and prevention of lipohypertrophy are available at https://www.bd.com/dc-anz/healthcare-professionals/education/managing-lipohypertrophy.

Hypoglycaemia

Hypoglycaemia is a common side effect of insulin therapy, particularly in people with T1DM[51] and can be a major barrier to people with diabetes achieving their target level of glycaemic control. Mild hypoglycaemia is defined as any plasma glucose level <4 mmol/L that can be self-treated.[52] Severe hypoglycaemia is defined as hypoglycaemia that requires assistance from another person to take corrective action.[51] Severe hypoglycaemia occurs in about 30–40% of people with T1DM and about 10–30% of people with insulin-treated T2DM each year.[51]

People with diabetes need to be provided with information on how to recognise the symptoms of both mild and severe hypoglycaemia and also how to manage and prevent episodes of hypoglycaemia.[1] Symptoms of mild to moderate hypoglycaemia may include one or more of the following adrenergic signs and symptoms: pallor, tremors, sweating, tachycardia or tingling around the mouth and tongue. As hypoglycaemia progresses and the brain becomes more deprived of glucose, neuroglycopaenic symptoms may be experienced such as headache, inability to concentrate, a rapid change in behaviour or irritability, confusion and blurred vision.[52]

Mild hypoglycaemic events can be treated by oral administration of rapidly absorbed carbohydrate, glucose tablets or glucose gel.[51] The 'rule of 15' has been used to treat mild hypoglycaemia. This rule recommends consuming 15 g of carbohydrate; allowing 15 minutes for absorption of nutrients and return of plasma glucose to levels within the normal range; and repeating glucose measurement after another 15 minutes.[51] For adults with T1DM a weight-based protocol of glucose 0.3 g/kg bodyweight has been shown to be more effective for treating hypoglycaemia than the common recommendation of 15 g glucose.[52]

Severe hypoglycaemic events in which the person is still conscious should be treated as those with mild hypoglycaemia with the person being given rapidly absorbed carbohydrate/glucose.[53] However, severe hypoglycaemia which results in changes in the level of consciousness will require intervention by another person.[51] All insulin-treated individuals should, therefore, be encouraged to carry rapid-acting glucose with them at all times and be provided with a glucagon kit. Their family members, friends and co-workers should be provided with education on first aid for an unconscious person and how to use the glucagon kit should a severe hypoglycaemic event occur.

The wearing of a Medic Alert bracelet or necklace is advised in people with diabetes at risk of hypoglycaemia.[53]

Information on hypoglycaemia for people with diabetes is provided on the Diabetes New Zealand website.

EXPERT COMMENTARY

Proper prescribing, dispensing and administration of insulin therapy are essential to ensure the best results are obtained from the therapy. Early insulin initiation is important so acknowledging and tackling any psychological insulin resistance to starting insulin, either for the prescriber or person with diabetes, is critical.

Consideration of the person's cultural and social context, as well as their dexterity and capability with managing different devices, will help inform decision making on appropriate insulin regimens and choice of administration devices. Whilst insulin pens are often chosen as the most convenient method of administering insulin, people with diabetes should be offered the choice and be able to self determine based on their preferences.

Correct administration technique is essential; otherwise, people can experience erratic blood glucose levels and problematic hypoglycaemia due to: inconsistent insulin administration from incorrect insulin needle length; insulin malabsorption from lipohypertrophy; inconsistent timing; and other errors.

A structured and comprehensive education programme should be undertaken at the time of commencing insulin as per the Ministry of Health Quality Standards of Diabetes Care (Standard 7), inclusive of education and guidance on self-titration of insulin dosing as appropriate.

All care and education should be provided in a way that is deemed to be culturally appropriate by the person with diabetes.

Management in specific situations

Physical activity/Exercise

Physical activity/exercise is an integral part of the overall management of diabetes.[54-57] Regular exercise not only improves cardiovascular fitness, but also enhances glycaemic control, insulin signalling and blood lipids, reduces low-grade inflammation, improves vascular function, and may encourage weight loss in overweight individuals.[55]

Nevertheless, despite its benefits in insulin-treated individuals, exercise causes major changes to glucose production and utilization rates and these responses, particular those with T1DM, may be highly variable based on activity type/timing.[57] If insulin levels are too high, hypoglycaemia may occur during and after exercise. However, if insulin levels are too low, exercise may lead to hyperglycaemia or ketoacidsis.[57] Exercising with hyperglycaemia and elevated blood ketones should be avoided.

With appropriate planning and by combining adjusted insulin therapy and diet, daily physical activity or exercise can be accomodated.[57] Additional carbohydrate intake and/or insulin reductions are typically needed to maintain optimal glycaemic management during and after physical activity that lasts longer than 30 minutes. However, given the variable glycaemic responses to physical activity, uniform recommendations for the management of food intake and insulin dosing are difficult. Frequent blood glucose tests should be conducted to assess when carbohydrate intake and/or insulin dose adjustment may be necessary. The risk of nocturnal hypoglycaemia following physical activity may be mitigated by reducing the basal insulin doses, and the inclusion of bedtime snacks. People treated with insulin, particularly those with T1DM, should discuss their exercise plans with a member of their specialist multidisciplinary diabetes team (diabetes nurse specialist, endocrinologist or diabetes specialist dietitian) so that an individualised plan on how to adjust their insulin doses and food intake can be made.

Driving

Diabetes can impair driving performance primarily through hypoglycaemia-induced cognitive impairment.[58] Longer-term complications, including those affecting vision, cognition and peripheral neural function, may also potentially impair driving performance.[59]

Driving is a complex activity that is both mentally and physically demanding.[59] Monitoring by the Transport Agency indicated that diabetes accounts for about 5–10% of motor vehicle crashes attributable to medical factors. However, a NZ survey of insulin-treated drivers found that only 28% of drivers could recall receiving education by a health professional about safe driving practices when using insulin.[60]

In people using insulin, hypoglycaemia usually arises through missed meals, inaccurate or inappropriate insulin dosing, and during or following exercise. Hypoglycaemia can induce cognitive impairment.[58] In people with T1DM, a driving performance study involving a driving simulator found that driving impairments occurred when blood glucose levels were lower than 4 mmol/L.[58] Studies indicate that most drivers rely on symptoms to detect hypoglycaemia while driving, and seldom test blood glucose before driving.[59]

Education for people taking insulin should emphasize the role of blood glucose monitoring in relation to driving (including testing before driving and every couple of hours on long journeys), the potential deterioration in driving performance associated with hypoglycaemia, the need for a supply of readily absorbed carbohydrate/glucose for the journey, the importance of a meal or snack before undertaking long journeys, and the need to take appropriate action should hypoglycaemia occur while driving.[61] The potential risk of hypoglycaemia-related road traffic accidents has led many countries, including New Zealand, to issue driving licenses for those with diabetes only if specific conditions are met.[62]

A useful education tool for drivers is the New Zealand Transport Agency's Diabetes and Driving fact sheet.[62] Advice for health professionals relating to driving and people with diabetes is available through the NZ Transport Agency's guide for medical practitioners.[61]

Eating out

Eating out, or eating pre-prepared or takeaway food, is a common part of life for many people who use insulin, but it is associated with the challenge of having less control over the content, portion size and timing of the meal. Postprandial hyperglycaemia appears to be a relatively common occurrence after eating out. A web-based survey of people with diabetes using bolus insulin reported nearly 25% of respondents experienced post-prandial hyperglycaemia when they ate at a restaurant.[63]

People using insulin can be proactive and ask for healthy options in cafes, restaurants and food outlets that fit as much as possible into health eating recommendations such as those outlined in the "Diabetes and healthy food choices" booklet produced by Diabetes New Zealand,[64] or as advised by their dietitian. Many restaurants have online menus which can make choosing healthier options easier. People with diabetes should attempt to schedule meals out at their usual meal time, and, if eating later than usual, should have a snack on hand in case they develop symptoms of hypoglycaemia.

For people using a basal/bolus regimen, the prandial (meal-time) doses of insulin can be adjusted and should take into account the result of the pre-meal blood glucose levels as well as the expected composition and size of meals.[21, 65]

People with diabetes treated with insulin may wish to use carbohydrate counting to match the expected carbohydrate content of the meal with their insulin requirements.

Ramadan

The Islamic practice of Ramadan involves abstinence from eating and drinking between dawn and sunset.[66, 67] International Diabetes Federation (IDF), in collaboration with the Diabetes and Ramadan (DAR) International Alliance, have published (2016) practical guidelines on the management of diabetes and Ramadan.[68] Due to the metabolic instability and change in lifestyle during the fasting and feasting hours, the guidelines recommend various steps to manage these challenges. These steps involve a pre-Ramadan assessment, medication adjustment during Ramadan and a post-Ramadan follow-up.[68]

After a thorough assessment, and with the correct advice and support from healthcare professionals, these guidelines suggest that most people with T2DM can fast safely during Ramadan.[68] The guidelines recommend that people with T2DM administering insulin will need to make adjustments to dose and or timings to reduce the risk of hypoglycaemia, while maintaining optimal glycaemic management.[68] Insulin analogues are recommended over regular human insulin due to a number of advantages including their lower risk of hypoglycaemia.[68, 69] Suggestions for dosage modifications are provided within the guidelines. The guidelines classify insulin-requiring people with T1DM, and pregnant woman with diabetes, as very high/high risk and advise close medical supervision and focused Ramadan-specific education if they insist on fasting.[68]

Sick day management

People with diabetes who are acutely ill, if not managed appropriately and expediently, may experience hyperglycaemia, diabetic ketoacidosis (blood ketones >3.0 mmol/L), hyperosmolar hyperglycaemic state, hypoglycaemia or other adverse outcomes.[70-72] Some illnesses, such as those associated with fever, may raise blood glucose levels because of higher levels of stress hormones. During illness, ketone body production may be increased due to inadequate insulin levels and the counter-regulatory hormone response. In contrast, vomiting and diarrhea may lower glucose levels with the increased possibility of hypoglycaemia. The insulin dose may need to be increased or decreased to maintain glucose metabolism, but it should never be stopped.[71,72]

All people with diabetes treated with insulin, and/or their carer, should work with their healthcare professional to develop a sick day management plan.[71,72]

Examples of sick day plans are available for T1DM or T2DM, or refer to your local Health Pathways. In addition to outlining the frequency and amount of recommended fluids and carbohydrate-containing food, the plan should include the recommended frequency of blood glucose monitoring and, if appropriate, blood or urine ketone testing, and any adjustments to diabetes medication.[71, 72]

More frequent blood glucose testing is recommended during a period of acute illness.[71, 72] In individuals with T1DM, ketone levels should be measured during times of illness, even if blood glucose is not high, and action taken (give additional rapid-acting insulin) if ketone levels are above 0.6 mmol/L regardless of blood glucose levels. In order to prevent a loss of metabolic control, people with diabetes should be advised by their healthcare professional to seek early treatment for any illness or injury.

Vaccinations

People with diabetes are at increased risk of medical complications attributable to influenza infections.[73] Studies have shown that influenza vaccination effectively reduced complication, hospitalisations, and deaths in people with diabetes.[74] Consequently, the annual influenza vaccine is recommended and funded for those with diabetes.[75, 76, 77]

COVID-19

Diabetes appears to be an important risk factor for adverse outcomes if a person is infected with COVID-19.[78-82] Given the high prevalence of cardiovascular disease, obesity, and hypertension in people with diabetes, it is as yet unclear if diabetes independently contributes to this increased risk.

People with diabetes should take extra precautions to avoid infection and, if infected, may require special management.[82, 83] Importantly, people with diabetes should maintain optimal glycaemic control, as it may help to reduce the risk and severity of infection. Other preventive measures, such as maintaining adequate nutrition, exercising, and being current with vaccinations for influenza and pneumonia, may be important. People with diabetes should also ensure they have adequate supplies of their insulin or oral diabetes medication if possible.

Travel

People with diabetes treated with insulin face many unique challenges when travelling.[84] Dehydration, a risk associated with long-distance air travel, is accentuated in people with diabetes; and extreme dehydration without proper insulin adjustment has been reported to trigger diabetic ketoacidosis.[85] Travelling across time zones, increases the risk of hypoglycaemia, as it effectively makes the day either longer or shorter, and may require adjustment of the dosage and timing of insulin administration, changes in the timing and content of meals and/or snacks, and potentially changes in the amount of exercise undertaken.[84, 86, 87] One of the ways to plan insulin management when travelling is for the person with diabetes to work with their specialist diabetes team to form a plan for these adjustments and changes before travelling.[88]

Insulin and all essential supplies for the management of diabetes should be carried with the traveller at all times.[88] Insulin should not be exposed to extremes of temperature, including the unpressurised baggage compartment of a plane where it can freeze. If necessary, insulin can be carried in an insulated bag or small wide-mouthed thermos flask.[88] All necessary documentation stating that the person has diabetes and is required to carry insulin, pens/syringes/needles or other medication should accompany the traveller.[88, 89]

EXPERT COMMENTARY

Optimal management of diabetes takes a lot of time and energy on the part of the person with diabetes and can be particularly challenging during times of unexpected illness or activities outside of their usual routine.

Providing comprehensive education at the time of commencing insulin and at annual review that encompasses advice on how to titrate insulin and food to effectively self-care during a sick day, physical activity, eating out or fasting for prolonged periods, driving safely and traveling is essential. In particular, all people with diabetes, but especially type 1 diabetes, should know what to do if they are sick and have their individualised sick day plan reviewed and refreshed on an annual basis.

TAKE HOME MESSAGES

- Awareness of insulin delivery options will enable people treated with insulin to choose a device best suited to their capabilities and personal lifestyle
- Safety must always be a priority when using insulin and appropriate checks should be in place at all stages of the insulin management process — assessment, prescribing, dispensing, administering and monitoring
- Injections should be into the SC fatty tissue and not IM
- Pen needles 4 mm in length, inserted at 90°, are recommended for insulin-treated adults and children, regardless of BMI
- PHARMAC now funds a new needle for each injection
- At least annually, practical aspects of insulin therapy should be discussed, and injection sites examined and palpated to detect lipohypertrophy
- Rotation of the injection site is important to prevent lipoatrophy and lipohypertrophy. People treated with insulin should:
  - divide injection areas into quadrants (abdomen) or halves (thighs or buttocks)
  - use one quadrant/half per week
  - rotate in a consistent direction
  - inject the insulin at least 1 cm from the previous injection
- Mild hypoglycaemia should be treated with
  - the 'rule of 15' — 15 g carbohydrate, 15 minutes for absorption, and repeat glucose measurement after another 15 minutes or
  - use the glucose 0.3 g/kg bodyweight rule
- Eating out:
  - Prandial (meal-time) doses of insulin can be adjusted and should take into account the result of the pre-meal blood glucose levels as well as the expected composition and size of meals
  - When eating out, the timing of the prandial insulin should be as near as possible to the usual timing of the prandial insulin dose when administered at home
- During illness:
  - In T1DM, ketone levels should be measured during times of illness, even if blood glucose is not high
  - If ketone levels are >0.6 mmol/L, action should be taken (extra rapid-acting insulin) regardless of blood glucose levels
- Flu vaccination should be administered on an annual basis
- Plans for special situations such as during exercise, sick days, travel, Ramadan, and hypoglycaemia should be regularly discussed with insulin-treated individuals

EXPERT CONCLUSION

Practical aspects of insulin therapy are multifaceted and should be fully understood and incorporated in the care and management plan for the person with diabetes. People with diabetes who are being prescribed insulin have a right to be fully informed on how to manage their insulin therapy during wellness and illness, and during specific situations that may lead to loss of optimal blood glucose management. A regular review of injection technique, storage of insulin, management of hypoglycaemia and sick day plans on an annual basis is very important to identify any problems early or to provide information where there are gaps in knowledge. Culturally appropriate care and education are essential. Consideration of health literacy is important to ensure care and education are provided in a way that is supportive and promotes self-care whenever possible. Involvement of family or whanau can be important to share the burden and provide valuable support of self-care.

RESOURCES FOR PRIMARY CARE

NZ Primary Care Handbook 2012 https://www.health.govt.nz/system/files/documents/publications/nz-primary-care-handbook-2012.pdf

Guidance on the Management of Type 2 Diabetes 2011

http://www.moh.govt.nz/notebook/nbbooks.nsf/0/60306295DECB0BC6CC257A4F000FC0CB/$file/NZGG-management-of-type-2-diabetes-web.pdf

Living well with diabetes: a plan for people at high risk of or living with diabetes 2015–2020. https://www.health.govt.nz/system/files/documents/publications/living-well-with-diabetes-oct15.pdf

Quality Standards for Diabetes Care Toolkit 2014. https://www.health.govt.nz/publication/quality-standards-diabetes-care-toolkit-2014

New Zealand Society for the Study of Diabetes www.nzssd.org.nz https://www.nzssd.org.nz/assets/table-files/resources-40-resource_file.pdf

Type 2 Diabetes Xplained (provides patient information in four languages; English, Samoan, Tongan and Maori) https://type2diabetesxplained.co.nz/

HealthMentorOnline http://pro.healthmentoronline.com

Diabetes New Zealand https://www.diabetes.org.nz/diabetes-supplies

Further information on insulin pens is provided on: Diabetes New Zealand website www.diabetes.org.nz/diabetes-supplies-insulin-pens Health Navigator NZ website www.healthnavigator.org.nz/medicines/i/insulin-pens-syringes-and-needles/

Further details relating to the detection, treatment and prevention of lipohypertrophy are available https://www.bd.com/dc-anz/healthcare-professionals/education/managing-lipohypertrophy

REFERENCES

1. New Zealand Guidelines Group. Guidance on the management of type 2 diabetes 2011. Wellington: New Zealand Guidelines Group; 2011.
2. New Zealand Guidelines Group. New Zealand Primary Care Handbook 2012. https://www.health.govt.nz/system/files/documents/publications/nz-primary-care-handbook-2012.pdf's. Accessed 28 July, 2020.
3. Davies MJ, D'Alessio DA, Fradkin J, et al. Management of hyperglycemia in type 2 diabetes, 2018. A consensus report by the American Diabetes Association (ADA) and the European Association for the Study of Diabetes (EASD). Diabetes Care. 2018;41:2669-701.
4. New Zealand Formulary. Insulin 2020. https://www.nzf.org.nz/nzf_3629. Accessed 28 July, 2020.
5. Pearson TL. Practical aspects of insulin pen devices. J Diabetes Sci Technol. 2010;4:522-31.
6. Health Navigator. Insulin pens, syringes and needles. 2020. https://www.healthnavigator.org.nz/medicines/i/insulin-pens-syringes-and-needles/#Insulin%20pens. Accessed 28 July, 2020.
7. New Zealand Formulary. Injector devices. 2020. https://www.nzf.org.nz/nzf_70440. Accessed 28 July, 2020.
8. Diabetes New Zealand. Insulin Pens. 2020. https://www.diabetes.org.nz/diabetes-supplies-insulin-pens Accessed 28 July, 2020.
9. Ministry of Health. Application for subsidy: Insulin pump. 2020. www.pharmac.govt.nz/latest/SA1603.pdf. Accessed .
10. Best Practice Advocacy Centre New Zealand. Understanding the role of insulin in the management of type 1 diabetes. 2019. https://bpac.org.nz/2019/diabetes-insulin.aspx#tab1. Accessed 8 April, 2020.
11. Health Quality and Safety Commission New Zealand. Patient story: Insulin error leads to medication safety improvements. 2014. https://www.hqsc.govt.nz/our-programmes/medication-safety/publications-and-resources/publication/3143/. Accessed 28 July, 2020.
12. Truong TH, Nguyen TT, Armor BL, et al. Errors in the administration technique of insulin pen devices: a result of insufficient education. Diabetes Ther. 2017;8:221-6.
13. Mitchell VD, Porter K, Beatty SJ. Administration technique and storage of disposable insulin pens reported by patients with diabetes. Diabetes Educ. 2012;38:651-8.
14. Health Quality and Safety Commisson New Zealand. Insulin. 2014. http://www.open.hqsc.govt.nz/medication/insulin. Accessed 28 July, 2020.
15. Prescrire Editorial Staff. Insulin use: preventable errors. Prescrire Int. 2014;23:14-7.
16. Diabetes New Zealand. Insulin. 2020. https://www.diabetes.org.nz/diabetes-supplies-insulin?rq=insulin%20storage. Accessed 28 July, 2020.
17. Health Navigator. Insulin overview. 2020. https://www.healthnavigator.org.nz/medicines/i/insulin/. Accessed 28 July, 2020.
18. Frid AH, Kreugel G, Grassi G, et al. New insulin delivery recommendations. Mayo Clin Proc. 2016;91:1231-55.
19. Blonde L, Aschner P, Bailey C, et al. Gaps and barriers in the control of blood glucose in people with type 2 diabetes. Diab Vasc Dis Res. 2017;14:172-83.
20. Khunti K, Millar-Jones D. Clinical inertia to insulin initiation and intensification in the UK: a focused literature review. Prim Care Diabetes. 2017;11:3-12.
21. American Diabetes Association. 9. Pharmacologic approaches to glycemic treatment: Standards of medical care in diabetes-2020. Diabetes Care. 2020;43:S98-s110.
22. American Diabetes Association. Insulin administration. Diabetes Care. 2004;27 Suppl 1:S106-9.
23. Karges B, Boehm BO, Karges W. Early hypoglycaemia after accidental intramuscular injection of insulin glargine. Diabet Med. 2005;22:1444-5.
24. Frid A, Gunnarsson R, Guntner P, et al. Effects of accidental intramuscular injection on insulin absorption in IDDM. Diabetes Care. 1988;11:41-5.
25. Gradel AKJ, Porsgaard T, Lykkesfeldt J, et al. Factors affecting the absorption of subcutaneously administered insulin: effect on variability. J Diabetes Res. 2018;2018:1205121.
26. Berger M, Cüppers HJ, Hegner H, et al. Absorption kinetics and biologic effects of subcutaneously injected insulin preparations. Diabetes Care. 1982;5:77-91.
27. Klemp P, Staberg B, Madsbad S, et al. Smoking reduces insulin absorption from subcutaneous tissue. Br Med J (Clin Res Ed). 1982;284:237.
28. Frid AH, Hirsch LJ, Menchior AR, et al. Worldwide Injection Technique Questionnaire Study: population parameters and injection practices. Mayo Clin Proc. 2016;91:1212-23.
29. Frid AH, Hirsch LJ, Menchior AR, et al. Worldwide injection technique questionnaire study: injecting complications and the role of the professional. Mayo Clin Proc. 2016;91:1224-30.
30. Bergenstal RM, Strock ES, Peremislov D, et al. Safety and efficacy of insulin therapy delivered via a 4mm pen needle in obese patients with diabetes. Mayo Clin Proc. 2015;90:329-38.
31. Hirsch LJ, Gibney MA, Albanese J, et al. Comparative glycemic control, safety and patient ratings for a new 4 mm x 32G insulin pen needle in adults with diabetes. Curr Med Res Opin. 2010;26:1531-41.
32. Kreugel G, Keers JC, Kerstens MN, et al. Randomized trial on the influence of the length of two insulin pen needles on glycemic control and patient preference in obese patients with diabetes. Diabetes Technol Ther. 2011;13:737-41.
33. Miwa T, Itoh R, Kobayashi T, et al. Comparison of the effects of a new 32-gauge × 4-mm pen needle and a 32-gauge × 6-mm pen needle on glycemic control, safety, and patient ratings in Japanese adults with diabetes. Diabetes Technol Ther. 2012;14:1084-90.
34. Nagai Y, Ohshige T, Arai K, et al. Comparison between shorter straight and thinner microtapered insulin injection needles. Diabetes Technol Ther. 2013;15:550-5.
35. Schwartz S, Hassman D, Shelmet J, et al. A multicenter, open-label, randomized, two-period crossover trial comparing glycemic control, satisfaction, and preference achieved with a 31 gauge x 6 mm needle versus a 29 gauge x 12.7 mm needle in obese patients with diabetes mellitus. Clin Ther. 2004;26:1663-78.
36. Frid A, Linde B. Intraregional differences in the absorption of unmodified insulin from the abdominal wall. Diabet Med. 1992;9:236-9.
37. Health Navigator. Insulin pen needles. 2020. https://www.healthnavigator.org.nz/medicines/i/insulin-pens-syringes-and-needles/#Needles. Accessed 28 July, 2020.
38. Gibney MA, Arce CH, Byron KJ, et al. Skin and subcutaneous adipose layer thickness in adults with diabetes at sites used for insulin injections: implications for needle length recommendations. Curr Med Res Opin. 2010;26:1519-30.
39. Pharmaceutical Management Agency. New Zealand Pharmaceutical Schedule Update October 2019. 2019. https://www.pharmac.govt.nz/2019/09/18/SU.pdf. Accessed 28 July, 2020.
40. BD – Your Diabetes Injection Experts. 2012. https://www.bd.com/resource.aspx?IDX=26507. Accessed 28 July, 2020.
41. Diabetes New Zealand Auckland Branch. Sharps disposal update. 2016. https://diabetesauckland.org.nz/blog/2016/02/15/sharps-disposal-update/. Accessed 28 July, 2020.
42. Vardar B, Kizilci S. Incidence of lipohypertrophy in diabetic patients and a study of influencing factors. Diabetes Res Clin Pract. 2007;77:231-6.
43. Deng N, Zhang X, Zhao F, et al. Prevalence of lipohypertrophy in insulin-treated diabetes patients: a systematic review and meta-analysis. J Diabetes Investig. 2017.
44. Blanco M, Hernández MT, Strauss KW, et al. Prevalence and risk factors of lipohypertrophy in insulin-injecting patients with diabetes. Diabetes Metab. 2013;39:445-53.
45. Grassi G, Scuntero P, Trepiccioni R, et al. Optimizing insulin injection technique and its effect on blood glucose control. J Clin Transl Endocrinol. 2014;1:145-50.
46. Sun Z, Li Q, Ji L, et al. Lipohypertrophy: prevalence, risk factors, clinical characteristics, and economic burden of insulin-requiring patients in China. Diabetologia. 2015;58 (Suppl. 1):S438-S439.
47. Gupta SS, Gupta KS, Gathe SS, et al. Clinical implications of lipohypertrophy among people with type 1 diabetes in India. Diabetes Technol Ther. 2018;20:483-91.
48. Deeb A, Abdelrahman L, Tomy M, et al. Impact of insulin injection and infusion routines on lipohypertrophy and glycemic control in children and adults with diabetes. Diabetes Ther. 2019;10:259-67.
49. Famulla S, Hövelmann U, Fischer A, et al. Insulin injection into lipohypertrophic tissue: blunted and more variable insulin absorption and action and impaired postprandial glucose control. Diabetes Care. 2016;39:1486-92.
50. Barola A, Tiwari P, Bhansali A, et al. Insulin-related lipohypertrophy: lipogenic action or tissue trauma? Front Endocrinol (Lausanne). 2018;9:638.
51. Umpierrez G, Korytkowski M. Diabetic emergencies - ketoacidosis, hyperglycaemic hyperosmolar state and hypoglycaemia. Nat Rev Endocrinol. 2016;12:222-32.
52. McTavish L, Krebs JD, Weatherall M, et al. . Weight-based hypoglycaemia treatment protocol for adults with type 1 diabetes: a randomized crossover clinical trial. Diabet Med. 2015;32(9):1143-48.
53. Diabetes New Zealand. Hypoglycaemia. 2020. https://www.diabetes.org.nz/type-1-diabetes-hypoglycaemia. Accessed 28 July, 2020.
54. Best Practice Advocacy Center New Zealand. Knowing your patient with type 1 diabetes: the transition to self-management. 2019. https://bpac.org.nz/2019/docs/diabetes-self-management.pdf. Accessed 28 July, 2020.
55. Kirwan JP, Sacks J, Nieuwoudt S. The essential role of exercise in the management of type 2 diabetes. Cleve Clin J Med. 2017;84:S15-s21.
56. Codella R, Terruzzi I, Luzi L. Why should people with type 1 diabetes exercise regularly? Acta Diabetol. 2017;54:615-30.
57. Colberg SR, Sigal RJ, Yardley JE, et al. Physical activity/exercise and diabetes: a Position Statement of the American Diabetes Association. Diabetes Care. 2016;39:2065-79.
58. Cox DJ, Gonder-Frederick LA, Kovatchev BP, et al. Progressive hypoglycemia's impact on driving simulation performance. Occurrence, awareness and correction. Diabetes Care. 2000;23:163-70.
59. Graveling AJ, Warren RE, Frier BM. Hypoglycaemia and driving in people with insulin-treated diabetes: adherence to recommendations for avoidance. Diabet Med. 2004;21:1014-9.
60. Bell D, Huddart A, Krebs J. Driving and insulin-treated diabetes: comparing practices in Scotland and New Zealand. Diabet Med. 2010;27:1093-5.
61. New Zealand Transport Agency. Medical aspects of fitness to drive - a guide for health practitioners. 2014. https://www.nzta.govt.nz/assets/resources/medical-aspects/Medical-aspects-of-fitness-to-drive-A-guide-or-health-practitioners.pdf. Accessed 28 July, 2020.
62. New Zealand Transport Agency. Diabetes and driving. 2013. https://www.healthnavigator.org.nz/media/1001/driving-and-diabetes-lta-fact-sheet-16.pdf. Accessed 28 July, 2020.
63. Brod M, Nikolajsen A, Weatherall J, et al. Understanding post-prandial hyperglycemia in patients with type 1 and type 2 diabetes: a web-based survey in Germany, the UK, and USA. Diabetes Ther. 2016;7:335-48.
64. Diabetes New Zealand. Diabetes and healthy food choices. 2020.
65. Krzymien J, Ladyzynski P. Insulin in type 1 and type 2 diabetes-should the dose of insulin before a meal be based on glycemia or meal content? Nutrients. 2019;11:607.
66. Lessan N, Ali T. Energy metabolism and intermittent fasting: the Ramadan perspective. Nutrients. 2019;11:1192.
67. Alabbood MH, Ho KW, Simons MR. The effect of Ramadan fasting on glycaemic control in insulin dependent diabetic patients: A literature review. Diabetes Metab Syndr. 2017;11:83-7.
68. International Diabetes Federation (IDF), Diabetes and Ramadan (DAR) International Alliance. Diabetes and Ramadan: practical guidelines. 2016. https://www.worlddiabetesfoundation.org/sites/default/files/IDF%20%26%20DAR%20Guidelines%20April-16-low_0.pdf. Accessed 28 July, 2020.
69. Grunberger G. Insulin analogs-are they worth it? Yes! Diabetes Care. 2014;37:1767-70.
70. Laffel L. Sick-day management in type 1 diabetes. Endocrinol Metab Clin North Am. 2000;29:707-23.
71. Australian Diabetes Educators Association. Clinical guiding principles for sick day management of adults with type 1 and type 2 diabetes. 2014.
72. Laffel LM, Limbert C, Phelan H, et al. ISPAD Clinical Practice Consensus Guidelines 2018: Sick day management in children and adolescents with diabetes. Pediatr Diabetes. 2018;19 Suppl 27:193-204.
73. Mertz D, Kim TH, Johnstone J, et al. Populations at risk for severe or complicated influenza illness: systematic review and meta-analysis. BMJ. 2013;347:f5061.
74. Looijmans-Van den Akker I, Verheij TJ, Buskens E, et al. Clinical effectiveness of first and repeat influenza vaccination in adult and elderly diabetic patients. Diabetes Care. 2006;29:1771-6.
75. World Health Organization. Strategic Advisory Group of Experts (SAGE) Working Group. Background paper on influenza vaccines and immunization. 2012. http://www.who.int/entity/immunization/sage/meetings/2012/april/1_Background_Paper_Mar26_v13_cleaned.pdf?ua=1. Accessed 28 July, 2020.
76. Ministry of Health. Immunisation Handbook 2017 (2nd edn). Wellington 2018.
77. Pharmac. Vaccinations. 2020. https://www.pharmac.govt.nz/wwwtrs/ScheduleOnline.php?osq=influenza. Accessed 28 July, 2020.
78. Bloomgarden ZT. Diabetes and COVID-19. J Diabetes. 2020;12:347-8.
79. Fang L, Karakiulakis G, Roth M. Are patients with hypertension and diabetes mellitus at increased risk for COVID-19 infection? Lancet Respir Med. 2020;8:e21.
80. Guo W, Li M, Dong Y, et al. Diabetes is a risk factor for the progression and prognosis of COVID-19. Diabetes Metab Res Rev. 2020:e3319.
81. Muniyappa R, Gubbi S. COVID-19 pandemic, corona viruses, and diabetes mellitus. Am J Physiol Endocrinol Metab. 2020.
82. Coppell KJ, Hall RM, Downie M, et al. Diabetes and COVID-19-the meeting of two pandemics: what are the concerns? N Z Med J. 2020;133(1514):85-7.
83. Gupta R, Ghosh A, Singh AK, et al. Clinical considerations for patients with diabetes in times of COVID-19 epidemic. Diabetes Metab Syndr. 2020;14:211-2.
84. Pinsker JE, Becker E, Mahnke CB, et al. Extensive clinical experience: a simple guide to basal insulin adjustments for long-distance travel. J Diabetes Metab Disord. 2013;12:59.
85. Tashima CK, Fillhart M, Cunanan A. Letter: Jet lag ketoacidosis. JAMA. 1974;227:328.
86. Lin IW, Chang HH, Lee YH, et al. Blood sugar control among type 2 diabetic patients who travel abroad: a cross sectional study. Medicine (Baltimore). 2019;98:e14946.
87. Burnett JC. Long- and short-haul travel by air: issues for people with diabetes on insulin. J Travel Med. 2006;13:255-60.
88. Diabetes New Zealand. Diabetes & travelling. 2020. https://www.diabetes.org.nz/managing-diabetes-travelling-2. Accessed 28 July, 2020.
89. New Zealand Customs Service. Medicines. 2020. https://www.customs.govt.nz/personal/travel-to-and-from-nz/travelling-to-nz/medicines/. Accessed28 July, 2020.

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