

Forum for
Injection Technique
Brunei Darussalam

FIT-BN

Recommendations
for Best Practice in
Injection Technique



Optimising
Diabetes Care

TABLE OF CONTENTS

FOREWORD	1	6.1 Injection Storage	32
PREFACE	2	6.2 Injection Storage During Travelling	32
OBJECTIVE	3	SECTION 7 SAFETY ISSUES	34
TARGET POPULATION	3	7.1 Safety	34
TARGET GROUP	3	7.2 Disposal of Injection Material/Sharps	34
WORKING COMMITTEE	4	7.3 Needle Stick Injuries/Blood-borne Infection Risk	35
EXTERNAL REVIEWERS	4	7.4 Institutional Practice	35
SECTION 1 INTRODUCTION	5	SECTION 8 SPECIAL CONSIDERATIONS IN INJECTABLE THERAPY	37
SECTION 2 INJECTABLE THERAPY IN DIABETES	6	8.1 Hypoglycaemia	37
2.1 Insulin Injection Therapy	6	8.2 Bleeding and Bruising	38
2.2 Insulin Pump Therapy or Continuous Subcutaneous Insulin Infusion	9	8.3 Painful Injection	39
2.3 Glucagon Like Peptide-1 Receptor Agonist (GLP-1 RA) Therapy	12	8.4 Hypersensitivity Reaction	39
SECTION 3 THERAPEUTIC EDUCATION	13	8.5 Lipohypertrophy	39
3.1 Initial Education	13	SECTION 9 SPECIAL POPULATIONS	45
3.2 Follow-up Education	14	9.1 Pregnancy	45
SECTION 4 INJECTION TECHNIQUE	16	9.2 Elderly	46
4.1 Insulin Injection	16	9.3 Paediatrics (Children and Adolescents)	47
4.2 Non-insulin Injectable Therapy	23	SECTION 10 PSYCHOSOCIAL CHALLENGES OF INJECTION	49
4.3 Needle Length	23	10.1 Psychosocial Challenges Among Adults	49
4.4 Lifted Skin Folds	25	10.2 Psychosocial Challenges Among Adolescents	50
4.5 Reused Needle	25	10.3 Psychosocial Challenges Among Children	50
SECTION 5 INJECTION SITES	28	10.4 Psychosocial Challenges Among Healthcare Professionals	51
5.1 Injection Sites Selection	28	CHECKLIST	54
5.2 Rotation of Injection Sites	29	APPENDIX	56
5.3 Insulin Absorption	29	GLOSSARY OF TERMS	58
SECTION 6 MEDICATION STORAGE	32	ACKNOWLEDGEMENTS	59

FOREWORD

It gives me great pleasure to introduce the first publication of the Forum for Injection Technique – Brunei Darussalam (FIT-BN). According to the Brunei STEPS Survey 2015-2016, 1 in every 10 adults in Brunei Darussalam has diabetes. Nationally, diabetes remains the third leading cause of death after heart attack and cancer.

The theme for the World Diabetes Day 2021-2023 is “Access to Diabetes Care” and the campaign for 2022-2023 focuses on the need for better access to quality of diabetes education for healthcare professionals and individuals living with diabetes. Hence this guideline is timely and serves to ensure evidence-based quality of care to all individuals with diabetes who require insulin and other non-insulin injectable therapy.

Whilst celebrating the landmark achievement of insulin discovery just over 100 years ago in 1921 and acknowledging advances made in drug therapies to treat diabetes, the fears and concerns regarding injectable therapy among the public and even healthcare professionals still exist. It is important to recognise the pivotal role of education for healthcare professionals involved in treating diabetes and education for individuals with diabetes to better address these challenges and manage diabetes holistically. I am pleased to see that this guideline covers all aspects of insulin and other non-insulin injectable therapies, from injection techniques and storage to preventing complications of injection and addressing psychosocial challenges across the lifespan.

The Ministry of Health remains fully committed to deliver excellence in diabetes care for the general public as set out in its Strategic Plan 2019-2023. I would like to congratulate the working committee on producing this comprehensive guideline, which will serve as an evidence-based tool in promoting a better standard of diabetes care in the country as we work towards a healthy nation Wawasan Brunei 2035.

YB Dato Seri Setia Dr Haji Mohammad Isham bin Haji Jaafar
Minister of Health, Brunei Darussalam

PREFACE

Globally, more than one in 10 adults are now living with diabetes. The rising burden of type 2 diabetes is a major concern in healthcare worldwide. It has been well established by landmark trials that the risks for both microvascular and macrovascular complications of diabetes can be reduced by improving blood glucose control. However, adequate glycaemic control can be difficult to achieve for a proportion of individuals with type 2 diabetes mellitus and often requires the addition of insulin or other non-insulin injectable therapy as part of treatment intensification.

This guideline is comprehensive and takes into consideration the types of insulin and other non-insulin injectables that are currently available in the country. It focuses on correct injection techniques, storage, safety issues including potential complications, and also covers special populations and psychosocial challenges. In addition, it highlights the importance of exploring potential barriers to injection and offers suggested solutions to be given to individuals through education. The roles of health care providers are to provide initial and supportive follow-up education to ensure that the individuals understand the indications for injectable therapy, and that they practice the recommended injection technique. Ultimately, the Forum for Injection Technique – Brunei Darussalam aims to furnish a standardised guide for all health care providers to enhance clinical outcomes for individuals with diabetes who are on insulin and non-insulin injectable therapies.

As the Chairperson of the Forum for Injection Technique – FIT-BN, I would like to express my thanks and gratitude to the working committee as well as the external reviewers in this guideline development for their support and contribution.

Dr Alice Yong Moi Ling
Chairperson, Forum for Injection Technique – Brunei Darussalam

WORKING COMMITTEE

OBJECTIVE

To develop an evidence-based Injection Technique Guideline for healthcare professionals (HCPs) who care for individuals with diabetes in Brunei Darussalam.

TARGET POPULATION

This guideline provides recommendations for individuals with diabetes who use injectable therapy in their daily management.

TARGET GROUP

This guideline may be used by HCPs (including diabetes educators, nurses, dieticians, pharmacists and medical practitioners) who provide diabetes education related to injectable therapy for individuals with diabetes.

OBJECTIVE, TARGET POPULATION, TARGET GROUP

Chairperson

Dr Alice Yong Moi Ling
Consultant Endocrinologist
Endocrine Centre
Raja Isteri Pengiran Anak Saleha Hospital

Deputy Chairperson

Dr Yung Chee Kwang
Consultant Endocrinologist
Endocrine Centre
Raja Isteri Pengiran Anak Saleha Hospital

Committee Members (Alphabetical Order)

Dr Hajah Haslinda Binte Haji Md Hassan
Consultant Endocrinologist
Endocrine Centre
Raja Isteri Pengiran Anak Saleha Hospital

Mrs Linda Lim Ying Ying
Pharmacist
Raja Isteri Pengiran Anak Saleha Hospital

Hajah Nor Zainah Binte Haji Metali
Diabetes Nurse Educator
Endocrine Centre
Raja Isteri Pengiran Anak Saleha Hospital

Dayang Fauzana Binte Hj Osman
Diabetes Nurse Educator
Primary Healthcare Services

External Reviewers

Dr Lina Chong Pui Lin
Consultant Endocrinologist
Endocrine Centre
Raja Isteri Pengiran Anak Saleha Hospital

Dr Dayang Hjh Musjarena binti Hj Awang Abd Mulok
Consultant in Primary Health Care Services
Department of Health Services
Ministry of Health

Ms Koh Paw Ling
Deputy Director of Nursing
Jerudong Park Medical Centre

SECTION 1

INTRODUCTION

Diabetes is a chronic disease characterised by elevated blood glucose due to insulin deficiency and/or insulin resistance. It represents a major health issue affecting millions worldwide. According to the IDF Atlas 9th Edition, there are currently 463 million people living with diabetes in 2019.¹ This is projected to double to 700 million by 2045. In Brunei Darussalam, the prevalence of diabetes is reported at 12.5% based on the 2nd National Health And Nutritional Status Survey (NHANSS) and the STEPS survey in 2016 reporting a prevalence of 9.7%.^{2,3} Unfortunately poor glycaemic control is a universal problem despite the availability of various glucose-lowering agents and clinical guidelines. The benefits of timely glycaemic control for reducing the risk of developing micro- and macrovascular complications are well-established.^{4,5,6,7}

Amongst the various blood glucose lowering agents available, insulin treatment has come a long way since its first discovery by Sir Frederick Banting in 1921. It is currently only available in the injectable form in different preparations in Brunei Darussalam. Therefore it is delivered via either a syringe, pre-filled insulin pen, refillable insulin pen or, insulin pump. However insulin therapy remains challenging for healthcare providers as well as for patients. Currently there are approximately 4500 patients who are on insulin treatment in the government healthcare facility setting. It is hence quintessential that all healthcare providers who manage individuals with diabetes should have the clinical and practical knowledge on the proper use, storage and transportation of insulin. With the expansion of the armamentarium in treatment choices for diabetes, there are also non-insulin injectable therapies such as GLP -1 receptor agonists. This will also be touched upon in this guideline.

References

1. International Diabetes Federation. *IDF Diabetes Atlas, 9th edn*. Brussels, Belgium: 2019. Available at: <https://www.diabetesatlas.org>
2. The 2nd National Health And Nutritional Status Survey (NHANSS) 2009-2011. Ministry of Health Brunei Darussalam
3. Ong SK, Lai DTC, Wong JY, et al. Cross-sectional STEPwise Approach to Surveillance (STEPS) Population Survey of Noncommunicable Diseases (NCDs) and Risk Factors in Brunei Darussalam 2016. *Asia Pac J Public Health*. 2017;29(8): 635-648. doi:10.1177/1010539517738072
4. Stratton IM, Adler AI, Neil HA, et al. Associations of glycaemia with macrovascular and microvascular complications of type 2 diabetes (UKPDS 35): prospective observational study. *BMJ*, 2000;321(7258): 405-412
5. Fong DS, Aiello LP, Ferris FL III, Klein R. Diabetic retinopathy. *Diabetes Care*, 2004; 27(10):2540-2553
6. Holman RR, Paul SK, Bethel MA, Matthews DR, Neil HA. 10-year follow up of intensive glucose control in type 2 diabetes. *N Eng J Med*. 2008;359(15):1577-1589
7. Ray KK, Seshasi SR, Wijesuriya S, et al. Effect of intensive control of glucose on cardiovascular outcomes and death in patients with diabetes mellitus: a meta-analysis of randomised controlled trials. *Lancet*. 2009;373(9677):1765-1772

SECTION 2

INJECTABLE THERAPIES IN DIABETES

There are several types of injectable therapies used for glycaemic lowering in diabetes. These are insulin, GLP-1 RA and amylin agonists. Amylin agonists is currently not available in Brunei.

2.1 Insulin Injection Therapy

Insulin therapy is an integral part of diabetes management in both type 1 diabetes mellitus (T1DM) and type 2 diabetes mellitus (T2DM). In T1DM, insulin therapy is required from the time of diagnosis and continued to be required over the lifetime of an individual. For T1DM, intensive insulin therapy with multiple dose injections to mimic physiological insulin secretion is the standard of care, with some individuals with T1DM requiring insulin pump therapy where indicated.

In T2DM, insulin therapy is used either during acute illness associated with hyperglycaemia, hyperglycaemic emergencies, perioperatively or during pregnancy and lactation. Long-term insulin therapy in T2DM is indicated following the failure of combination anti-diabetic therapy with oral or non-insulin injectables to maintain optimal glycaemic control.¹ Insulin therapy is usually initiated gradually, progressing from once daily basal insulin regimens to either premixed, basal-plus or basal bolus insulin regimens while the patient is maintained on certain oral anti-diabetic therapies as pancreatic beta cell failure progresses (Refer to Table 1 and 2).

2.1.1 Insulin – Classification and Types

Two types of insulin are currently in used in Brunei, i.e. **human insulin** derived by recombinant technology or **insulin analogues** which are genetically modified human insulin, in which the amino acid sequence have been altered to change the pharmacokinetic profile.

The types of insulin available according to their pharmacokinetic profiles are shown in Table 1.

- **Prandial insulin**, which is rapid or short-acting insulin. It is administered pre-meal because of its short or rapid onset of action in controlling post-prandial glucose excursion.
- **Basal insulin**, which is intermediate or long-acting analogue insulin. It is administered once or twice daily and covers the basal insulin requirements in between meals and overnight.
- **Premixed insulin**, which is biphasic insulin that incorporates both the short or rapid-acting insulin with intermediate-acting insulin/long-acting insulin analogue in a single preparation to cover for both post-prandial glucose excursion as well as basal insulin needs.

SECTION 2

Table 1: Classification and Types of Insulin currently available in Brunei Darussalam

Insulin preparation	Onset of action	Peak action (hours)	Duration of action (hours)	Timing of insulin administration
Prandial				
Short-acting, regular Actrapid Humulin R	30 – 60 min	2 – 4	6 – 10	15-30 min before meal
Rapid analogue Aspart (NovoRapid) Lispro (Humalog)	0 – 20 min	1 – 3	3 – 5	5 to 15 min before or immediately after meal
Basal				
Intermediate-acting, NPH Insulatard Humulin N	1 – 2 hrs	4 – 8 hrs	8 – 12 hrs	Pre-breakfast/ Pre-dinner / At bed time
Long-acting analogue Determir (Levemir)	30 – 60 min	Less peak	16 – 24	Evening meal or bedtime
Glargine 100 U/ml (Lantus)	30 – 60 min	Less peak	16 – 24	Same time everyday check dosage window
Glargine 300 U/ml (Toujeo)	30 – 60 min	Peakless	24 – 36	Same time daily, ±3 hrs flexible dose window
Premixed insulins				
Biphasic insulin 30/70 (Mixtard 30) (Humulin 30/70)	30 min 30 min	Dual Dual	18 – 23 16 – 18	15-30 min before meal
Biphasic insulin aspart (Novomix 30)	10 – 20 min	1 – 4	16 – 20	5 – 15 min before meal

SECTION 2

2.1.2 Insulin Regimens

- An ideal insulin regimen should mimic the physiological insulin response to meals and endogenous hepatic glucose production. The choice of insulin regimen should be individualised, based on the individual's glycaemic profile, dietary pattern and lifestyle (Refer to Table 2).

Table 2: Insulin Regimens

No. of injections per day	Insulin regimen	Type of insulin and timing
1	BASAL	Intermediate-acting (NPH) insulin pre-breakfast/at bed time.
	BASAL	Long-acting analogue once daily
	PREMIXED OD	Premixed prandial
2	BASAL	Intermediate-acting (NPH) pre-breakfast and pre-dinner
	PREMIXED BD	Premixed insulin pre-breakfast and pre-dinner
	BASAL-PLUS 1	Basal insulin once daily + 1 prandial insulin
3	BASAL-PLUS 2	Basal insulin once daily + 2 prandial insulin
	PRANDIAL	Prandial insulin pre-breakfast, pre-lunch and pre-dinner
	PREMIXED TDS	Premixed pre-breakfast, pre-lunch and pre-dinner
	PREMIXED-PLUS 1	Premixed insulin pre-breakfast and pre-dinner + 1 prandial insulin pre-lunch
4	PREMIXED-PLUS 2	Prandial insulin pre-breakfast and pre-lunch + 1 premixed insulin pre-dinner
	BASAL-BOLUS	Basal insulin once daily + prandial insulin pre-breakfast, pre-lunch and pre-dinner

OD: once a day; BD: two times a day; TDS: three times a day

2.1.3 Insulin therapy – Initiation, Optimisation and Intensification

- Insulin initiation can be done safely in an outpatient setting. At initiation, the insulin dose prescribed is usually low to avoid hypoglycaemia. All individuals with diabetes prescribed with insulin therapy should be advised to perform self-monitoring of blood glucose (SMBG) and empowered to self-adjust their insulin doses.

SECTION 2

- Insulin dose optimisation requires gradual, safe and prompt titration of insulin dose according to SMBG. The insulin dose should be adjusted at least weekly within the first 3 months of starting insulin to achieve optimal glycaemic targets. Adjustment of the insulin dose should be an interactive process between HCPs and the individual with diabetes (including their caregivers) and can be done at health facilities such as clinics, or via telephone calls or text messages.
- Often, the initiated insulin regimens may need modification if glycaemic control remains suboptimal despite dose adjustment. In such scenario, intensification of insulin therapy is then required by switching to a more intensive insulin regimens (usually by increasing the number of injections) to achieve better glycaemic control. Insulin pump therapy may be considered in individuals with diabetes who are still not controlled despite basal-bolus regimen at optimal doses (Refer to Figure 1).
- To ensure successful insulin intensification, the following key elements of ideal care are important: continuous patient education, a dedicated diabetes healthcare team (consists of diabetes educator, physician, pharmacist and dietitian), SMBG, frequent contact with healthcare team and a peer support group.

- Notes:**
- Metformin should be continued while on insulin therapy unless contraindicated or intolerant.
 - Sulphonylureas/meglitinides can be withdrawn once prandial insulin is used regularly with meals.
 - Insulin dose should be optimised prior to switching/intensifying regimens.

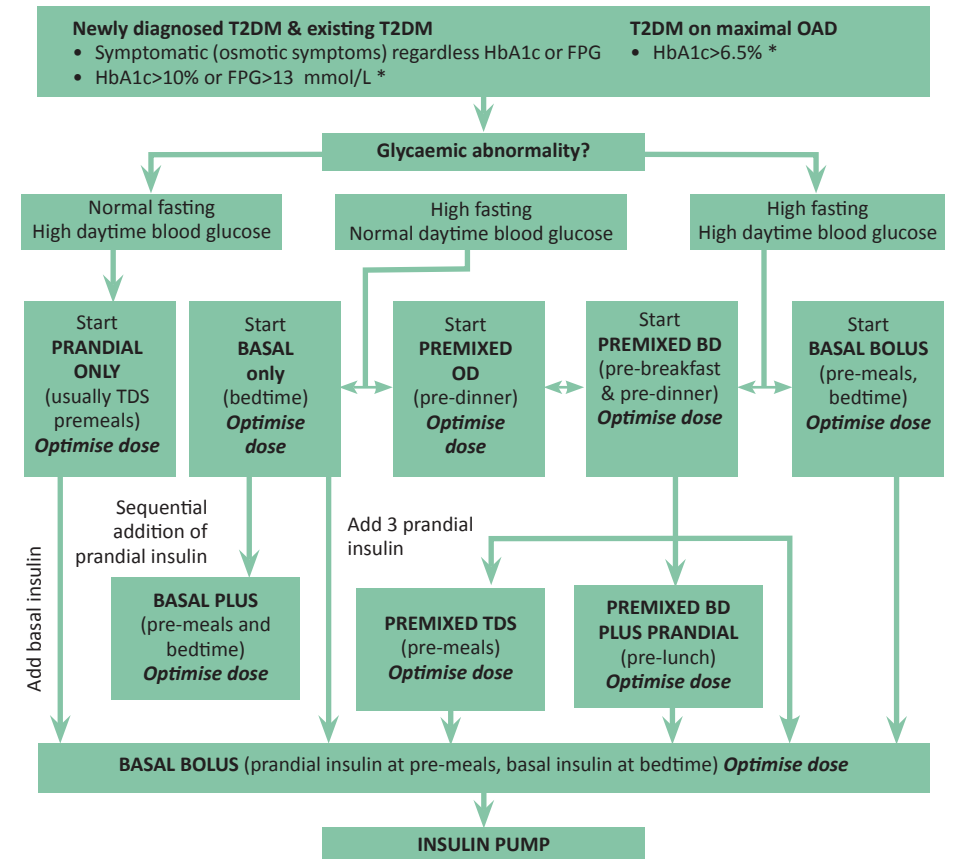
2.2 Insulin Pump Therapy or Continuous Subcutaneous Insulin Infusion (CSII)

- Insulin pump therapy is an alternative method of administering insulin subcutaneously by providing continuous delivery of rapid acting insulin via an infusion (tubing) set and a battery operated hand-held pump device. The infusion set is connected to the reservoir, which is filled with insulin and stored inside the pump device. The other end of the infusion set is connected to a needle called the cannula which is placed subcutaneously and secured by adhesive skin covering. The pump is programmed to deliver insulin at variable rates to mimic basal (background insulin for overnight and between meals) and bolus insulin (for meals and correction doses).

SECTION 2

- Insulin pump therapy is usually prescribed for individuals with T1DM who have frequent hypoglycaemia or hypoglycaemia unawareness and have poor glycaemic control. Recently, there are increasing numbers of insulin-treated individuals with T2DM who experience improved glycaemic control with insulin pump therapy. Selecting the suitable candidate for pump therapy is important, as successful outcome with this form of insulin therapy requires adequate understanding of the disease, close blood glucose monitoring and the use of advanced carbohydrate counting.

Figure 1: Algorithm of Insulin Initiation, Optimisation and Intensification



*HbA1c and FPG threshold to initiate insulin need to be individualised according to an individual characteristic and comorbidity (Adapted from Malaysia Clinical Practice Guideline: Management of Type 2 Diabetes Mellitus 2015)

SECTION 2

- Complications that may occur are infusion site reactions, infusion/tubing set problems and pump malfunction that may lead to glucose variability. Infusion site reactions include inflammation, infection, pain, lipohypertrophy, nodules and swelling which can potentially affect insulin flow and absorption. Infusion set problems include occlusion or flow interruption, disconnection and leakage. Pump malfunction includes failure of insulin delivery, keypad and battery problems. Silent occlusion is a situation of pump malfunction where insulin flow is interrupted for indeterminate length of time and for unknown reasons, and without an alarm trigger. This can lead to glycaemic variability.

2.2.1 Infusion Sites

- The preferred infusion site is at the abdomen, with alternative sites at the upper arms and thighs.
- Every new site should be at least 2.5 cm away from the previous site.
- Individuals with diabetes should be taught to rotate infusion sites along the same principles of injection sites rotation.
- Individuals with diabetes should have their infusions sites checked frequently for lipohypertrophy and nodules by healthcare providers.
- Individuals with diabetes who develop hypersensitivity reaction to adhesives may need alternative options of tapes or skin barriers.

2.2.2 Insertion and Infusion Sets

- Plastic cannula sets are generally preferred. However, some individuals with diabetes may experience frequent kinking or hypersensitivity reaction.
- Steel needle sets are recommended in pregnancy or for individuals with diabetes with hypersensitivity reaction to plastic cannulae or who experience frequent kinks in plastic cannulae.
- The smallest diameter needle/cannula should be used to reduce pain.
- Shorter needles will prevent intramuscular infusions.
- A mechanical insertion device may be used by individuals with diabetes who experience difficulty inserting their infusion set manually.
- Any individual with diabetes who experiences unexplained glucose variability or frequent hypoglycaemia should be evaluated for the presence of silent occlusion.

2.2.3 Angle of Insertion

- The needle or cannula should be inserted either at a 90° angle or a 30°–45° angle.
- The insertion angle of 90° is widely used.
- 30°–45° angled insertion sets may be considered in individuals with diabetes who experience infusion site complications with 90° insertion set.

SECTION 2

- Individuals with diabetes who are lean, muscular and active may benefit from 30°–45° angled insertion, as there is less risk of the cannula and tubing being dislodged.

2.2.4 Optimal Frequency for Changing Infusion Sets

- Infusion set and injection site problems occur more frequently after the 3rd day of infusion and insertion set use.
- Potency of insulin, and consequently, glucose control are diminished with a deterioration in pump performance, especially if infusion sets are used for longer periods of time.
- Insulin pump insertion and infusion sets should only be used for 48–72 hours to avoid adverse events and potential metabolic deterioration.

2.3 GLP-1 RA Therapy

- GLP-1 RAs are non-insulin injectable therapies that are used in combination with oral anti-diabetic (OAD) agents and occasionally with insulin. These agents promote post-prandial glucose lowering by increasing incretin-mediated pancreatic insulin secretion, inhibiting glucagon secretion as well as delaying gastric emptying. There is an additional central effect on stimulating satiety, which results in reduced food intake and promotes weight loss.¹
- These are the GLP-1 RA currently available in Brunei Darussalam:
 - Liraglutide (Victoza) – once daily injections
 - Dulaglutide (Trulicity) – once weekly injections
 - Semaglutide (Saxenda) – once daily injections
- GLP-1 RAs are available in specific prefilled pen devices and are administered subcutaneously, just like insulin.
- Individuals who inject GLP-1 RA should follow the recommendations for insulin injection technique using pen devices with regard to needle length and site rotation.¹
- GLP-1 RA may be injected at any of the usual injection sites as the pharmacokinetics do not appear to be site-specific.²
- The injection technique for Liraglutide and Dulaglutide are similar to insulin pen devices.

Reference

1. Pen User Manual. Eli Lilly and Company; 2007.
2. Calara F, Taylor K, Han J, Zabala E, Carr EM, Wintle M, et al. A randomized, open-label, crossover study examining the effect of injection site on bioavailability of exenatide (synthetic exendin-4). *Clin Ther.* 2005;27:210–215.

SECTION 3

THERAPEUTIC EDUCATION

Most individuals with diabetes express fear and concern when told the necessity to commence insulin or injectable treatment. A study done in Malaysia reported that 51% of individuals with T2DM were reluctant to commence insulin therapy when needed.¹ A systematic review reported that barriers to insulin initiation were multifactorial that included patient, HCPs and system-related barriers. The common barriers for people with diabetes were fear of needles and pain, side effects like hypoglycaemia and weight gain, lifelong dependency, inconvenience, personal failure, low self-efficacy and the myth that insulin therapy causes organ damage (e.g. kidney failure).^{2,3,4}

3.1 Initial Education

- At the initiation of insulin or injectable therapy, individuals with diabetes and their caregivers should be given time to explore their anxiety, perception, beliefs and barriers to injectable therapy. HCPs should also ask about fear of needle-related pain early and explore the possible strategies to overcome this pain perception through the use of pen devices, smaller needles, injection pot and injectable tool. Younger children may be helped by distraction, play therapy or Cognitive Behavioural Therapy.⁵
- Starting insulin or injectable therapy should be a shared decision by individuals with diabetes and their caregivers.
- The role of HCPs is to provide education and support as well as ensuring that the individual understand the indications for commencing insulin or injectable therapy. For individuals with T2DM, the possible need for insulin and injectable therapy should be addressed early, preferably at the initial diagnosis of the condition and at subsequent follow-up educations. The individual should be reassured that starting insulin or injectable therapy is not an indicator of their personal failure in controlling their condition. On the contrary, it is an indicator of the natural progression of diabetes and that oral therapy may not be adequate to achieve good glycaemic control in preventing and delaying chronic complications. Finding the right combination of treatment to achieve good glycaemic control usually include insulin therapy.
- Other educational topics at initial insulin or injectable therapy include:
 - Indication for insulin or injectable therapy
 - How insulin or injectable therapy works
 - Prescribed insulin or injectable regimen
 - Choice and management of devices used including self monitoring of blood glucose

SECTION 3

- Individualised target
 - Correct injection techniques
 - Care and self-examination of injection sites
 - Possible injection complications and its prevention
 - Psychosocial issues related to insulin or injectable therapy
- The above instructions should be given in verbal and written form (if available) to both individuals with diabetes and their caregivers at initiation of insulin and injectable therapy.

3.2 Follow-up Education

- Adherence and potential barriers to insulin and injectable therapy as well as solutions to overcome them should be addressed on each follow-up visits⁷ (Refer to Table 3).

Table 3: Potential Barriers and Suggested Solution of Insulin and Injectable Therapy

Barriers	Suggested solutions
Poor understanding of diabetes, its complications, and the role of insulin	<ul style="list-style-type: none"> • Provide comprehensive education • Explain the reduction of risk for complications with better glycaemic control • Explain the role of insulin in glucose regulation
Seeing insulin or non-insulin therapy as treatment failure	<ul style="list-style-type: none"> • Explain that insulin production decreases with ageing; most individuals with diabetes will eventually need insulin to maintain glucose control
Fear of needle	<ul style="list-style-type: none"> • Provide reassurance that today's needles are much smaller and are coated with silicon, allowing them to slide in more easily. In fact, most people say that it is almost painless and less uncomfortable than a finger prick to monitor blood glucose level • Use trial injection
Fear of side effects of insulin (i.e. hypoglycaemia and weight gain)	<ul style="list-style-type: none"> • Provide education on how to prevent, recognise and treat hypoglycaemia • Refer to a dietitian before starting insulin
Lifelong medications/ change in lifestyle	<ul style="list-style-type: none"> • Provide reassurance that many individuals with diabetes experience higher energy level and feel better when they achieve good glucose control after starting insulin

(Adapted from Diabetes Education Manual 2020 Available at: https://www2.moh.gov.my/index.php/database_stores/attach_download/554/79)

SECTION 3

- The follow-up education should be reviewed regularly and recorded in the care plan.
- By facilitating the acceptance of injectable treatment, this can enhance the adherence to therapy and quality of life.

Key Points

1. At initiation of insulin or injectable therapy, individuals with diabetes and their caregivers should be given time to explore their anxiety, concern and barriers to injectable therapy.
2. The decision to commence insulin or injectable therapy should be a shared decision between HCPs and individuals with diabetes (and their caregivers)
3. The roles of HCPs are to provide initial and supportive follow-up education to ensure individuals' understanding of the indications for insulin or injectable therapy and that they practice the recommended injection technique.

References

1. Nur Azmiah Z, Zulkarnain KL, Tahir A. Psychological insulin resistance (PIR) among type 2 diabetes patients at public health clinics in Federal Territory of Malaysia. *IMJM*. 2011;10:7–12.
2. Ng CJ, Lai PS, Lee YK, Azmi SA, Teo CH. Barriers and facilitators to starting insulin in patients with type 2 diabetes: a systematic review. *Int J of Clin Pract*. 2015;69:1050–1070.
3. Marrero DG. Overcoming patient barriers to initiating insulin therapy in type 2 diabetes mellitus. *Clin Cornerstone*. 2007;8:33–43.
4. Shaefer Jr CF. Patient and physician barriers to instituting insulin therapy: a case-based overview. *Insulin*. 2007;2:S41–S46.
5. Joslin Diabetes Center. To the point: six simple tips to overcome a fear of needles. Available from: <http://blog.joslin.org/2016/05/to-the-point-six-simple-tips-to-overcome-a-fear-of-needles/> [Accessed 4th May 2016].
6. Lee YK, Low WY, Ng CJ. Exploring patient values in medical decision making: a qualitative study. *PLoS One*. 2013;8:e80051.
7. Malaysia Ministry of Health. Diabetes Education Manual 1st edition; 2016.

SECTION 4

INJECTION TECHNIQUE

For individuals with diabetes, injection therapy can be insulin or non-insulin therapy such as GLP-1 RA. Proper injection technique is vital to avoid intradermal or intramuscular injections and ensures the appropriate delivery of insulin to the subcutaneous tissue.

4.1 Insulin Injection

4.1.1 Insulin Appearance

- Both rapid/short-acting insulin and long-acting analogue appear as a clear solution. Premixed insulin and intermediate-acting insulin appear as a cloudy solution.

4.1.2 Insulin Formulation

- Insulin is available in different formulations such as pen-fills and vials. For pen devices, there are disposable and prefilled pens (usually for insulin analogues).
- Currently, the main type of insulin in use in Brunei is U-100 in strength or concentration, i.e. consisting of 100 units of insulin per milliliter of solution. Other formulation available include insulin glargine U-300 (Toujeo).

4.1.3 Insulin Delivery Devices

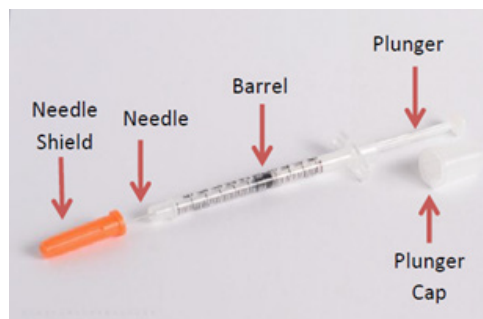
- There are various ways to administer insulin, including syringes, insulin pens and insulin pumps. Syringes are the primary injecting device used by individuals with diabetes in Brunei Darussalam. However, insulin pens are also available locally.

SECTION 4

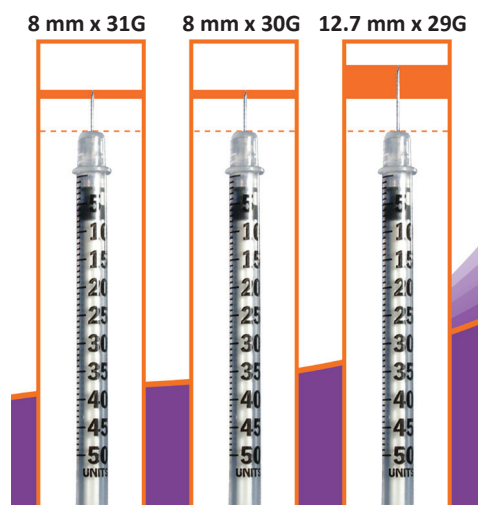
4.1.3.1 Syringe and Vial

- Syringes are often used in healthcare settings in Brunei Darussalam. Before injecting, choose the right size of syringe (volume U-100 is widely used in our local healthcare setting) and the length of the needle (Refer to Picture 1 and 2). The most commonly used needle locally is the 13mm needle. However, smaller size needles (6-8mm) are recommended due to lower risk intramuscular injection.⁹

Picture 1: Component of an Insulin Syringe



Picture 2: Syringe Size and Needle Length




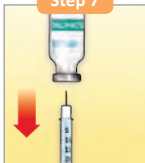
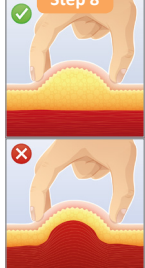
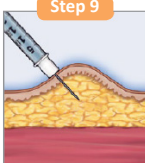

SECTION 4

- Administration using syringes and vials** — Before injecting, the insulin vial should be taken out from the refrigerator 30 minutes prior to injection to ensure that the insulin is at room temperature. Table 4 shows the steps while injecting insulin using vial and syringe.

Table 4: Steps for Injecting Insulin Using Syringe and Vial

<p>Step 1</p>	<ul style="list-style-type: none"> Wash your hands before handling syringe and vial.
<p>Step 2</p>	<ul style="list-style-type: none"> Warm the insulin by rolling the insulin vial between your hands. When injecting cloudy insulin (e.g. NPH and premixed insulin), the vial need to be gently rolled 10 times and inverted 10 times until it becomes evenly milky white. Do not shake the vial.^{1,3,10}
<p>Step 3</p>	<ul style="list-style-type: none"> Wipe the top of the insulin bottle/vial with an alcohol swab.
<p>Step 4</p>	<ul style="list-style-type: none"> Remove the cap from the plunger and the shield from the needle. Pull the plunger back to draw air into the syringe equal to the dose of insulin to be injected.
<p>Step 5</p>	<ul style="list-style-type: none"> Insert the needle through the rubber stopper of the insulin vial at a 90° angle. Press down the plunger to inject the air into the vial.

SECTION 4

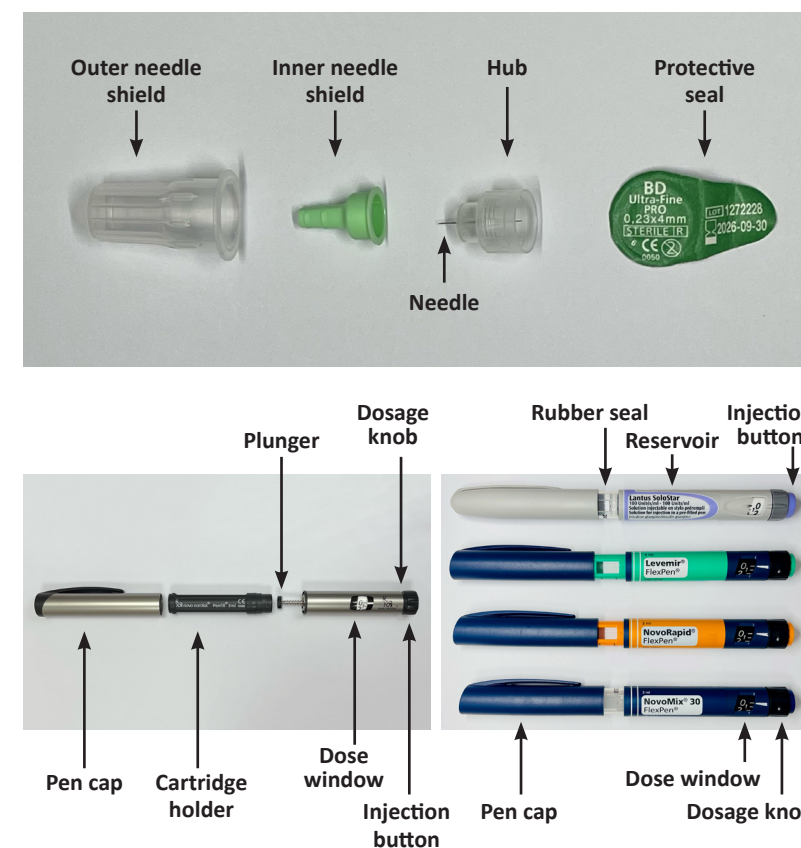
 <p>Step 6</p>	<ul style="list-style-type: none"> • Turn the vial upside down. • Pull the plunger back to draw the desired dose into the syringe. • To remove air bubbles (if present) in the syringe, draw up several more units of insulin, tap the barrel to move them to the top then expel them by pushing the plunger.
 <p>Step 7</p>	<ul style="list-style-type: none"> • Remove the needle straight out of the vial.
 <p>Step 8</p>	<ul style="list-style-type: none"> • If cleaning the site of injection with an alcohol swab, wait until alcohol has completely dry before injecting.^{11,12,13,14} • Gently pinch up the skin using your thumb and index finger.
 <p>Step 9</p>	<ul style="list-style-type: none"> • Inject the insulin at 45° angle for needle length ≥ 8 mm.¹⁵ • Depress the plunger in completely. • Remove the syringe quickly and then release the pinch.
 <p>Step 10</p>	<ul style="list-style-type: none"> • Dispose the syringe according to local regulation (Please refer to Section 7 Safety Issues). • Syringes should ideally only be used once.^{5,16}

SECTION 4

4.1.3.2 Pen/Prefilled Pen

- Insulin pen devices or injectors are a common and discreet way of administering insulin. The pen has three components: a built-in dial that allows the individual with diabetes to determine the amount of insulin to be injected, a short needle at one end and a plunger at the other end. Some pens are disposable and do not need to be assembled before use, while others have a replaceable insulin cartridge on penfill that needs to be inserted (Refer to Picture 3).

Picture 3: Components of Pen Devices and Insulin Needle









SECTION 4

- **Administration using pen devices** — An insulin pen offers the benefits of accuracy, convenience and confidence to individuals with diabetes. Table 5 shows the steps on how to use insulin pen devices safely and easily.

Table 5: Step-by-step of Using Insulin Pen Devices

 <p>Step 1</p>	<ul style="list-style-type: none"> • Wash your hands before handling insulin pen devices.
 <p>Step 2a</p>	<ul style="list-style-type: none"> • Cloudy insulin (e.g. NPH and premixed insulin) must be resuspended prior to each injection to ensure the suspension has a consistently milky white appearance (Picture 4).^{1,2,3,4} <ol style="list-style-type: none"> Gently roll in between your palms for 10 times (for cold insulin only). Tip up and down for 10 cycles. Visually check for milky white appearance. <ul style="list-style-type: none"> • Vigorous shaking should be avoided since this produces bubbles which reduce dose accuracy. • Inadequate resuspension of cloudy insulin (e.g. NPH and premixed insulin) before pen injection may lead to varying concentration of medication dosage that can cause unpredictable clinical responses.
 <p>Step 2b</p>	
 <p>Step 2c</p>	
<p>Picture 4: Suspension of NPH Insulin Before and After 10 Cycles of Electronic Tipping</p>  <p>Before (after 24 hours sedimentation) After 7 cycles After 10 cycles</p>	
 <p>Step 3</p>	<ul style="list-style-type: none"> • Place a new needle onto the pen device. • Using a new needle each time may reduce the risk of needle breakage in the skin, clogging of the needle, inaccurate dosing and complications (e.g. lipohypertrophy, abscess).^{5,6}

SECTION 4

 <p>Step 4</p>	<ul style="list-style-type: none"> • Remove the outer and inner cap. • Discard the inner cap and keep the outer cap.
 <p>Step 5</p>	<ul style="list-style-type: none"> • Prime insulin pen device with the needle pointing upwards. • Observe at least a drop of insulin at the needle tip before each injection.
 <p>Step 6</p>	<ul style="list-style-type: none"> • Dial the desired dose.
 <p>Step 7</p>	<ul style="list-style-type: none"> • Insert pen needle into the skin at 90°, push down the dose button completely.
 <p>Step 8</p>	<ul style="list-style-type: none"> • Count to 10 slowly before withdrawing the needle from the skin. • Counting past 10 may be necessary for higher insulin doses.⁷ • This is to ensure full dose delivery and prevent insulin leakage.
 <p>Step 9</p>	<ul style="list-style-type: none"> • Recap the used pen needle using the outer cap. • Remove pen needle and dispose it safely. • Used pen needle should not be left attached to the pen. This allows the entry of air and other contaminants into the cartridge, or leakage of insulin from the cartridge, which can affect subsequent dose accuracy.⁸

SECTION 4

4.1.3.3 Insulin Pump

- Insulin pump therapy is an alternative method of administering insulin subcutaneously by providing continuous delivery of rapid-acting insulin via an infusion (tubing) set and a battery operated hand-held pump device. The infusion set is connected to a reservoir that is filled with insulin and stored inside the pump device. The other end of the infusion set is connected to a needle called the cannula which is placed subcutaneously and secured by adhesive skin covering (Refer to Picture 5). The pump is programmed to deliver insulin at variable rates to mimic basal (background insulin for overnight and between meals) and bolus insulin (for meals and correction doses).

Picture 5: Components of an Insulin Pump



4.2 Non-insulin Injectable Therapy

- Non-insulin therapies such as GLP-1 RA are also administered with a prefilled pen device or injector, which is usually disposable after complete use (Refer to Appendix).

4.3 Needle Length

The choice of needle length should be appropriate for adults, adolescents and children to ensure that insulin and non-insulin injectable (e.g. GLP-1 RA) are administered into the subcutaneous layer and avoiding the intradermal and intramuscular spaces.¹⁷

Ultrasound and other research technologies have shown that the subcutaneous fat layer may vary within a particular anatomical area, e.g. the abdomen.¹⁸ The use of a 4 mm needle minimizes the potential for intramuscular injection and allows individuals to use a larger area for injection, i.e. a postcard-size area as opposed to a postage stamp-sized area.¹⁹

SECTION 4

4.3.1 Adults

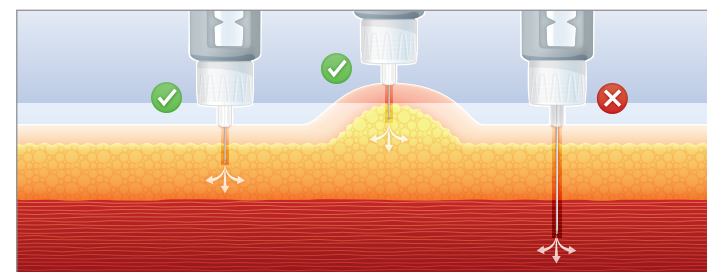
- The needle lengths available are 4, 5, 6 and 8 mm with different gauges (G) as shown in Table 6.

Table 6: Needle Lengths

Needle	4 mm	5 mm	6 mm	8 mm
BD	32G	31G	31G	31G
Novofine	32G	-	31G, 32G	-

- Shorter needles (4, 5, 6 mm) provide equal efficacy and safety when compared with the longer needle (8 mm), even in obese individuals.²¹
- 4, 5 and 6 mm needles are suitable for all individuals with diabetes regardless of body mass index (BMI).^{22,23}
- Injections with shorter length needles (4, 5, 6 mm) should be administered in adults at 90° to the skin surface.²²
- The safest pen needle for all individuals with diabetes is 4 mm in length. The 4 mm needle inserted at 90° to the skin surface is long enough to penetrate the skin and enter the subcutaneous tissue, with little risk of intramuscular injection.^{24,25}
- For extremely thin individuals with diabetes (BMI <19), the proper injection technique is to use the 4 mm needle accompanied with lifting of skin fold when injecting to avoid the intramuscular injection.^{22,23,24}
- Shorter and finer-gauge needles help to reduce pain. The 5-bevel needle tip has less penetration force in a skin hence provides more comfort and easier to insert.^{26,27}
- 8 mm needles should be discouraged to prevent the risk of intramuscular injection (Refer to Diagram 1).

Diagram 1 : Needle Length and Risk of Intramuscular Injection



SECTION 4

- Individuals who have to continue using ≥ 8 mm needles should always lift a skin fold and/or inject at 45° in order to avoid intramuscular injections.²⁷

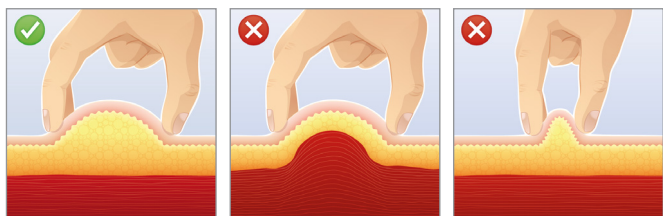
4.3.2 Children and Adolescents

- Refer to Section 9 Special Populations.

4.4 Lifted Skin Folds

- The lifted skin fold should not be squeezed too tightly until it causes skin blanching or pain.
- The optimal sequence should be:
 - Make a lifted skin fold. Only the thumb, index finger and middle finger should be used.
 - Insert needle into skin at 90° .
 - Administer the therapy.
 - Leave the needle in the skin for at least 10 seconds after the dose button is fully depressed.
 - Withdraw needle from the skin.
 - Release lifted skin fold.
 - Dispose of used needle safely.
- A proper skin-fold technique should take up the skin and subcutaneous tissue only, leaving the muscle layer behind (Refer to Diagram 2).

Diagram 2: Correct and Incorrect Technique of Performing Skin Fold



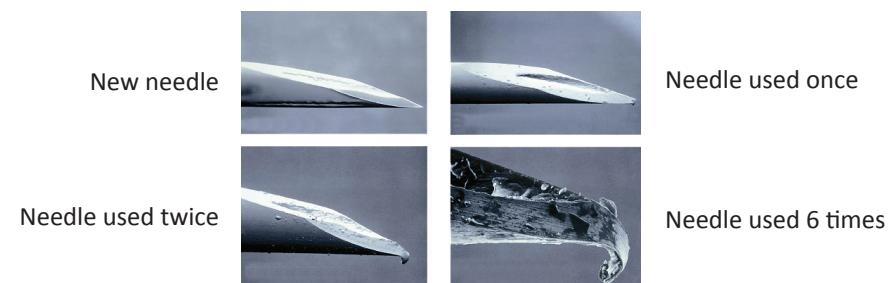
4.5 Reused Needle

- Pen needles and syringes should only be used once. Picture 6 shows how reusing needles damages the tip of the needle.^{19,20,28}
- There is a probable association between reused needle and the presence of lipohypertrophy, although a direct causal relationship has not been proven.
- Reused needles and syringes may cause pain, bleeding and bruising at injection sites.

SECTION 4

- Reused needles may cause the insulin in the barrel to crystallise and block its flow during the next injection.
- Reusing pen needles and syringes is not an optimal injection practice. Individuals with diabetes should be discouraged from doing so.
- Needles should be disposed immediately after use. It should not be left attached to the pen. This allows the entry of air and other contaminants into the cartridge, or leakage of insulin from the cartridge, which can affect subsequent dose accuracy.⁸

Picture 6: Comparing the Tips of New and Reused Needles



Key Points

- Shorter length pen needles (4, 5, 6 mm) are suitable for all individuals with diabetes regardless of BMI and provide equal efficacy and safety.
- 4 mm insulin pen needles inserted at 90° to the skin surface is long enough to penetrate the skin and enter the subcutaneous tissue with little risk of intramuscular injection.
- Pen needles and syringes should ideally only be used once.
- Cloudy insulin (e.g. NPH and premixed insulin) must be resuspended prior to each injection to ensure the suspension has a consistently milky white appearance.
- Insulin Injection using syringe in healthcare setting should be administered at 45° angle for needle length ≥ 8 mm.

References

- Brown A, Steel JM, Duncan C, et al. An assessment of the adequacy of suspension of insulin in pen injectors. *Diabet Med.* 2004;21:604–608.
- Jehle PM, Micheler C, Jehle DR, Breitig D, Boehm BO. Inadequate suspension of neutral protamine Hagedorn (NPH) insulin in pen. *Lancet.* 1999;354:1604–1607.
- Nath C. Mixing insulin: shake, rattle or roll? *Nursing.* 2002;32:10.
- Kaiser P, Maxeiner S, Weise A, Nolden F, Borck A, Forst T, et al. Assessment of the mixing efficiency of neutral protamine Hagedorn cartridges. *J Diabetes Sci Technol.* 2010;4:652–657.
- Torrance T. An unexpected hazard of insulin injection. *Pract Diab Int.* 2002;19:63.

SECTION 4

6. Misnikova IV, Dreval AV, Gubkina VA, et al. The risks of repeated use of insulin pen needles in patients with diabetes mellitus. *J Diabetology*. 2011;1:1.
7. Rissler J, Jørgensen C, Rye Hansen M, Hansen NA. Evaluation of the injection force dynamics of a modified prefilled insulin pen. *Expert Opin Pharmacother*. 2008;9:2217–2222.
8. Bartsch U, Comtesse C, Wetekam B. Injectable therapy pen devices for treatment of diabetes (article in German). *Ther Umsch*. 2006;63:398–404.
9. Clauson PG, Linde B. Absorption of rapid-acting insulin in obese and nonobese NIDDM patients. *Diabetes Care*. 1995;18:986–991.
10. King L. Subcutaneous insulin injection technique. *Nurs Stand*. 2003;17:45–52.
11. Ahern J, Mazur ML. Site rotation. *Diabetes Forecast*. 2001;54:66–68.
12. Straughen JK, Trudeau S, Misra VK. Change in adipose tissue distribution during pregnancy in overweight and obese compared with normal weight women. *Nutr Diabetes*. 2013;3:e84.
13. Armour TA, Norris SL, Jack L Jr, Zhang X, Fisher L. The effectiveness of family interventions in people with diabetes mellitus: a systematic review. *Diabet Med*. 2005;22:1295–1305.
14. Bangstad HJ, Danne T, Deeb LC, Jarosz-Chobot P, Urakami T, Hanas R. ISPAD clinical practice consensus guidelines 2006–2007. Insulin treatment. *Pediatr Diabetes*. 2007;8:88–102.
15. Australian Diabetes Educators Association. ADEA Clinical Recommendations: Subcutaneous Injection Technique for Insulin and Glucagon-like Peptide 1; 2014.
16. Strauss K, De Gols H, Letondeur C, Matyjaszczyk M, Frid A. The second injection technique event (SITE), May 2000, Barcelona, Spain. *Pract Diab Int*. 2002;19:17–21.
17. Sim KH, Hwang MS, Kim SY, Lee HM, Chang JY, Lee MK. The appropriateness of the length of insulin needles based on determination of skin and subcutaneous fat thickness in the abdomen and upper arm in patients with type 2 diabetes. *Diabetes Metab J*. 2014;38:120–133.
18. Cunningham MT, McKenna MJ. Lipohypertrophy in insulin-treated diabetes: prevalence and associated risk factors. *J Diabetes Nurs*. 2013;17:340–343.
19. Danish Nurses Organization. Evidence-based Clinical Guidelines for Injection of Insulin for Adults with Diabetes Mellitus 2nd edition; 2006.
20. Association for Diabetes Care Professionals (EADV). Guideline: The Administration of Insulin with the Insulin Pen; 2008.
21. de la Peña A, Yeo KP, Linnebjerg H, Catton E, Reddy S, Brown-Augsburger P, et al. Subcutaneous injection depth does not affect the pharmacokinetics or glucodynamics of insulin lispro in normal weight or healthy obese subjects. *J Diabetes Sci Technol*. 2015;9:824–830.
22. Birkebaek NH, Solvig J, Hansen B, Jørgensen C, Smedegaard J, Christiansen JS. A 4-mm needle reduces the risk of intramuscular injections without increasing backflow to skin surface in lean diabetic children and adults. *Diabetes Care*. 2008;31:e65.
23. Kreugel G, Keers JC, Jongbloed A, Verweij-Gjaltema AH, Wolffenbuttel BHR. The influence of needle length on glycemic control and patient preference in obese diabetic people with diabetes. *Diabetes*. 2009;58:A117.
24. Gibney MA, Arce CH, Byron KJ, Hirsch LJ. Skin and subcutaneous adipose layer thickness in adults with diabetes and sites used for insulin injections: implications for needle length recommendations. *Curr Med Res Opin*. 2010;26:1519–1530.
25. Hirsch L, Byron K, Gibney M. Intramuscular risk at insulin injection sites—measurement of the distance from skin to muscle and rationale for shorter-length needles for subcutaneous insulin therapy. *Diabetes Technol Ther*. 2014;16:867–873.
26. Grassi G, Scuntero P, Trepiccioni R, Marubbi F, Strauss K. Optimizing insulin injection technique and its effect on blood glucose control. *J Clin Transl Endocrinol*. 2014;1:145–150.
27. Schwartz S, Hassman D, Shelmet J, Sievers R, Weinstein R, Liang 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 gauge x 12.7 mm needle in obese people with diabetes mellitus. *Clin Ther*. 2004;26:1663–1678.
28. Strauss K, De Gols H, Letondeur C, Matyjaszczyk M, Frid A. The second injection technique event (SITE), May 2000, Barcelona, Spain. *Pract Diab Int*. 2002;19:17–21.

SECTION 5

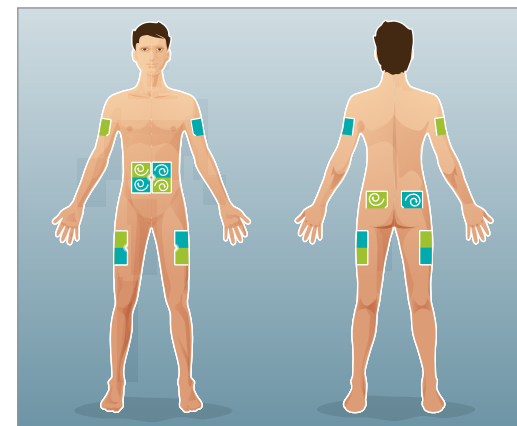
INJECTION SITES

Besides proper injection technique, education should also include the importance of site rotation and inspection of injection sites for better glycaemic control. For consistent absorption, insulin and non-insulin injectable agents should be injected into the subcutaneous layer in the abdomen, buttocks and thighs if self-administered, or arms and buttocks if given by caregivers.

5.1 Injection Sites Selection

Diagram 3 shows the current recommendation on insulin injection sites.

Diagram 3: Recommended Injection Sites



For ease of self-injection, the **abdomen** and **thighs** are the two main recommended injection sites for adults.¹⁸

- **Abdomen** – Abdominal sites are within the following boundaries: ~1 cm above the symphysis pubis, ~1 cm below the lowest rib, ~1 cm away from the umbilicus and laterally at the flanks.¹⁵
- **Thighs** – use the upper 3rd anterolateral aspect.
- ***Buttocks and flanks** – Posterolateral aspect of both upper buttocks and flanks.
- ***Arm** – mid 3rd posterior aspect of upper arm.

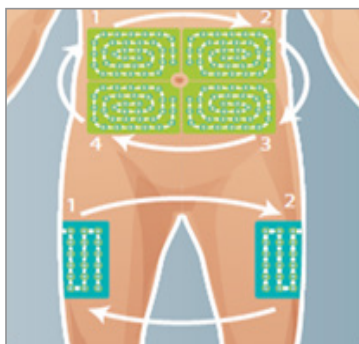
*These sites are not the preferred site for self-injection in view of the difficulty in accessing the correct zone, difficulty in injecting at 90° and lessened thickness of subcutaneous fat, all of which are potential risk factors for intramuscular injection. Caregivers' assistance are required for administering injection to these sites.^{15,18,19}

SECTION 5

5.2 Rotation of Injection Sites

- Individuals with diabetes should be educated on the importance of injection site rotation to prevent lipohypertrophy and ensure the consistency of insulin absorption.^{1,2,3,4}
- The pattern of site rotation that has been shown to be effective involves dividing the injection site into quadrants (or halves when using thighs and buttocks). Use one quadrant per week and rotate in a consistent direction (e.g. clockwise).⁴
- Injection sites rotation within any quadrant or half should be done systematically with spacing of at least 1 cm apart from each injection in order to prevent repeat tissue trauma as shown in Diagram 4 below.⁴

Diagram 4: Systematic Rotation Within the Recommended Injection Sites



5.3 Insulin Absorption

- Optimal absorption of insulin depends on injection into subcutaneous tissue. Absorption rate can be affected by various factors such as type of insulin, insulin storage, skin temperature, site of injection and exercising.

5.3.1 Factors Affecting Absorption Rates

- **Type of insulin**
Insulin type affects the rate of absorption from the injection site. Rapid and short-acting insulin are absorbed faster than intermediate- and long-acting insulin.

SECTION 5

• Site of insulin injection

Insulin absorption is fastest and most consistent when injected on the abdomen, followed by moderate absorption rate in the upper arm and lateral thigh. The slowest rate of absorption is at the buttock area. However, insulin absorption also differs based on the type of insulin, as shown in Table 7.

Table 7: Injection Site and Absorption Rate

Prandial insulin	Basal insulin	Premixed insulin
<p>Short-acting, regular: Abdomen preferred due to fastest absorption rate.^{7,8,9}</p> <p>Rapid analogue: May be given at any of the recommended sites of injection; absorption rates do not appear to be site specific.^{11,12}</p>	<p>Intermediate-acting, NPH and Long-acting analogue: Maybe given at any of the recommended sites of injection; absorption rates do not appear to be site specific.^{11,12} However, abdomen is the preferred site.</p>	<p>Human or analogue: Abdomen preferred to increase speed of absorption to cover post-breakfast glycaemic excursion.¹⁰</p>

• Others Factors:

- Rotation of injection sites within the selected area is crucial to ensure optimal and consistent insulin absorption.
- Intramuscular injection may accelerate the absorption rate of insulin.^{13,14,15}
- Massaging the site before or after injection may speed up the absorption. Hence, it is not recommended.^{16,17}
- Higher skin temperature (e.g. sauna or hot bath) may increase the absorption rate of insulin.⁶
- Injecting into an exercising limb may increase the absorption of insulin which may hasten blood glucose-lowering effect.^{5,6}

SECTION 5

Key Points

1. For ease of self-injection, abdomen and thighs are the two main recommended injection sites for adults.
2. Injection sites showing signs of lipohypertrophy, inflammation, oedema, ulceration or infection should be avoided.
3. Injection site rotation should be done systematically (using one quadrant per week and rotate in a consistent direction with at least 1 cm apart).
4. The absorption of insulin differs based on the type of insulin, site of insulin injection, skin temperature and exercising.

References

1. Johansson UB, Amsberg S, Hannerz L, Wredling R, Adamson U, Arnqvist HJ, et al. Impaired absorption of insulin aspart from lipohypertrophic injection sites. *Diabetes Care*. 2005;28:2025–2027.
2. Overland J, Molyneaux L, Tewari S, Fatouros R, Melville P, Foote D, et al. Lipohypertrophy: Does it matter in daily life? A study using a continuous glucose monitoring system. *Diabetes Obes Metab*. 2009;11:460–463.
3. Ariza-Andraca CR, Altamirano-Bustamante E, Frati-Munari AC, Altamirano-Bustamante P, Graef-Sánchez A. Delayed insulin absorption due to subcutaneous edema. *Arch Invest Med (Mex)*. 1991;22:229–233.
4. Diagram Courtesy of Lourdes Saez-de Ibarra and Ruth Gaspar, Diabetes Nurses and Specialist Educators from La Paz Hospital, Madrid, Spain.
5. American Diabetes Association. Insulin administration. *Diabetes Care*. 2004;27:s106–s107.
6. Houtzagers CM. Subcutaneous insulin delivery: colon present status. *Diabet Med*. 1989;6:754–761.
7. Annersten M, Willman A. Performing subcutaneous injections: a literature review. *Worldviews Evid Based Nurs*. 2005;2:122–130.
8. Henriksen JE, Djurhuus MS, Vaag A, Thye-Rønn P, Knudsen D, Hother-Nielsen O, et al. Impact of injection sites for soluble insulin on glycaemic control in type 1 (insulin-dependent) diabetic patients treated with a multiple insulin injection regimen. *Diabetologia*. 1993;36:752–758.
9. Sindelka G, Heinemann L, Berger M, Frenck W, Chantelau E. Effect of insulin concentration, subcutaneous fat thickness and skin temperature on subcutaneous insulin absorption in healthy subjects. *Diabetologia*. 1994;37:377–380.
10. Frid A, Gunnarsson R, Güntner P, Linde B. Effects of accidental intramuscular injection on insulin absorption in IDDM. *Diabetes Care*. 1988;11:41–45.
11. Frid A. Fat thickness and insulin administration: what do we know? *Infusystems International*. 2006;5:17–19.
12. Guerci B, Sauvanet JP. Subcutaneous insulin: pharmacokinetic variability and glycemic variability. *Diabetes Metab*. 2005;31:4S7–4S24.
13. Frid A, Östman J, Linde B. Hypoglycemia risk during exercise after intramuscular injection of insulin in thigh in IDDM. *Diabetes Care*. 1990;13:473–477.
14. Vaag A, Handberg A, Laritzen M, Henriksen JE, Pedersen KD, Beck-Nielsen H. Variation in absorption of NPH insulin due to intramuscular injection. *Diabetes Care*. 1990;13:74–76.
15. Danish Nurses Organization. Evidence-based Clinical Guidelines for Injection of Insulin for Adults with Diabetes Mellitus 2nd edition; 2006.
16. Association for Diabetes Care Professionals (EADV). Guideline: The Administration of Insulin with the Insulin Pen; 2008.
17. Ezzo J, Donner T, Nickols D, Cox M. Is massage useful in the management of diabetes? A systematic review. *Diabetes Spectrum*. 2001;14:218–224.
18. Sim KH, Hwang MS, Kim SY, Lee HM, Chang JY, Lee MK. The appropriateness of the length of insulin needles based on determination of skin and subcutaneous fat thickness in the abdomen and upper arm in patients with type 2 diabetes. *Diabetes Metab J*. 2014;38:120–133.
19. Ludescher B, Rommel M, Willmer T, Fritsche A, Schick F, Machann J. Subcutaneous adipose tissue thickness in adults – correlation with BMI and recommendations for pen needle lengths for subcutaneous self-injection. *Clin Endocrinol (Oxf)*. 2011;75:786–790.

SECTION 6

MEDICATION STORAGE

Proper storage of insulin and non-insulin injectable agents is important to ensure the potency and effectiveness of the medication.

6.1 Injection Storage

- All injectable medications have expiry dates printed on them. The expiry date indicates the date before which the unopened vial, pen or cartridge should be used.
- Unopened injectable medications should be stored at refrigeration temperature between 2°C–8°C. (Check the manufacturer’s storage instructions as there may be possible differences from one manufacturer to the other).
- Once insulin is opened, it should be used within 4 – 6 weeks (follow the manufacturer’s recommendation).
- Write the opening and disposal date on the injectable medications to keep track of the date.
- In-use insulin pen can be stored at room temperature of <30°C. However if the room temperature is >30°C, in-use insulin pen should be stored in the refrigerator. It should be taken out and kept at room temperature for at least 30 minutes before use.
- Insulin or non-insulin injectable medications should never be frozen or exposed to extreme heat (>30°C) for prolonged periods; this will affect its potency and action. Avoid extreme temperatures such as direct sunlight, kitchen, closed cars, top of a radiator or a television.¹
- Keep the caps on insulin pens to protect the insulin from light.
- Never leave the pen needle attached to the injectable pen as varying temperatures may cause leakage from the pen or possible air entry into pen hence affecting dosage delivery.³²
- Injectable medications should never be used after the product expiry date.
- Injectable medications should be kept out of the reach of children.

6.2 Injection Storage During Travel

6.2.1 Travel: On Land

- Insulin should be stored in an appropriate container, such as an insulated cooler bag.
- Insulin should never be kept in the glove compartment of a car, or left in a locked car.³

SECTION 6

6.2.2 Travel: Air

- Insulin should be stored in a appropriate container in personal bag or hand luggage.
- Insulin should not be placed in the baggage hold of the plane due to the risk of exposure to extreme temperatures.³
- Carry an extra insulin pen or vial for any unforeseen circumstances that may occur.⁴

Key Points

1. Follow the manufacturer's recommendation for storage of insulin and non-insulin injectable.
2. Always store unopened injectable medication at refrigeration temperature between 2°C–8°C.
3. In-use insulin can be stored at room temperature <30°C.
4. Avoid exposing insulin and other injectable medications to extreme temperatures of either too cold or too hot.
5. Injectable medications should never be used past the product expiry date.

References

1. American Diabetes Association. Insulin administration. *Diabetes Care*. 2003;26:s121–s124.
2. Dolinar R. The importance of good insulin injection practices in diabetes management. *US Endocrinol*. 2009;5:49–52.
3. Diabetes State/Territory Organisations. Travel and Diabetes. Available from: <http://diabetesnsw.com.au/wp-content/uploads/2014/12/DA-41-Travel-and-diabetes.pdf> [Accessed 12th December 2016]. Reassess date.

SECTION 7

SAFETY ISSUES

Insulin and other injectable with individuals with diabetes to handle needle pen or insulin syringes to administer the medication effectively. Thus, it is important to educate individuals with diabetes and caregivers on safety issues pertaining to handling of injection materials and sharp items properly.

7.1 Safety

- Sharp devices represent a risk for the transmission of blood-borne pathogens to the user in the event of a needle stick injury (NSI) or blood exposure.
- Any healthcare setting which uses injectable pens should follow a strict one-person/one-pen policy.¹
- All individuals at risk must receive appropriate education and training on ways to minimize risk, including the importance of following optimal injection or lancing techniques as well as using the available safety engineered devices and Personal Protective Equipment.

7.2 Disposal of Injection Material/Sharps

- All healthcare professionals, individuals with diabetes and caregivers should be aware of proper disposal of sharps and the consequences of inappropriate disposal (e.g. NSI).
- Proper disposal technique should be demonstrated at initiation of injection therapy and reinforced at subsequent visits.
- Needle recapping should not be done for insulin syringes.
- To discard pen needles, recap the outer needle cap using the scoop technique as shown in Picture 7 followed by careful removal of the pen needle and disposal into a sharp bin or a puncture proof container (for home user).

Picture 7: Scooping Technique of Outer Needle Cap



- Sharp materials should never be disposed into public trash bins.
- Use a sharp container or a puncture proof/metal container with lid to store used pen needles. Seal the container properly and label as “SHARP” before disposal. Keep the container out of the reach of children.
- Empty pen devices can be disposed in normal household refuse after the needle is removed.

SECTION 7

7.3 NSI/Blood-borne Infection Risk

- To minimize the risk of NSI through a skin fold, the use of shorter needles (e.g. 4 and 5 mm pen needles, 6 mm insulin syringe) without lifting a skin fold upon injecting is recommended.
- If a lifted skin fold is used, do ensure that the finger and thumb making the skin fold are approximately 1 inch (25 mm) apart and the needle should be inserted into the centre of the fold thus minimizing the risk of through-skin fold NSI (Refer to Section 4 Lifted Skin Fold).
- HCPs and caregivers should use Personal Protective Equipment (e.g. glove) when administering injectable therapies or monitoring blood glucose for people with diabetes known to be seropositive for Human immunodeficiency virus (HIV), Hepatitis B virus (HBV) and Hepatitis C virus (HCV).

7.4 Institutional Practice

- The safety of individuals with diabetes and HCPs in medical institutions and long-term care facilities is an important consideration regarding injection technique.
- NSI are frequent yet largely preventable among HCPs. Consideration must also be given to the safe disposal of all injection and infusion devices to prevent injury to healthcare workers.
- Cross-contamination among individuals with diabetes is also preventable by the appropriate use and disposal of injection or infusion devices. Institutions are encouraged to develop a 'safety first culture' through staff education and increased awareness of best practice.
- Procedures on what to do in the event of NSI must be clearly communicated as per local guidelines. Formal protocols with named clinical care contacts must be available in all areas where sharps are used.²

Key Points

1. Sharps items should be disposed in a proper way to prevent NSI and the transmission of blood-borne pathogens to third party.
2. Any healthcare setting which uses injectable pens should follow one-patient/one-pen policy.
3. Proper disposal technique should be demonstrated at the initiation of injection therapy and reinforced at subsequent visits.
4. Minimize the risk of NSI by using shorter needles or the proper technique of lifting the skin fold when injecting.
5. Use of Personal Protective Equipment is required when handling of individuals with diabetes who are seropositive for HIV, HBV and HCV.
6. Formal protocol in dealing with a NSI injury should be clearly communicated.

References

1. Sonoki K, Yoshinari M, Iwase M, Tashiro K, Iino K, Wakisaka M, et al. Regurgitation of blood into insulin cartridges in the pen-like injectors. *Diabetes Care*. 2001;24:603–604.
2. Standard Operating Procedure and Workflow: Management of Occupational Sharps Injury or Body Fluid Exposure, RIPAS Hospital; 2014

SECTION 8

SPECIAL CONSIDERATIONS IN INJECTABLE THERAPY

Individuals with diabetes who are on injectable medications may experience some important issues that may affect the medication absorption and also their daily function. HCPs should educate all individuals with diabetes who are prescribed with insulin treatment on the symptoms and early management of hypoglycaemia. Other injection issues such as pain, bruising, bleeding and lipodystrophy need to be explored and assessed.

8.1 Hypoglycaemia

Hypoglycaemia is defined by either one of the following two conditions:¹

- Low plasma glucose level (<4.0 mmol/L).
- Development of autonomic or neuroglycopenic symptoms (Refer to Table 8) in individuals with diabetes treated with insulin or OAD agents which are reversed by caloric intake.

Table 8: Symptoms of Hypoglycaemia

Autonomic	Neuroglycopenic
Trembling	Difficulty concentrating
Palpitation	Confusion
Sweating	Weakness
Anxiety	Drowsiness
Hunger	Vision changes
Nausea	Difficulty speaking
Tingling	Headache
	Dizziness

SECTION 8

8.1.1 Severity of hypoglycaemia

- The severity of hypoglycaemia can be defined by its clinical manifestations:
 - **Mild** – Autonomic symptoms present and the individual is able to self-treat.
 - **Moderate** – Autonomical and neuroglycopenic symptoms present and the individual is able to self-treat.
 - **Severe** – Severe cognitive or neurological impairment requiring external assistance for recovery. Loss of consciousness may occur
- Risk factors for hypoglycaemia in individuals with T2DM are:
 - Advancing age
 - Severe cognitive impairment
 - Poor health knowledge
 - Increased HbA1c
 - Hypoglycaemia unawareness
 - Long-standing insulin therapy
 - Renal impairment
 - Neuropathy
- Prevention of hypoglycaemia requires identification of risk factors, the individual's treatment regimen and glycaemic targets.
- Improving patient education and recognition could prevent and reduce the frequency of hypoglycaemic events.

8.2 Bleeding and Bruising

- Local bruising, bleeding or pain will occasionally occur at the injection site.
- This does not appear to be associated with specific needle length or site but more likely to be affected by injection technique.^{3,7}
- Individuals with diabetes should be reassured that local bleeding and bruising do not have adverse clinical consequences on the absorption of insulin or overall diabetes management.⁷
- Individuals with diabetes on anticoagulant therapy may experience bruises after insulin injection and are advised to apply direct pressure to the injection site once the needle is removed.⁷

SECTION 8

8.3 Painful Injection

- Tips for making injections less painful:
 - Keeping injectable therapy that is in use at room temperature.
 - Using needles of shorter length and smaller diameter.⁵
 - Using a new needle at each injection.
 - Insert the needle in a quick smooth movement into the skin.
 - Inject slowly and ensure that the plunger (syringe) or thumb button (pen) has been fully depressed.
 - Remove at same angle and keep hand steady.
 - If bruising occurs repeatedly, revising the injection technique with the individuals with diabetes (or the caregivers) is recommended.
 - Sites with bleeding and bruising should be avoided until fully recovered.
 - Reassure the individuals with diabetes that bleeding and bruising do not have adverse effects on the absorption of insulin or overall diabetes management.
 - To prevent bleeding and bruising, avoid injecting into visible blood vessels and hair roots.

8.4 Hypersensitivity Reaction

- Localized skin reaction such as rash or itch around the injection area may indicate that the person with diabetes is allergic to a certain type of insulin.
- Any adverse events shall be reported using the Ministry of Health Adverse Event form and submitted to the Pharmacovigilance Section of the Department of Pharmaceutical Services, Ministry of Health.
- Individuals with diabetes who develop hypersensitivity reaction may be admitted to the hospital and restarted on insulin at a lower dose before gradually increasing the dose (desensitisation).

8.5 Lipohypertrophy

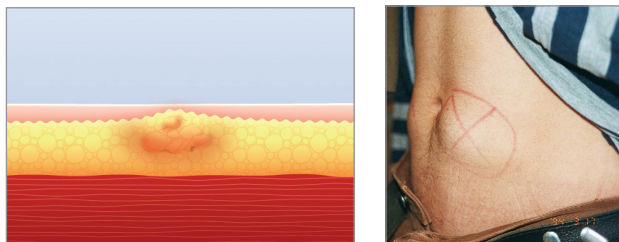
Lipohypertrophy is the most common lipodystrophy found at injection sites.^{6,7} Lipohypertrophic areas may be visible or palpable, and identified as thickened or rubbery lesions that may feel hard when palpated with the finger tip.^{2,8,9,10} Lipohypertrophy is formed when injections of insulin or other injectable therapy are repeatedly given in the same localised area. Microtrauma caused by the injection, combined with the effect of insulin on the repairing cells, causes fatty lumps to build up at the trauma site, causing fat and scar tissue formation over time. This can be exacerbated if needles are reused.

SECTION 8

8.5.1 Detection of Lipohypertrophy

- The lesions may vary in size; some are visually apparent, while others require palpation for detection.¹¹
- Lipohypertrophic areas can also be identified by pinching the skin: while healthy skin can be pinched together tightly, this cannot be done on lipohypertrophic areas (Refer to Diagram 5).

Diagram 5: Lipohypertrophy



- Due to the irregular absorption of insulin injected into the lipohypertrophic lesion, lipohypertrophy can lead to unexplained hyperglycaemia, glycaemic variation and larger-than-required doses of insulin.

8.5.1.1 Assessment of Lipohypertrophy

- Create an optimal environment for lipohypertrophy detection:
 - The room must be warm to prevent chilling, shivering and muscle tension.
 - Use directional task lighting if possible. Light should be oblique at 30°–45° to the skin surface, preferably not overhead (Refer to Diagram 6).

Diagram 6: Direction of Lighting for Assessment of Lipohypertrophy



SECTION 8

8.5.1.2 Preparing for Clinical Examination

- Refer to Table 9 for steps of clinical examination of lipohypertrophy.

Table 9: Preparation for Clinical Examination of Lipohypertrophy

<ul style="list-style-type: none"> • Position the individual lying down on his back, then examine his abdomen, arms and thigh injection zones. 	
<ul style="list-style-type: none"> • Ask the individual to lie on alternate sides and flex his knees towards the chest to examine the buttock area. 	
<ul style="list-style-type: none"> • If an examination bed is not available, ask the individual to sit upright in a chair with both hands resting on the lap and with his legs at right angles to the floor to examine the arms and thigh. For abdomen site examination, ask the individual to stand upright with both his arms and hands by his sides. 	

SECTION 8

8.5.1.3 Visual Examination of the Injection Site

- Visually examine the injection sites using angled lamp. Lipohypertrophy usually manifests as a raised or mound-like convex area, sitting above the surrounding skin surface.
- Occasionally, lipohypertrophic areas can manifest as shiny or hyper-pigmented zones, especially in darker skins. You may also notice some hair loss.
- Mark the areas if lipohypertrophy is detected.
- Bring clinical examination gel close to body temperature and apply into the area liberally. Palpate with your fingertips using a light massage motion, making forward thrust and circular sweeps.
- Use a skin-safe marker pen to draw a line around the lipohypertrophic areas.

8.5.1.4 After Examination Care

- Teach individuals with diabetes to conduct self-examination for lipohypertrophy at regular intervals. The use of hand or body lotion may help to locate lipohypertrophy more easily.
- Do not inject into lipohypertrophic areas. Choose an alternative area.
- When injecting into a healthy area, monitor blood glucose levels closely and adjust the dose of insulin accordingly.

8.5.2 Lipohypertrophy Prevention

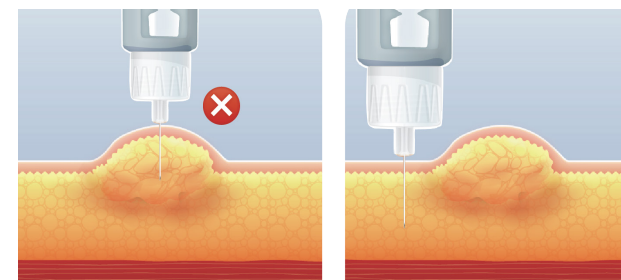
- Teach individuals with diabetes to rotate injection sites (Refer to Section 5 Injection Sites) using the zone system and to avoid the reuse of needles.

8.5.3 Effects of Lipohypertrophy

- Insulin is a growth factor and plays a role in the development of lipohypertrophy.^{2,4,12} Injecting or infusing medication into a lipohypertrophic site may decrease or cause variability in the rate of insulin absorption resulting in variable glycaemic response and the development of disfiguring anatomical lesions.⁴
- Some individuals with diabetes may repeatedly choose lipohypertrophic sites for injections or infusions, as these areas have limited nerve innervations and thereby render the injections to be relatively painless (Refer to Diagram 7).^{13,14,15}
- Majority of lipohypertrophy in individuals with diabetes are due to a lack of injection site rotation.¹⁶

SECTION 8

Diagram 7: Incorrect Injection Site – Lipohypertrophy



- Higher HbA1c levels have been reported in individuals with diabetes who administer injections into lipohypertrophic sites. Pen devices and syringes (all needle lengths and gauges) and insulin pump cannulae have all been reported to be associated with lipohypertrophy.^{3,4}
- Switching injections from lipohypertrophic to normal tissues often requires a decrease in the dose of insulin injected. The amount of insulin reduction varies from one individual to another and should be guided by frequent blood glucose measurements. Reduction often exceeds 20% of their original dose.¹⁷

Key Points

1. Individuals with diabetes on insulin injection need to be educated on the early recognition and management of hypoglycaemia.
2. Injection issues such as pain, bleeding and bruising need to be explored and the injection technique has to be corrected when necessary.
3. Education regarding lipohypertrophy should be included during injectable therapy initiation and reinforced at subsequent visits. Sites should be examined by HCPs at least once per year or more frequently if lipohypertrophy is already present.
4. Individuals with diabetes should be taught to inspect their own injection sites and should be given training on sites rotation, proper injection technique as well as detection and prevention of lipohypertrophy.
5. Individuals with diabetes should be encouraged through education and guidance to avoid insulin injection into areas of lipohypertrophy until the next examination by HCPs. The use of larger injection zones and new needles should be recommended.

SECTION 8

References

1. Malaysia Ministry of Health. Clinical Practice Guidelines on the Management of Type 2 Diabetes 5th edition; 2015.
2. Hicks D, Kirkland F, Pledger J, Down S. Diabetes Care in the UK: the First UK Injection Technique Recommendations 2nd edition. London, UK: Forum for Injection Technique UK; 2011. Available from: http://fit4diabetes.com/files/2613/3102/3031/FIT_Recommendations_Document.pdf [Accessed 17th September 2014].
3. Grassi G, Scuntero P, Trepiccioni R, Marubbi F, Strauss K. Optimizing insulin injection technique and its effect on blood glucose control. *J Clin Transl Endocrinol*. 2014;1:145–150.
4. Saltiel-Berzin R, Cypress M, Gibney M. Translating the research in insulin injection technique: implications for practice. *Diabetes Educ*. 2012;38:635–643.
5. Kreugel G, Beijer HJM, Kerstein MN, Maaten ter JC, Sluiter WJ, Boot BS. Influence of needle size for SC injectable therapy administration on metabolic control and patient acceptance. *Eur Diabetes Nursing*. 2007;4:1–5.
6. Teft G. Lipohypertrophy: patient awareness and implications for practice. *J Diabetes Nurs*. 2002;6:20–23.
7. Frid AH, Kreugel G, Grassi G, Halimi S, Hicks D, Hirsch LJ, et al. New insulin delivery recommendations. *Mayo Clin Proc*. 2016;91:1231–1255.
8. Blanco M, Hernández MT, Strauss KW, Amaya M. Prevalence and risk factors of lipohypertrophy in insulin-injecting patients with diabetes. *Diabetes Metab*. 2013;39:445–453.
9. Richardson T, Kerr D. Skin-related complications of insulin therapy: epidemiology and emerging management strategies. *Am J Clin Dermatol*. 2003;4:661–667.
10. Seyoum B, Abdulkadir J. Systematic inspection of insulin injection sites for local complications related to incorrect injection technique. *Trop Doct*. 1996;26:159–161.
11. Vardar B, Kizilic S. Incidence of lipohypertrophy in diabetic patients and a study of influencing factors. *Diabetes Res Clin Pract*. 2007;77:231–236.
12. Heinemann L. Insulin absorption from lipodystrophic areas: a (neglected) source of trouble for insulin therapy? *J Diabetes Sci Technol*. 2010;4:750–753.
13. De Coninck C, Frid A, Gaspar R, Hicks D, Hirsch L, Kreugel G, et al. Results and analysis of the 2008–2009 insulin injection technique questionnaire survey. *J Diabetes*. 2010;2:168–179.
14. Straughen JK, Trudeau S, Misra VK. Change in adipose tissue distribution during pregnancy in overweight and obese compared with normal weight women. *Nutr Diabetes*. 2013;3:e84.
15. Zhou L, Fan YF, Lu XQ, Ye JP, Ye MH. Feasibility study of vertical subcutaneous injection of insulin with an insulin pen injector in diabetic patients with normal body mass index. *J Int Med Res*. 2010;38:669–673.
16. Sim KH, Hwang MS, Kim SY, Lee HM, Chang JY, Lee MK. The appropriateness of the length of insulin needles based on determination of skin and subcutaneous fat thickness in the abdomen and upper arm in patients with type 2 diabetes. *Diabetes Metab J*. 2014;38:120–133.
17. Cunningham M, McKenna M. Lipohypertrophy in insulin-treated diabetes: prevalence and associated risk factors. *J Diabetes Nurs*. 2013;17:340–343.

SECTION 9

SPECIAL POPULATIONS

Education and treatment approaches for injectable therapy in special populations with diabetes mellitus such as in pregnancy, the elderly, children and adolescents are challenged by physical changes such as changes in muscle mass and strength, skin integrity as well as the differences in cognitive functions.

9.1 Pregnancy

- There is limited research published on insulin injection during pregnancy. Recommendations are based on a study using routine foetal ultrasonography assessing the subcutaneous fat patterns of pregnant women between 16 to 38 weeks gestation and the expert opinion from practitioners.^{1,2}
- Pregnant women with diabetes are most concerned about the effect of insulin injection or infusion on the foetus – this must be addressed to ensure medication adherence. Other safety issues like hypoglycaemia and technical use of insulin pens and blood glucose monitoring device should also be discussed.³ They should be reassured that insulin is not only safe in pregnancy but contributes to foetal and maternal well-being.
- Insulin requirement will change as the pregnancy advances. There will be insulin dose adjustments to achieve the blood glucose target recommended in pregnancy.
- The abdomen is a safe site for insulin administration in pregnancy.^{2,4} The thigh may be used as an alternative area.⁵
- It is important to reassure pregnant women that there is no indication to change the insulin injection site or technique in the first trimester of pregnancy.
- The lateral sides of the abdomen are the recommended zones for injections when the skin is taut over the central abdomen during the second and third trimesters while ensuring that the skin fold is properly raised (Refer to Diagram 8).
- The use of skin fold and shorter needles (4 mm, 5 mm) decreases the potential for intramuscular injection^{6,7,8,9} due to the thinning in abdominal fat from uterine expansion. Avoid injections within 2–3 cm around the umbilicus^{7,9} or areas of the abdomen with taut skin.

SECTION 9

Diagram 8: Recommended Injection Sites During the Second and Third Trimesters of Pregnancy



9.2 Elderly

- Education and treatment on insulin or non-insulin injection for the elderly are challenged by both psychological and physical impairments. Both issues involve loss of muscle mass and strength, decreased skin integrity, and changes in memory, sight and hearing.
- Impairment of counter-regulatory hormones in the elderly reduces the recognition of hypoglycaemia, creating a potential for falls and fractures.¹⁰
- Therefore, the treatment approach in elderly individuals with diabetes must be individualised, while integrating all aspects of the person's life including physical, social and spiritual issues.^{11,12}
- Elderly individuals with diabetes need to be assessed individually using standardised tests for cognitive and functional abilities.¹⁴
- A structured diabetes management and injection technique plan should be written down, based on comprehensive physical and psychological assessments.^{5,12,13}
- Education of family members and friends is encouraged for support and safety. Family members are encouraged to be involved on a daily basis.^{12,14}
- The recommended area for injections in elderly individuals with diabetes is on the abdomen. The use of 4 mm pen needles is encouraged to avoid the need for a skin lift.
- All training on injection therapy should include follow-up demonstrations.^{13,15}

SECTION 9

9.3 Paediatrics (Children and Adolescents)

- Many children and adolescents are emaciated at the time of diagnosis. Furthermore, lean and slim children especially teenage boys have minimal subcutaneous fat tissues.
- All these factors are very challenging in ensuring that the appropriate insulin injection and correct dose are administered. Proper injection techniques are key to achieve optimal blood glucose control.
- HCPs should perform an individualised assessment to determine the amount of subcutaneous fat thickness at each injection site. This will guide the choice of needle length and administration technique.¹⁶
- Insulin pens are the injection device of choice as they fit shorter needle lengths (4, 5 or 6 mm); 4 mm needles are the safest needle length currently available.¹⁷ A 4 mm needle can be inserted at a 90° angle without a skin lift in most children above 6 years old and adolescents.¹⁸ However, children aged 2 to 6 years may need a skin lift to avoid an intramuscular injection with the 4 mm needle.
- If the children are lean, a 5 or 6 mm needle may require a 45° angle for injection with a skin lift.^{18,19,20}

Key Points

1. The abdomen is the preferred site of injection in pregnancy; injections around the umbilicus or areas of the abdomen with taut skin should be avoided.
2. A structured management plan is desirable and should be based on a comprehensive assessment of physical, cognitive and functional changes in elderly individuals with diabetes mellitus.
3. Assessment of subcutaneous fat thickness in children is important to determine the choice of needle length and administration technique.
4. Involvement and education of parents, family members or friends are encouraged for support and safety in children and elderly individuals with diabetes mellitus.
5. All training on injection therapy should include follow-up demonstrations.

SECTION 9

References

1. Engstrom L, Jinnerot H, Jonasson E. Thickness of subcutaneous fat tissue where pregnant diabetics inject their insulin – an ultrasound study. *Diabetes Research & Clinical Practice*. 2000;50:S214–S215.
2. Sacks DA (ed). *Diabetes and pregnancy: a guide to a healthy pregnancy*. American Diabetes Association; 2011.
3. De Valk HW, Visser GH. Insulin during pregnancy, labour and delivery. *Best Pract Res Clin Obstet Gynaecol*. 2011;25:65–76.
4. Straughen JK, Trudeau S, Misra VK. Change in adipose tissue distribution during pregnancy in overweight and obese compared with normal weight women. *Nutr Diabetes*. 2013;3:e84.
5. Sim KH, Hwang MS, Kim SY, Lee HM, Chang JY, Lee MK. The appropriateness of the length of insulin needles based on determination of skin and subcutaneous fat thickness in the abdomen and upper arm in patients with type 2 diabetes. *Diabetes Metab J*. 2014;38:120–133.
6. Gibney MA, Arce CH, Byron KJ, Hirsch LJ. 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;26:1519–1530.
7. Lauren A, Mistretta F, Dottigoli D, Dahel K, Goujon C, Nicolas JF, et al. Echographic measurement of skin thickness in adults by high frequency ultrasound to assess the appropriate microneedle length for intradermal delivery of vaccines. *Vaccine*. 2007;25:6423–6430.
8. Tan CY, Statham B, Marks R, Payne RA. Skin thickness measured by pulsed ultrasound: its reproducibility, validation and variability. *Br J Dermatol*. 1982;106:657–667.
9. Vora JP, Burch A, Peters JR, Owens DR. Relationship between absorption of radiolabeled soluble insulin, subcutaneous blood flow and anthropometry. *Diabetes Care*. 1992;15:1484–1493.
10. Ligthelm RJ, Kaiser M, Vora J, Yale JF. Insulin use in elderly adults: risk of hypoglycaemia and strategies for care. *J Am Geriatr Soc*. 2012;60:1564–1570.
11. Canadian Diabetes Association Clinical Practice Guidelines Expert Committee, Meneilly GS, Knip A, Tessier D. Diabetes in the elderly. *Can J Diabetes*. 2013;37:S184–S190.
12. Huang ES, John P, Munshi MN. Multidisciplinary approach for the treatment of diabetes in the elderly. *Aging Health*. 2009;5:2:207–216.
13. Hendra TJ. Starting insulin therapy in elderly patients. *J R Soc Med*. 2002; 95:453–455.
14. Armour TA, Norris SL, Jack L Jr, Zhang X, Fisher L. The effectiveness of family interventions in people with diabetes mellitus: a systematic review. *Diab Met*. 2005;22:1295–1305.
15. Saltiel-Berzin R, Cypress M, Gibney M. Translating the research in insulin injection technique: implication for practice. *Diabetes Educ*. 2012;38:635–643.
16. Cocoman A, Barron C. Administering subcutaneous injections to children: What does the evidence say? *J Child Young People Nurs*. 2008;2:84–89.
17. Lo Presti D, Ingegnesi C, Srauss K. Skin and subcutaneous thickness at injecting sites in children with diabetes: ultrasound findings and recommendations for giving injection. *Pediatr Diabetes*. 2012;13:525–533.
18. Hofman PL, Lawton SA, Pearttt JM, Holt JA, Jefferies CA, Robinson E, et al. An angled insertion technique using 6-mm needles markedly reduces the risk of intramuscular injections in children and adolescent. *Diabet Met*. 2007;24:1400–1405.
19. Hofman PL, Derraik JG, Pinto TE, Tregurtha S, Faherty A, Peart JM, et al. Defining the ideal injection techniques when using 5-mm needles in children and adults. *Diabetes Care*. 2010;33:1940–1944.
20. Tubiana-Rufi N, Belarbi N, Du Pasquier-Fediaevsky L, Polak M, Kakou B, Leridon L, et al. Short needles (8-mm) reduce the risk of intramuscular injections in children with type 1 diabetes. *Diabetes Care*. 1999;22:1621–1625.

SECTION 10

PSYCHOSOCIAL CHALLENGES OF INJECTION

Injection and insulin therapy are associated with numerous negative perceptions and side effects.^{4,22,24} More than one-fourth of individuals with diabetes may refuse insulin therapy after prescription¹⁹ or delay the initiation of insulin treatment and titration due to psychological factors.¹⁵ This phenomenon is called psychological insulin resistance (PIR).

10.1 Psychosocial Challenges Among Adults

Managing diabetes in adults may be challenging in certain cases because of PIR that could be due to several factors.

- Very few adults have true needle phobia but many have anxiety about injecting, especially at the beginning of therapy.^{18,21}
- Loss of quality of life: less flexible in performing daily activities, difficulty in injecting the right amount and at the right time daily.²¹
- Social stigma: embarrass to inject in public.⁵
- Social economic status: cost of medicine and injection equipment.⁵
- Misconceptions on insulin therapy²¹:
 - Insulin initiation means their condition as ‘more ill’ or a ‘last resort’ of treatment.
 - Insulin causes serious health problems.

Practical Tips

- Assess an individual’s attitude towards insulin and his or her expectations about insulin therapy.⁸
- Prepare all individuals with T2DM early after diagnosis that they will likely require injectable therapy in the future to treat their diabetes.¹⁷
- Explain the progressive nature of diabetes and making clear that injectable therapy treatment is not a sign of patient failure.¹⁷
- Discuss the advantages and disadvantages of injectable therapy versus other therapy.^{7,8}
- Provide information on insulin and the various formulations.²⁶
- Discuss both short- and long-term advantages of achieving target glucose level. It is important to explain that finding the right combination of therapies, which may include the use of injectable therapy to achieve individualised glycaemic targets is the treatment goal.³
- Involve the individual in decision making (e.g. selecting needle sizes, injection frequency).²⁰
- Use devices such as i-Port® or InsuJet™ if needed.

SECTION 10

- Feeling a sense of personal failure or self-blame.²¹
- Fear of side effects: hypoglycaemia, diabetic ketoacidosis, weight gain.⁵

10.2 Psychosocial Challenges Among Adolescents

Adolescents is defined as children of puberty to 18 years of age.⁶ They may exhibit sub-optimal adherence to insulin injection schedule due to⁹:

- Peer pressure
- Forgetfulness
- Lack of seriousness about their condition/treatment
- Rebellion
- Pain and frustration
- Fear of weight gain (especially girls)

Practical Tips

- Encourage adolescents to discuss their feelings about injection particularly their frustration and struggles.⁶
- Reassurance that no one manages diabetes perfectly all the time; slip-ups do occur (as long as they do not become routine) and are not signs of failure.⁶
- Explain the benefits of injectable therapy^{7,8}:
 - Improve blood glucose control
 - Reduce long-term complications
- Apply Cognitive Behavioural Therapy²⁵:
 - Relaxation training
 - Guided imagery
 - Graded exposure
 - Active behavioural rehearsal
 - Modelling and reinforcement
- Give them a sense of control (e.g. flexible injection schedule for weekends and holidays).⁶

10.3 Psychosocial Challenges Among Children

The age at which children can self-inject is related to development maturity rather than chronological age. Most children over the age of 10 years can administer their own injections.² There are several concerns regarding injection among children.

- Needle fear is common in both children with diabetes and their parents. Younger children report more fear and pain.^{10,12,23}
- Children have lower threshold of pain and do not bring it up spontaneously.¹¹
- Intentional underdosing or overdosing of insulin is common in children (and adolescents) and can lead to severe diabetic ketoacidosis or hypoglycaemia.^{4,22,24}

SECTION 10

Practical Tips

- For parents or guardians:
 - Project a calm and composed attitude towards injections.⁹
 - Inform parents that their displayed distress and negative attitudes can influence their child's co-operation.³
 - Let parents experience an injection with a pen tip needle attached to an empty insulin pen device.³
 - Encourage parents to be involved in insulin administration if insulin dose manipulation is suspected or confirmed.¹
- For children:
 - Show concern to the child by asking about pain and use positive words.¹⁴
 - Use diversion techniques or play therapy³:
 - ◆ Injecting into a soft toy animal
 - ◆ Watching a favorite show
 - ◆ Looking for hidden objects in picture books
 - ◆ Blowing bubbles
- If self-injecting, young children should share this responsibility with their parents and do so under supervision.
- If omission or overdosing is an ongoing problem, the parents should be instructed to take over the task of injecting insulin.

10.4 Psychosocial Challenges among HCPs

Despite ample evidence showing that relatively few individuals with T2DM achieve glycaemic control with oral therapy alone, physicians are still reluctant to initiate insulin injection.⁸ The reluctance to add insulin injection may be due to¹⁶:

- having negative perceptions about injectable therapy
- lack of motivation and confidence
- concern about the lack of continuity of care for the individuals with diabetes
- lack of manpower and resources

SECTION 10

Practical Tips

- Reflect on own perceptions of injectable therapy. Avoid using any terms which might imply that such therapy is a sign of failure or a form of punishment.⁹
- Ask individuals with diabetes about their use of complementary therapies when initiating insulin.¹⁶
- Initiate insulin with a lower starting dose.¹³
- Customize a follow-up plan for individuals with diabetes to facilitate initiation and optimisation of insulin.¹⁶
- Address misconceptions by counselling individuals with diabetes about the natural progression of diabetes at the early stage of the illness.¹⁶
- Policymakers to design and implement training curriculum of HCPs.¹⁶

Key Points

1. PIR causes more than 25% of the individuals with diabetes to delay the initiation of insulin and non-insulin injectable therapy.
2. Different age groups of the diabetes population demonstrated different concerns about injectable therapy. In general, fear and anxieties about injectable therapy occur in all ages.
3. It is advisable to use appropriate approaches to manage an individual's psychological challenges. Spending some time in addressing these challenges can be worthwhile.
4. Some HCPs have reservations in initiating injectable therapy. This may be due to personal negative perceptions towards the therapy and safety issues in using insulin.

SECTION 10

References

1. Anderson BJ, Svoren B, Laffel L. Initiatives to promote effective self-care skills in children and adolescents with diabetes mellitus. *Disease Management & Health Outcomes*. 2007;15:101–108.
2. Bangstad H-J, Danne T, Deeb LC, Jarosz-Chobot P, Urakami T, Hanas R. ISPAD clinical practice consensus guidelines: insulin treatment. *Pediatr Diabetes*. 2009;10:82–99.
3. Berard, L, Derochers, F, Husband A, MacNeill G, Roscoe R. FIT Forum for Injection Technique Canada; 2012.
4. Boileau P, Aboumrad B, Bougneres P. Recurrent comas due to secret self-administration of insulin in adolescents with type 1 diabetes. *Diabetes Care*. 2006;29:430–431.
5. Brod M, Kongsø JH, Lessard S, Christensen TL. Psychological insulin resistance: patient beliefs and implications for diabetes management. *Qual Life Res*. 2009;18:23–32.
6. Davel H, Van Der Merwe L, Allie R, Berg GI. FIT Forum for Injection Technique in South Africa.
7. Davidson MB. No need for the needle (at first). *Diabetes Care*. 2008; 31:2070–2071.
8. Davis SN, Renda SM. Psychological insulin resistance: overcoming barriers to starting insulin therapy. *Diabetes Educ*. 2006;32:1465–1525.
9. Genev NM, Flack JR, Hoskins PL, Overland JE, Yue DK, Turtle JR. Diabetes education: whose priorities are met? *Diabet Med*. 1992;9:475–479.
10. Hanas R, Ludvigsson J. Experience of pain from insulin injections and needle-phobia in young patients with IDDM. *Pract Diab Int*. 1997;14:95–99.
11. Hicks D, Kirkland F, Pledger J, Down S. Diabetes Care in the UK: the First UK Injection Technique Recommendations 2nd edition. London, UK: Forum for Injection Technique UK; 2011. Available from: http://fit4diabetes.com/files/2613/3102/3031/FIT_Recommendations_Document.pdf [Accessed 17th September 2014].
12. Howe CJ, Ratcliffe, SJ, Tuttle A, Dougherty S, Lipman TH. Needle anxiety in children with type 1 diabetes and their mothers. *MCN Am J Matern Child Nurs*. 2011;36:25–31.
13. Jenkins N, Hallowell N, Farmer AJ, Holman RR, Lawton J. Initiating insulin as part of the Treating To Target in Type 2 Diabetes (4-T) trial: an interview study of patients' and health professionals' experiences. *Diabetes Care*. 2010;33:2178–2180.
14. Karlegard M, Eldholm S, Lindblad B, Sigstrom L. Fear of injection in children and adolescent with diabetes. *Sv Lakaresallskapetets Handlingar Hygiea*. 2001;110:301(32P).
15. Lee KP. Psychosocial factors associated with psychological insulin resistance in primary care patients in Hong Kong. *J Clin Transl Endocrinol*. 2015;2:157–162.
16. Lee YK, Lee PY, Ng CJ: A qualitative study on healthcare professionals' perceived barriers to insulin initiation in a multi-ethnic population. *BMC Fam Pract*. 2012;13:28.
17. Meece J. Dispelling myths and removing barriers about insulin in type 2 diabetes. *Diabetes Educator*. 2006;31:95–185.
18. Martinez L, Consoli AM, Monnier L, Simon D, Wong O, Yomtov B, et al. Studying the Hurdles of Insulin Prescription (SHIP): development, scoring and initial validation of a new self-administered questionnaire. *Health Qual Life Outcomes*. 2007;5:53.
19. Okazaki K, Goto M, Yamanoto T, Tsujii S, Ishii H. Barriers and facilitators in relation to starting insulin therapy in type 2 diabetes (abstract). *Diabetes*. 1999;48:SA319.
20. Patel N, Stone MA, McDonough C, Davies MJ, Khunti K, Eborall H. Concerns and perceptions about necessity in relation to insulin therapy in an ethnically diverse UK population with Type 2 diabetes: a qualitative study focusing mainly on people of South Asian origin. *Diabet Med*. 2014;32:635–644.
21. Polonsky WH, Jackson RA. What's so tough about taking insulin? Addressing the problem of psychological insulin resistance in type 2 diabetes. *Clin Diab*. 2004;22:147–150.
22. Schober E, Wagner G, Berger G, Gerber D, Mengl M, Sonnenstatter S, et al. Prevalence of intentional under- and overdosing of insulin in children and adolescents with type 1 diabetes. *Pediatr Diabetes*. 2011;12:627–631.
23. Simms JH, MCFann KK, Brown AC, Rewers A, Follansbee D, Temple-Trujillo RE, et al. Reliability of the diabetes fear of injecting and self-testing questionnaire in paediatric patients with type 1 diabetes. *Diabetes Care*. 2007;30:987–988.
24. Smith CP, Firth D, Bennett S, Howard C, Chisholm P. Ketoacidosis occurring in newly diagnosed and established diabetic children. *Acta Paediatr*. 1998;87:537–541.
25. Strauss K, De Gols H, Hannel I, Partanen T-M, Frid A. A pan-European epidemiologic study of insulin injection technique in people with diabetes. *Pract Diab Int*. 2002;19:71–76.
26. Wang HF, Yeh MC. Psychological resistance to insulin therapy in adults with type 2 diabetes: mixed-method systematic review. *J Adv Nurs*. 2012;68:743–757.

CHECKLIST

Injection Technique Using Pen Devices	Yes / No	Follow-up
1. Hand wash		
2. Check insulin for discolouration and formation of clumps. Discard if these occur		
3. Resuspension of cloudy insulin, roll 10 times and tip up and down 10 cycles (only for cloudy insulin)		
4. Place a new needle onto pen device		
5. Prime the pen		
6. Dial the correct dose		
7. Inspect injection site. Injection should be given to a soft and clean site		
8. Insert pen needle into the skin at 90° angle, push down the dose button completely		
9. Count to 10 slowly before withdrawing the needle from the skin		
10. Recap pen needle using outer cap		
11. Remove the used pen needle and dispose safely		

CHECKLIST

Injection Technique Using Insulin Syringe	Yes / No	Follow-up
1. Hand wash		
2. Check insulin for discolouration and formation of clumps. Discard if these occur		
3. Resuspension of cloudy insulin, roll 10 times and tip up and down 10 cycles (only for cloudy insulin)		
4. Cleanse the insulin vial's lid with alcohol swab		
5. Remove plunger protector and uncap the needle of insulin syringe		
6. Draw air into the syringe by pulling back the plunger to the level equal to the prescribed dose (the air is equal to the units of insulin to be injected)		
7. Inject syringe into the insulin vial at 90° angle		
8. Push the air into the insulin vial		
9. With the needle still in the vial, turn the insulin vial and syringe upside down		
10. Slowly pull down the plunger to withdraw/aspirate insulin into the syringe up to a unit past the prescribed dose. Check for the presence of air bubbles and remove using appropriate techniques		
11. Pull the needle out of the insulin vial		
12. Inspect injection site. Injection should be given to a soft and clean site (alcohol swab is recommended in healthcare setting).		
13. Lift gently a skin fold using thumb and index fingers		
14. Insert needle into the skin at 45° degree angle for needle length >8 mm, push down the dose button completely		
15. Count to 10 slowly before withdrawing the needle from the skin		
16. Release lifted skin fold		
17. Dispose used syringe safely		

GLOSSARY OF TERMS

Abbreviation	Terminology
BMI	Body mass index
GLP-1	Glucagon like peptide-1
GLP-1 RA	GLP-1 receptor agonist
HCP	Healthcare professional
HIV	Human immunodeficiency virus
HBV	Hepatitis B virus
HCV	Hepatitis C virus
NSI	Needle stick injuries
OAD	Oral anti-diabetic
PIR	Psychological insulin resistance
SMBG	Self-monitoring blood glucose
T1DM	Type 1 diabetes mellitus
T2DM	Type 2 diabetes mellitus

ACKNOWLEDGEMENTS

We would like to extend our gratitude and appreciation to the following parties for their contributions:

- Panel of external reviewers for their time and professional expertise.
- Becton Dickinson (M) Sdn. Bhd. for the support in the development of the guideline.
- All those who have contributed directly or indirectly to the development of the guideline.

