DIABETES CARE IN THE UK

FIT UK Forum for Injection Technique UK

The UK Injection and Infusion Technique Recommendations 5th Edition

fit odc™

Optimising Diabetes Care

Preface

Forum for Injection Technique (FIT) UK is a multi-disciplinary board made up of specialist nurses, a GP with special interest, pharmacists and a person living with diabetes, all of whom have experience of managing/treating or living with diabetes.

Patient safety is a fundamental principle of the FIT UK Board. Having a diverse multi-disciplinary board lends itself to a comprehensive understanding of the impact of injection technique thus optimising diabetes care in different psychological and physical settings.

These recommendations are evidence based to support people living with diabetes to achieve optimal health outcomes by ensuring that the appropriate dose of medication is delivered to the optimal injection site, using the correct technique.

This evidence-based guidance is for all healthcare professionals who will interact with people living with diabetes who inject their medication. A multi-disciplinary team be it in hospital, primary care, community pharmacy or peer support online can help patients living with diabetes to have the knowledge to allow them to achieve their optimal outcomes. We understand injection technique is only one of many factors in holistic care, but it is one that can have a significant impact on psychological wellbeing and overall glycaemic management.

Guidance Objectives:

- To be an evidence-based recommendation for reference
- To be for all Health Care Professionals regardless of setting
- To help inform part of a holistic patient care pathway

Everyone with Type1 Diabetes Mellitus (T1DM) will need insulin from diagnosis (3). Currently there are 400,000 people in the UK with T1DM and over 29,000 of them are children. The number of people diagnosed is increasing by 4 percent every year and most commonly in children under five years old. (4)

New and emerging evidence shows that optimal injection technique is critical to improving physical and psychological health outcome. A pioneering study by Blanco (5) demonstrated that almost two thirds of patients have lipohypertrophy due primarily to sub-optimal or no rotation of injection sites. Of the patients with lipohypertrophy 39.1% had unexplained hypoglycaemia and 49.1% had glycaemic variation. Patients with lipohypertrophy were found to be using much more insulin than those without, estimated to cost the Spanish Healthcare system 122million Euros per year in excess insulin usage.

A study by Grassi (6) demonstrated that a multimodal approach to injection technique education and support could reduce glycated haemoglobin (HbA1c) by 6 mmol/mol (0.58%) in patients treated with insulin. Interestingly this was achieved using less insulin and without any weight gain. The development of FIT UK and the subsequent UK Injection and Infusion Technique Recommendations 5th Edition have been supported by BD Europe.

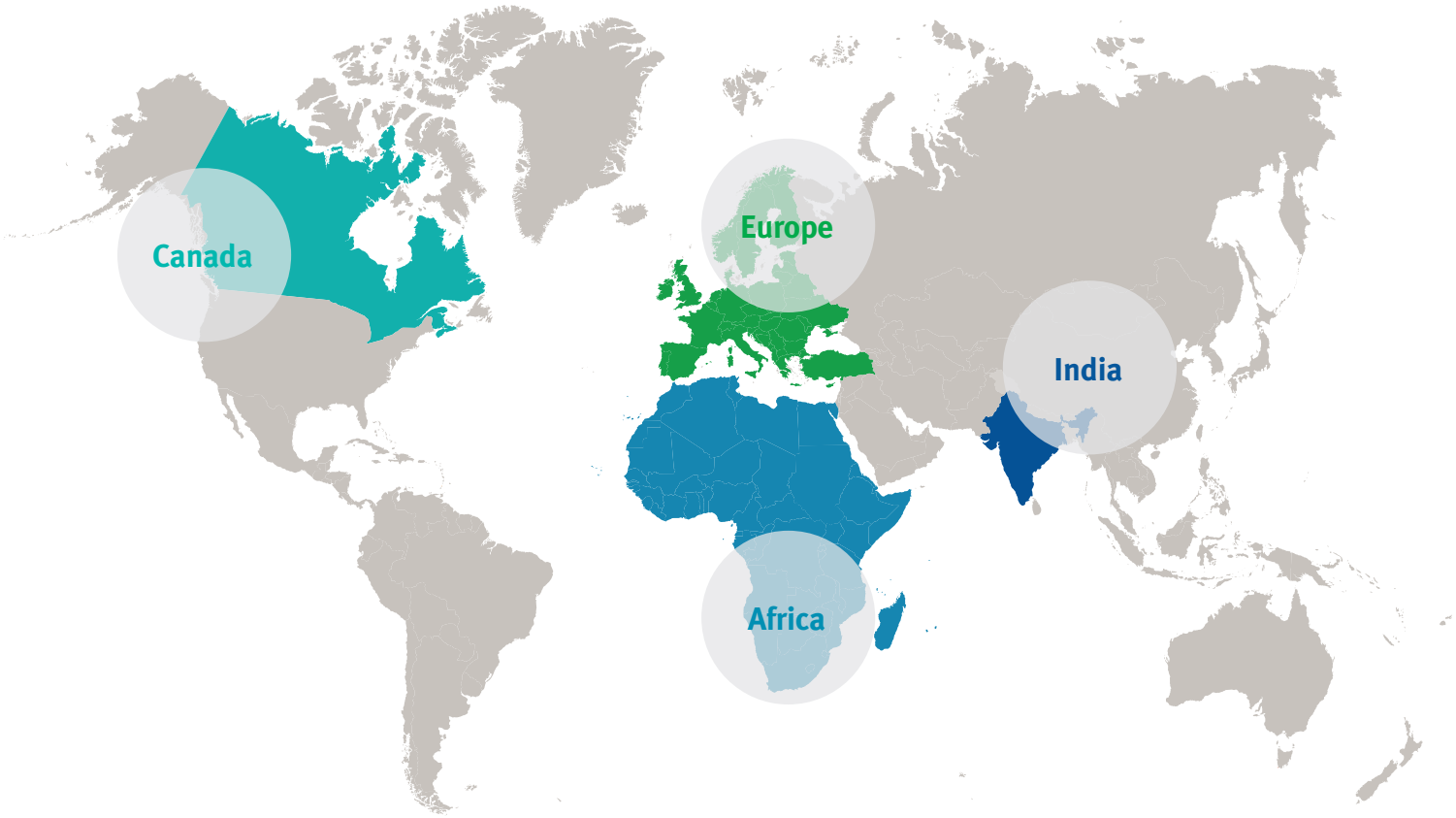
They have also been endorsed by Diabetes UK along with the pharmaceutical companies whose therapies include subcutaneous injections of insulin and glucagon-like peptide-1 receptor agonists (GLP-1 receptor agonists).
FIT UK's overarching mission is:

'To support people with diabetes using injectable therapies to achieve the best possible health outcomes that are influenced by correct injection technique'.

To date FIT UK has delivered many education programmes and produced the First UK Injection Technique Recommendations (2010) and Safety Recommendations (2012) which have been distributed and accessed online by many thousands of health care professionals. FIT UK has also produced a range of educational support materials and e-learning modules.

Over 16 years ago a small pioneering group of medical and nursing professionals gathered for the first time to explore the evidence for optimal injection technique.

FIT UK was established following the 3rd International Injection Technique meeting in Athens 2009. FIT UK has grown from a single entity based in the UK and is now represented across the globe.



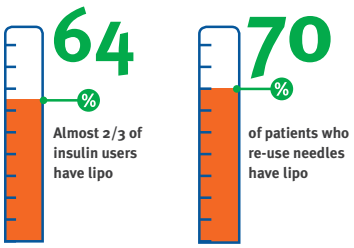
Contents

Lipohypertrophy - prevalence and link to needle re-use

Injection technique was observed in a number of study environments. In patients who exhibited lipohypertrophy, there was an increased use of insulin. Insulin is designed to be injected into healthy subcutaneous fat tissue, where blood flow is stable and predictable, as opposed to damaged lipotrophic fat tissue.[1]

Blanco et al[2]

The research found that the incidence of lipos increased with the re-use of needles.

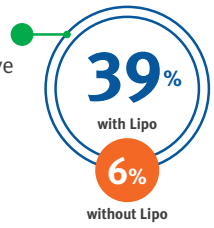


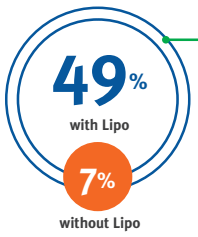
The frequency of lipo is high

Lipohypertrophy also impacts on patients' blood glucose (BG) control

Unexplained hypoglycaemia

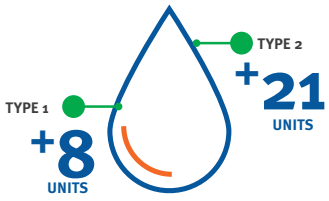
39% of patients with lipo have unexplained hypoglycaemia, compared to **6%** of patients without lipo.





Glycaemic variation

49% of patients with lipo have glycaemic variability, compared to **7%** of patients without lipo.



Patients with lipo require higher doses of insulin (on average).

FIT Summary

1

2

1 Psychological Issues around Insulin Therapy and Administration

1 All patients and care givers should be offered personalised education/counselling which will facilitate optimal care.

2 Ensure all patients and carers are supported by their HCP using person-centred evidence-based psychological educational tools / strategies to achieve mutually-agreed goals.

3 Diabetes HCPs should be skilled in identifying psychological issues which impact on insulin therapy and administration.

4 HCPs must have a range of therapeutic behavioural and communication skills to minimise the psychological distress and impact of injectable therapy.

5 Various methods of minimizing barriers, pain and/or fear of injection should be utilised in order to reduce psychological distress.

2 Injection Technique in Adults

1 Insulin and GLP-1 receptor agonists must be deposited into healthy subcutaneous tissue, avoiding the intradermal and intramuscular spaces as well as scars and lipohypertrophy.

2 4mm and 5mm pen needles are recommended for all adults regardless of age, gender or Body Mass Index (BMI). If patients need to use needle lengths > 4mm or a syringe (or where the presumed skin surface to muscle distance is less than the needle length) they must use a correctly-lifted skinfold to avoid intramuscular injections. **Note that 6mm and 8mm pen needles are no longer recommended.**

3 Recommended sites for injection are abdomen, thigh, buttocks, upper arms:

- Abdomen within the following areas: 2cm above the symphysis pubis, 2cm below the lowest rib, 2cm away from the umbilicus and laterally at the flanks. (Pregnant women should avoid abdominal sites around the umbilicus during the last trimester)
- Upper 3rd anterior lateral aspect both thighs
- Upper, outer quadrants of buttocks
- Mid 3rd posterior aspect of upper arm, if given by a third party

3

4 Inspect site before injecting and avoid areas of lipohypertrophy.

5 Rotation of injection sites within an area is recommended:
- Spacing injections approximately 1 cm breadth apart
- Using a single injection site no more frequently than every 4 weeks when feasible.
- Avoid mixing injection areas and insulin type

6 Pen needles are designed to be used only once. Do not reuse pen needles.

3 Injection Technique in Children and Young People

1 Insulin must be injected into healthy subcutanous (SC) tissue, avoiding the intradermal(ID) and intramuscular (IM) tissue as well as lipohypertrophy, lipoatrophy and scar tissue.

2 Injections should avoid bony prominences by one to two centimetres. Sites, in order of preference are:
- Upper outer quadrant of the upper buttocks
- Abdomen, two centimetres away from umbilicus
- Middle 3rd of the back of the upper arm
- Upper outer 3rd of both thighs

3 Consideration should be given to the type of insulin and the time of day when selecting injection sites.

4 Correct rotation of injection sites must be followed at all times to prevent lipohypertrophy.

5 4mm pen needles should be used for all children and young people regardless of age, gender or BMI.

6 Children and young people are at risk of accidental IM injection particularly in the thigh; therefore, always use a lifted skinfold especially if using a pen or syringe with a safety needle attached.

7 Pen needles are designed to be used only once. Do not reuse pen needles.

FIT Summary

4

4 Treating and Preventing Lipohypertrophy

1 All HCPs who administer diabetes injectables must be trained in correct injection technique and to correctly screen for lipohypertrophy and other site complications.

2 All patients, caregivers, and family members must be taught the techniques of correct injection or infusion at the initiation of therapy and at subsequent reviews, at least on an annual basis.

3 Injection sites should be checked by a HCP on a regular basis, at least annually or more often if LH has been detected.

4 All persons who self-inject/infuse insulin or other injectables must be taught to self-inspect sites and be able to distinguish healthy from unhealthy tissue.

- Patients should be encouraged to avoid injecting into lipohypertrophy or unhealthy sites
- Clinicians must document lipohypertrophy and other site complications in patient records. Clinicians must monitor and record any area of lipohypertrophy to map change, possibly using the following tools:
  - Photography
  - Body maps with descriptors for size, shape, texture
  - Transparent graduated recording sheets.

- With patient consent, clinicians should mark the border of all lipohypertrophy and other site complications with skin-safe single-use markers and instruct patients to avoid using marked areas until instructed otherwise

5 Patients with lipohypertrophy who have been instructed to stop injecting/infusing into affected tissue must be:

- Educated about the improved/changed absorption when injecting into normal tissue instead of lipohypertrophy
- Advised that pain may be experienced when injecting into normal tissue
- Encouraged by a HCP to monitor glucose levels frequently due to the risk of unexpected hypoglycaemia
- Supported to reduce their insulin doses in line with glucose results, knowing that reductions often exceed 20% of their original dose
- Changed to 4mm pen needles/8mm insulin syringes to minimise accidental intramuscular risk due to using larger areas

6 All patients must be encouraged to correctly rotate injection/ infusion sites and educated of the risks of reusing needles in order to minimise risk of injection site complications:

- Principles of correct rotation technique must be taught to patients and rotation technique assessed at least every year and more frequently if required
- Correct rotation ensures that injections are spaced out approximately 1 cm (a finger breadth) from each other and that a single injection site is used no more frequently than every 4 weeks when feasible.

5 Insulin Infusion Technique

1 Insulin infusion cannulae must be inserted into healthy subcutaneous tissue, avoiding underlying muscle as well as areas of skin irritation, scarring, lipohypertrophy and lipoatrophy.

2 If bleeding or significant pain occurs upon insertion, the set should be removed and replaced.

3 Preferred sites for infusion cannulae should be individualised and include:

- Abdomen, avoiding bony prominences and umbilicus
- Upper outer quadrant of the upper buttocks and flanks
- Middle 3rd of the back of the upper arm
- Upper outer 3rd of both thighs

4 Infusion cannulae sites should be rotated to avoid lipohypertrophy. This involves full rotation within each site.

5 Infusion cannulae should be changed within 72 hours.

6 If kinking occurs consider a shorter cannula or an angled or steel infusion set.

7 If silent occlusion, interuption in flow or unexplained hyperglycaemia occur, consider using a cannula with a side port.

FIT Summary

6

6 Needlestick Injuries and Sharps Disposal

1 All HCP, employers and employees must comply with relevant UK legislation, national and local legislation for the use of sharps.

2 Sharp medical devices present a potential risk for injury and transmission of disease. All HCPs, employers and employees must ensure the safest possible working environment by:

- Conducting regular risk assessment in all situations where there is potential for exposure to sharps injury
- Preventing and controlling risk by means of continuing education and training
- Providing and using a means of safe disposal of used sharps conforming with National standards
- Encouraging reporting of incidents

3 Safety-engineered devices must be used by all HCPs and by all 3rd party carers using sharps (e.g. injections, blood testing, infusion) in situations where a risk for disease transmission (i.e. Human Immunodeficiency Virus [HIV] and hepatitis) may be present, and in risky environments such as care homes, schools, and prisons.

4 Frequent and regular sharps awareness campaigns must be conducted by all employers for personnel at risk of contact with medical sharps.

5 Recapping of needles is strictly prohibited (except by the self-injector).

6 Where possible safety-engineered devices with passive activation should be used.

7 Insulin delivery by 3rd party carers or family member must be carried out using correct injection or infusion techniques and with safety-engineered devices which shield/guard the patient end of the needle at a minimum. Best practice for pen needles requires that both ends of the needle be protected.

8 Safe disposal requires that:

- Correct disposal procedures and personal responsibility be taught to patients and care givers by the dispensing clinician (including pharmacists) and be regularly reinforced
- Safe sharps disposal systems and processes be present and known to all persons at risk of sharps contact (conforming to National standards)
- Environments where others are at risk of exposure to sharps (e.g. care homes, schools and prisons or around refuse workers and cleaners) be highlighted to the patient
- Patients diagnosed with blood bourne diseases such as Human Immunodeficiency Virus (HIV) or Hepatitis be supported to use safety-engineered devices and dispose of them safely
- Sharps should never be placed directly in public or household rubbish.

KEY

A Scientific Advisory Board (SAB) (Athens 2009) led the review of available evidence and decided that for the strength of a recommendation the following scale would be used:

- A STRONGLY RECOMMENDED
- B RECOMMENDED
- C UNRESOLVED ISSUE

For the scientific support the following scale was used.

1. At least one rigorously performed study, peer-reviewed and published.
2. At least one observational, epidemiologic or population-based study.
3. Consensus expert opinion based on extensive patient experience.

A number of significant studies have been published in the intervening years since 2009. Therefore FITTER has conducted a further review of critical evidence and included this within the 4th Edition of the New Injection and Infusion Recommendations. The body of evidence has been subjected to the rigour of the strength scale of recommendations as above however with a slightly modified KEY for the scientific support:

Thus each recommendation is followed by both a letter and number (i.e. A2). The letter indicates the weight a recommendation should have in daily practice and the number, its degree of support in the medical literature. The most relevant publications bearing on a recommendation are also cited. There are few randomised clinical trials in the field of injection technique (compared, for example, with blood pressure control) so judgements such as 'strongly recommended' versus 'recommended' are based on a combination of the weight of clinical evidence, the implications for patient therapy and the judgement of the group of experts.

These recommendations apply to the majority of people with diabetes using injectable therapy, but there will inevitably be individual exceptions for which these recommendations must be adjusted.

Acknowledgment

The New Insulin Injection and Infusion Recommendations for Patients with Diabetes: Frid AH, Kreugel G, Grassi G, et al. New insulin delivery recommendations. Mayo Clin Proc. September 2016;91(9):1231-1255. informed these recommendations and we thank the editors of the Mayo Clinic for permission to use material from this article.

A STRONGLY RECOMMENDED
B RECOMMENDED
C UNRESOLVED ISSUE

1 At least one rigorously performed study, peer-reviewed and published
2 At least one observational, epidemiologic or population-based study.
3 Consensus expert opinion based on extensive patient experience.

1.0 Psychological Challenges of Injections

1.1 Emotional and Psychosocial Issues

1 Show empathy by addressing the patients' emotional concerns first. The healthcare professional (HCP) should explore worries and barriers to treatment and acknowledge that anxiety is normal when beginning any new medication, especially injection therapy. (7,8,9,10,11,12,13,14,15,16,17,18) A 2

2 People, with diabetes should be encouraged to express their feelings about injecting, particularly their fears; frustration, anger and struggles. A 3

3 Patients of all ages should be reassured that this is a learning process and the health care team is there to help along the way. The message is: 'you are not alone, we are here to help you; we will be supporting you until you are comfortable and confident giving yourself an injection'. A 3

4 The language we use as healthcare professionals is important as patient should not see insulin as a punishment or failure. Insulin when used correctly is the most effective treatment we have for managing blood glucose. For patients with Type 1 Diabetes Mellitus (T1DM) it is the primary treatment and for patients with Type 2 Diabetes Mellitus (T2DM), it may be used in addition to oral therapy but may also be used in combination with GLP-1 receptor agonists to improve blood glucose control. For patients with T2DM it is important they understand the natural progression of the condition and that insulin therapy is a part of the logical progression in its management. (19,20,7) A 3

5 Inform patients that improving their blood glucose levels may make them feel better in the long term. Many patients report an overall improvement in their health and well-being when taking insulin. Managing blood glucose levels with insulin helps to prevent long-term complications'. (8,21) A 3

6 All patients should be supported to self-manage as much as possible and be involved in designing their regimen to fit their lifestyle. This could include basal bolus therapy, carbohydrate counting, using insulin pens and insulin pumps. A 3

1.0 Psychological Challenges of Injections

1.2 Strategies for Reducing Fear, Pain, and Anxiety

1 Include caregivers and family members in the planning and education of the person who is injecting where appropriate and agreed by the individual. A 3

2 Tailor the therapeutic regimen to the individual needs of the patient. A 3

3 Have a compassionate and clear approach when teaching correct injection technique. A 3

4 Demonstrate the correct injection technique to the individual and assess their ability to self-inject. A 3

5 In the case of fear provoked by seeing needles consider the use of devices which hide the needle. A 3

6 Consider the use of vibration, cold temperature or pressure to suppress pain during injection. (254) A 3

7 If bleeding or bruising occur, assess and reassure the patient that these do not affect the absorption of insulin or overall blood glucose control. If bruising continues or haematomas develop, observe the injection technique and suggest improvements (e.g. correct rotation of injection sites). A 3

8 Children have a lower threshold for pain. The HCP should ask about pain. (9) (22) For young children consider distraction techniques or play therapy (e.g. injecting the child's own soft toy or doll). Older children respond better to cognitive behavioural therapies (CBT). (7) (10) (23) A 2

9 CBT includes relaxation training, guided imagery, graded exposure, active behavioural rehearsal, modelling and positive reinforcement as well as appropriate rewards. (23) A 2

10 Fear and anxiety can be significantly reduced by having the person (parent and child) give themselves a dry injection.

11 Most are surprised at how relatively painless the injection is. A 3

12 On rare occasions the use of injection ports may help reduce fear of injections and associated pain. Fig 1 (24) (25) (11) (26) (27) B 1

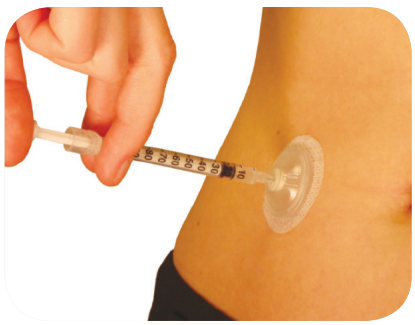


Figure 1: Medtronic Port in situ.

With kind permission. i-Port Advance® injection port is a registered trademark.

A STRONGLY RECOMMENDED
B RECOMMENDED
C UNRESOLVED ISSUE

1 At least one rigorously performed study, peer-reviewed and published

2 At least one observational, epidemiologic or population-based study.

3 Consensus expert opinion based on extensive patient experience.

1.0 Psychological Challenges of Injections

13 Insulin pens with very short needles may be more acceptable to patients than the syringe and vial. This should be discussed with the person (and family) when teaching injection technique. The 4 mm pen needle is reported by patients to be less painful than longer needles. (8,28,29,30) A 2

14 If patients occasionally experience sharp pain on injection they should be reassured that the needle may have touched a nerve ending which happens randomly and will not cause any damage. A 3

15 If pain persists the HCP should see the patient and evaluate their injection technique. A 3

2.0 Therapeutic Education

2.1 Role of the Health Care Professional

1 Teach patients (and other care-givers) how to inject correctly and addressing the many psychological hurdles the patient may face when injecting or infusing, especially at the initiation of treatment. (50,48) A 2

2 Is to understand the anatomy of insulin delivery sites in order to help patients avoid intramuscular (IM) injections or infusions and ensure that injections and infusions are consistently given into the subcutaneous (SC) tissue, without leakage/backflow or other complications. (52,53,54,55,56) A 3

3 Is to have knowledge of the time action profile of the different types of insulin and GLP-1 receptor agonists and the absorption profiles from different injection sites. (57,58,59,60) A 2

4 Educate other allied healthcare professionals and raise awareness of the importance of injection technique for people living with diabetes and care givers. A 3

2.0 Therapeutic Education

2.2 Educational Content

1 The HCP should spend time exploring patient (and other care-givers') anxieties and barriers to the injecting process and insulin itself. (48,19) A 3

2 At the beginning of injection therapy the HCP should discuss each of the essential topics and ensure this information has been fully understood, and this should be assessed at least every year thereafter. (12) A 3

3 The essential injection technique topics include:
- the injectable therapy regimen
- the choice and management of the devices including safety devices
- the choice, care and self-examination of injection sites
- correct injection techniques (including site rotation, injection angle and possible use of lifted skin folds)
- Resuspension of insulin where appropriate
- injection complications and how to avoid them
- optimal needle lengths
- Safe disposal of used sharps
- hypoglycaemia, where appropriate

(19,20,21,28,48,49,50,51) A 1

4 Instructions should be given in both verbal and written form, individually, along with digital resources, tailored to the needs of the person. A 3

5 Level of knowledge should be assessed and observed, and all aspects of injection technique including injection sites inspected and palpated, if possible at each visit but at least every year. This should be documented in the patient's records. (48,49,51) A 3

2.3 Suggestions to improve patient experience

1 Demonstrate the correct injection technique to the person (and family.) Then ask the patient (and family) to demonstrate the correct technique. A 3

2 Advise that insulin in use is kept at room temperature to make for a more comfortable injection. Cold insulin often produces more pain. A 3

3 Advise that the skin should be clean and dry before injecting. Patients do not need to use a disinfectant (e.g. alcohol swab) on the skin, but if they do, they should allow it to dry completely before injecting. A 3

4 Use needles of the shortest length (4mm), smallest diameter (highest gauge number), and the tip with the lowest penetration force to minimize pain. (31) A 1

A STRONGLY RECOMMENDED
B RECOMMENDED
C UNRESOLVED ISSUE

1 At least one rigorously performed study, peer-reviewed and published
2 At least one observational, epidemiologic or population-based study.
3 Consensus expert opinion based on extensive patient experience.

2.0 Therapeutic Education

5 Insert the needle through the skin in a smooth but not jabbing movement. Pain fibres are in the skin and going through the skin too slowly or too forcefully may increase the pain. (31) A 1

6 Inject the insulin slowly ensuring that the plunger (syringe) or thumb button (pen) has been fully depressed and all insulin has been injected. With pens the patient should count to 10 after the button has been fully depressed before withdrawing the needle. A 3

7 Use a sterile, new needle for each injection. (5,32,33,34,35, 36,37,38,39,40,41,42,43) A 1

8 HCPs should teach the importance of rotation and agree a rotation pattern with the patient when initiating injection therapy. (5) A 1

9 Insulin will not be well-absorbed if it is always injected into the same area. (5) (44) A 1

10 It is important to move injections at least 1 cm (half an inch) away from the previous injection. (5) A 1

11 Use all injection sites appropriate to the patients' preference on the body including the back of the arms, buttocks, thighs and abdomen. (5) A 1

12 If the same injection site is used repeatedly lipohypertrophy may develop (lumpy, firm and enlarged tissue). The insulin will not be absorbed correctly if injected into these areas. (5,45,46) A 1

13 If pain is experienced when injecting large volumes of insulin the dose may need to be divided into two injections of a smaller volume or the concentration of insulin may need to be increased. A 1

14 Insulin pens, pen cartridges and vials should not be shared in order to prevent the transmission of infectious diseases. (32,33,47,34,35,36, 37,38,39,40,41,42,43) A 1

15 Larger doses may be split to reduce the volume of insulin. Consider using higher strength insulin for large doses to reduce volume. (199,202)

3.0 Injection Technique

3.1 Injection Site Care

1 The site should be inspected by the patient prior to injection. Injections should then be given in a clean site using clean hands. Fig 2 (61,62,63) A 2

2 Soiled skin should be cleaned according to basic common standards with soap and water. If alcohol is used to clean the site, the skin must be allowed to dry completely before the injection is administered. (64,65) A 2

3 Disinfection of the site is usually not required although local decisions may be taken in a clinical setting to do so. (32,66,67,68,69) A 3

4 Patients should never inject into sites of lipohypertrophy, inflammation, oedema,ulceration or infection, nodules, scar tissue, tattoos, hernias and stomas. (70,52, 71,72,73,(74,75,76,77,78) A 1

5 Patients should not inject through clothing. (64, 257) B 2

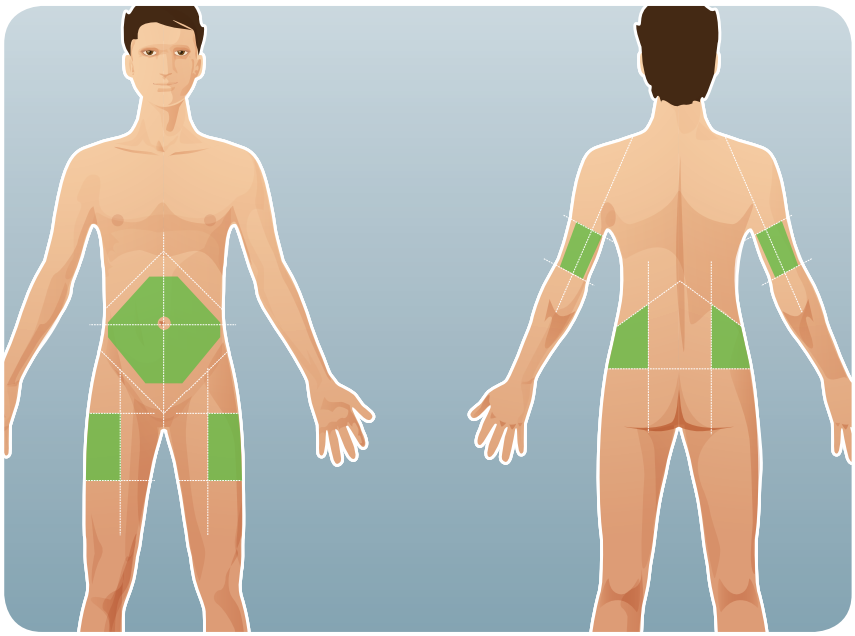


Figure 2:
Recommended injection sites.

A STRONGLY RECOMMENDED
B RECOMMENDED
C UNRESOLVED ISSUE

1 At least one rigorously performed study, peer-reviewed and published
2 At least one observational, epidemiologic or population-based study.
3 Consensus expert opinion based on extensive patient experience.

3.0 Injection Technique

3.2 Re-suspension of Cloudy Insulin

1 Cloudy insulins (e.g. NPH and pre-mixed insulins) must be gently rolled and inverted ten times each but not shaken until the crystals go back into suspension and the solution becomes milky white. Fig 4 and Fig 5 (79,80,81,82,83,84) A 2

2 Invert the pen or vial and roll (a full rotation cycle between the palms). Inversion and/or rolling should be performed a total of 20 times immediately before every injection with cloudy insulin. A 3

3 Visually confirm that the re-suspended insulin is sufficiently mixed after each rolling and inversion, and repeat the procedure if crystal mass remains in the cartridge. (82,83,85,86) A 2

4 Vigorous shaking should be avoided since this produces bubbles which reduce accurate dosing.(82,83,85) A 2

5 Store unopened insulin in a refrigerator where freezing is unlikely to occur, as per manufacturer's instructions. (87,88) A 2

6 After initial use, insulin (in pen, cartridge or vial) should be stored at room temperature for up to 30 days or according to manufactures recommendations and within expiry date. Pre-mixed insulin pens and some of the newer insulins may vary – check individual manufacturer's recommendations. (89,90) A 2

7 Storage of Insulin
Insulin IN USE should be stored below thirty degrees Celcius but do not refridgerate however, Insulin NOT IN USE should be stored in a refridgerator (two to eight degrees Celcius), do not freeze, do not expose to direct sunlight. It should be allowed to warm up for approximately fifteen minutes prior to use for the first time. (87,88) A 2

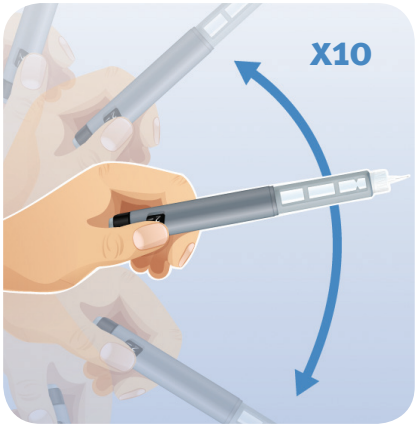


Figure 3: Re-suspension of cloudy insulin

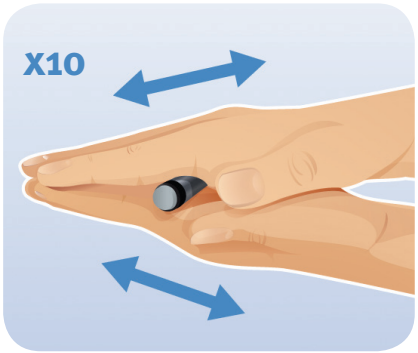


Figure 4: Re-suspension of cloudy insulin

3.0 Injection Technique

3.3 Needle Length

1 The 4mm pen needle inserted perpendicularly (at ninety degrees) is long enough to penetrate the skin and enter the subcutaneous tissue, with little risk of intramuscular (or intradermal) injection. Therefore it should be considered the safest pen needle for adults and children regardless of age, gender and Body Mass Index (BMI). (9,92,93,94,95) A 1

WARNING! Longer pen needles increase the chance of injecting into the muscle, therefore it is crucial to perfect the technique for the needle you are using or switch to short pen needles.

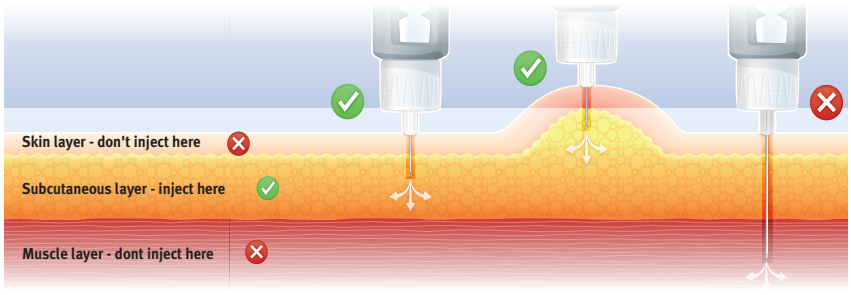


Figure 5: Intramuscular injection (IM)

2 The 4 mm pen needle may be used safely and effectively in all obese patients. Although it is the needle of choice for these patients, a 5mm needle may be acceptable. (96,97,98,99,100,101,102) A 1

3 The 4 mm pen needle should be inserted perpendicular (at 90 degrees) to the skin surface and not at an angle, regardless of whether a skin fold is raised. Fig 6 (103,104) A 1

4 Very young children (6-years old and under) and extremely thin adults (BMI<19) should use the 4mm needle by lifting a skin fold and inserting the needle perpendicularly into it.

Others may inject using the 4 mm needle without lifting a skin fold. (58,100,105,103) A 1

5 When any syringe needle is used in children, adolescents or slim to normal weight adults (BMI 19-25), injections should always be administered into a lifted skin fold. (57,58,53,106,93,100,101, 102,105,94,56,103,104,107,108, 109,110,111,112,113,114,115,116, 117,118,119,120,121,122,123,124, 125,126,127,128,129,130,131) A 1

6 Use of syringe needles in very young children (less than 6 years old) and extremely thin adults (BMI <19) is not recommended, even if they use a raised skin fold, because of the excessively high risk of intramuscular (IM) injections. (57,58,53,106,93, 100,101,102,105,94,56,103, 104,107,108,109,110,111,112, 113,114,115,116,117,118,119, 120,121,122,123,124,125,126, 127,128,129,130,131) A 1

7 Children still using the 5mm

A STRONGLY RECOMMENDED
B RECOMMENDED
C UNRESOLVED ISSUE

1 At least one rigorously performed study, peer-reviewed and published
2 At least one observational, epidemiologic or population-based study.
3 Consensus expert opinion based on extensive patient experience.

3.0 Injection Technique

pen needle should inject using a lifted skin fold. But children using pen needles ≥5mm should be changed to 4 mm pen needles if possible; and if not, should always use a lifted skin fold. (58,100,105,103) A 2

8 If arms are used for injections with needles ≥6mm long, a skinfold must be lifted, which requires injection by a third party. (103) A 2

9 Avoid indenting the skin by excessive pressure during injection, as the needle may penetrate deeper than intended and enter the muscle. B 3

10 Health care authorities and payers should be alerted to the risks associated with using syringe or pen needles ≥6mm in children. (35,106,110) A 2

3.4 Lifting a Skin Fold

1 Each injection site should be examined individually and a decision made as to whether lifting a skin fold is required, taking into account the needle length used. The recommendation should be provided to the patient in writing and documented in their care plan. A 3

2 The lifted skin fold should not be squeezed so tightly that it causes skin blanching or pain. Fig 7 A 3

3 The optimal sequence should be:
- Lift a skin fold;
- Inject insulin slowly at ninety degrees to the surface of the skin fold;
- Leave the needle in the skin for a count of 10 after the plunger is fully depressed (when injecting with a pen);
- Withdraw needle from the skin at the same angle it was inserted;
- Release skin fold;
- Dispose of used needle safely. A 3

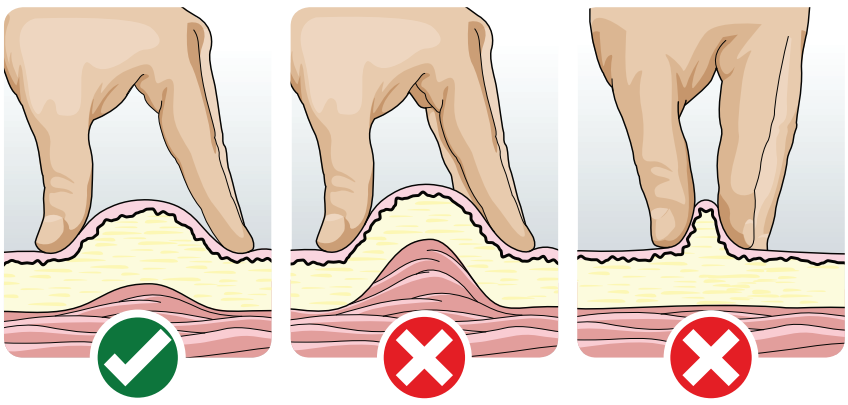


Figure 6: Correct (left) and incorrect (right) ways of performing the skin fold.

3.0 Injection Technique

3.5 Needle Reuse

1 Syringe or pen needles should only be used once. Reusing insulin needles is not optimal injection practice and patients should be discouraged from doing so. Fig 8 (1,68,78,132,133,134) A 2

2 There is an association between needle reuse and the presence of lipohypertrophy, with studies showing an increased presence of lipohypertrophy in patients who reuse needles. Patients should be made aware of this association (and also the association between reuse and pain or bleeding). (5,6,68,70,135) A 2

3.6 Rotation of Injecting Sites

1 Injections should be systematically rotated in such a way that they are spaced at least 1cm from each other in order to avoid repeat tissue trauma. Fig 9 (90,136,47,137) A 2

2 One scheme with proven effectiveness involves dividing the injection site into quadrants using one per week and moving quadrant to quadrant in a consistent direction (e.g. clockwise). Fig 10 (138) A 3

3 Patients should be taught an easy-to-follow rotation scheme from the onset of injection therapy. This may be adjusted as needed while therapy progresses. The HCP should review the site rotation scheme with the patient at least once a year. (139,140,141,44,142,143, 144,145) A 1

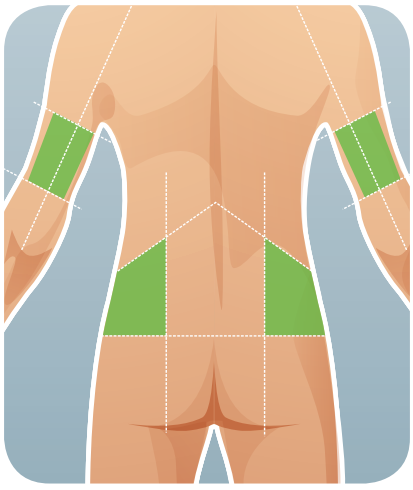


Figure 7: Injections within any quadrant should be spaced at least 1cm from each other.

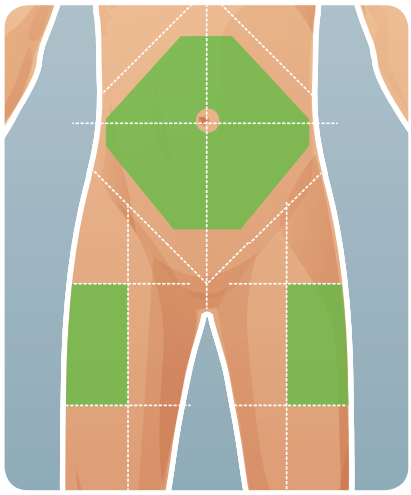


Figure 8: Sample structured rotation plan for abdomen and thighs. Divide the injection area into quadrants or zones. Use 1 zone per week and move clockwise.

A STRONGLY RECOMMENDED
B RECOMMENDED
C UNRESOLVED ISSUE

1 At least one rigorously performed study, peer-reviewed and published
2 At least one observational, epidemiologic or population-based study.
3 Consensus expert opinion based on extensive patient experience.

3.0 Injection Technique

3.7 Correct Use of Pens

1 Pens should be primed (using a two unit air shot) accordingaccording to the manufacturer's instructions before the injection in order to ensure there is unobstructed flow and to clear needle dead space. Once flow is verified, the desired dose should be dialled and the injection administered. (29,146) A 3

2 Pens and cartridges are for a single patient and should never be shared between patients due to the risk of biological material from one patient being drawn into the cartridge and then injected into another person. (30,32) A 2

3 Needles should be safely disposed of immediately after use and not left attached to the pen. This prevents the entry of air (or other contaminants) into the cartridge as well as the leakage of medication, either of which can affect dose accuracy. (30,33,147,148,149,150) A 2

4 Pen needles should be used only once. (62,63,68,106,151,152,153,154) A 2

5 The thumb button should only be touched once the pen needle is fully inserted. After that the button should be pressed along the axis of the pen, not at an angle. (155) A 2

6 After pushing the thumb button completely in, patients should count slowly to 10 before withdrawing the needle in order to get the full dose and prevent the leakage of medication. Fig 10 (79,33,147,149,156, 157, 199) A 1

7 Pressure should be maintained on the thumb button until the needle is withdrawn from the skin in order to prevent aspiration of patient tissue into the cartridge. (158,159) A 2

3.8 Correct Use of Syringes

1 When drawing up insulin from an insulin vial, the air equivalent to the dose (or slightly greater) should be drawn up first and injected into the vial to facilitate insulin withdrawal. Ensure that the syringe to be used is an INSULIN syringe. Use of any other type of syringe can cause serious harm. "All regular and single insulin (bolus) doses are measured and administered using an insulin syringe or commercial insulin pen device. Intravenous syringes must never be used for insulin administration" Rapid Response Report 2010. (253) A 3

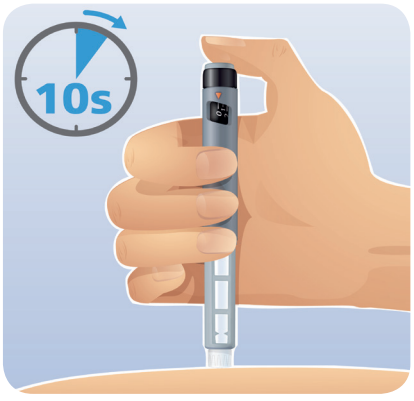


Figure 9: Count to 10 before removing pen

3.0 Injection Technique

2 If air bubbles are seen in the syringe, patients should tap the barrel to bring them to the surface and then remove the bubbles by pushing up the plunger. A 3

3 Unlike pens, it is not necessary to hold the syringe needle under the skin for a count of 10 after the plunger has been depressed.(33,147,157) A 3

4 Syringes must be used only once. Fig 11 (62,63,68,106,151,152,153,154) A 2

Figure 10: Syringes must be used only once

4.0 Injectable therapies

4.1 Human Insulins

1 Intramuscular (IM) injections of Neutral pH suspension of crystalline insulin, protamine and zinc (NPH) and long acting insulin must be strictly avoided due to the risk of hypoglycaemia. (160,161,162,163) A 1

2 The abdomen is the preferred site for soluble human insulin since absorption of this insulin is fastest there. (164,165,166,55,167,95) A 1

3 Soluble human insulin /NPH mix should be given in the abdomen to increase the speed of absorption of these short-acting insulins, in order to cover post-prandial glycaemic changes (56) A 1

4 If there is risk of nocturnal hypoglycaemia, NPH and soluble human insulin mixes given in the evening should be injected into the thigh or buttock as these sites have slower absorption of NPH. (168,169,170) A 1

4.2 Insulin Analogues and GLP-1 agents

1 Rapid-acting insulin analogues may be given at any of the injection sites, as absorption rates do not appear to be site-specific. (171,172,173,174,175) A 1

2 Rapid-acting analogues should be given subcutaneous and not IM. (172,173,176) A 2

3 Patients may inject long-acting insulin analogues in any of the usual injecting sites as absorption rates do not appear to be site specific. (107) B 2

4 Patients using non-insulin injectable therapies should follow the recommendations already established for insulin injections with regards to needle length, site selection and site rotation. (148,177) A 2

A STRONGLY RECOMMENDED
B RECOMMENDED
C UNRESOLVED ISSUE

1 At least one rigorously performed study, peer-reviewed and published
2 At least one observational, epidemiologic or population-based study.
3 Consensus expert opinion based on extensive patient experience.

5.0 Lipohypertrophy (LH)

Examination for Detection of Lipohypertrophy:

The following points ensure best practice and evidence based technique is used when performing physical examination for lipohypertrophy (LH). A good history take should always preceed physical examination. Once gained informed consent, the examination should be performed at least once a year on all persons injecting insulin. For those known to have LH lesions, the physical examination should be conducted more frequently. Fig 12

Figure 11: Examples of lipohypertrophy

5.1 Initiate consultation

1 Patient should be asked about abnormalities at injection sites (Introduce self to patient. Obtain informed consent. Take history); this should guide examinations but not limit it to one area.

2 Patient must disrobe to only underclothes to expose injection sites. An offer of chaperone should be made to patient and if needed the HCP may request a chaperone for the physical part of the consultation.

3 Light should be oblique to the skin (not overhead); the use of an examining light with an adjustable neck is ideal; light should be shined onto skin surfaces at an angle of 30-45 degrees.

4 Room must be warm to prevent patient chilling (this ensures patient comfort but also prevents shivering and muscle tension which can interfere with the examinations).

5 If there is no table, an alternative is for the patient to stand.

5.2 Examination Positioning of Patient

1 Patient should be in a supine position with one supporting pillow on an examination bed (to relax abdominal muscles) with knees bent (to relax thigh [quadriceps] muscles) and arms folded over chest (to relax arm muscles). (255, 256)

2 If the patient is frail then an alternative is for the patient to be sitting with knees bent and arms relaxed in lap.

3 Inspect site with lamp first, adjusting its angle to be able to detect any subtle risings or depressions across the surface of the skin.

5.0 Lipohypertrophy

4 Lipohypertrophy (LH) is usually manifested as a raised or mound-like, convex pattern with no change in skin colour or hair distribution; occasionally it can be manifested as only a shiny or hyper-pigmented (especially in dark-skinned persons) area and/or an area of hair loss.

5 If detected, gain consent and mark centre point with pen so that area can be palpated later.

Figure 12: Palpation technique

5.4 Technique of Palpation

1 Hands must be washed and warmed before touching patient.

2 After hands are warmed by rubbing them together or washing in warm water, apply gel (ultrasound gel or another water-soluble lubricant for clinical use) to the injecting area and palpate with the tips of the fingers, working in towards the injecting area with light massage-like motions (forward thrusts or circular sweeps). Fig. 13

3 Lipohypertrophy is manifest by a change in the subcutaneous (SC) tissue, which is replaced by a harder, and more rubbery or less bouncy tissue.

4 Often the edges of this abnormal area are clearly demarcated and it is easy to feel the transitional zone, which appears as a 'step-up' from the surrounding soft tissue.

5.5 Measuring and Documenting the Lipohypertrophy

1 With the patient's consent and using skin safe marker pen, mark the exact position of the lesion on the patient's skin so that the patient can clearly see the extent of the lesion and avoid injecting into it.

2 Measure the distance along its largest dimension (usually the longest diameter) in mm and record in patient's chart.

3 Photograph the lesion from a distance of 1 meter without flash, using the light from an oblique source so as to reveal surface contours once consent has been given.

4 Use the measurements and photograph to follow progression of the lesion long-term.

5 Patient should be taught to do the visual and palpation examination monthly (using soap or hand lotion as a lubricant) and to report any change to the HCP.

A STRONGLY RECOMMENDED
B RECOMMENDED
C UNRESOLVED ISSUE

1 At least one rigorously performed study, peer-reviewed and published
2 At least one observational, epidemiologic or population-based study.
3 Consensus expert opinion based on extensive patient experience.

5.0 Lipohypertrophy

5.6 Role of Ultrasound in Lipohypertrophy

1 Ultrasound (US) has been used in various LH studies but its exact role has yet to be defined, either for diagnosis or management of the disorder.

2 US appears to be more sensitive and specific than clinical examination in early clinical studies, but this remains to be confirmed.

3 An US 'signature' for LH may exist and ongoing studies are attempting to define the various image profiles of LH.

5.7 Management of Lipohypertrophy

1 Patients should be taught to inspect their own sites and should be given training in site rotation, correct injection technique as well as in detection and prevention of lipohypertrophy. (5,48,66, 67,69,72,73,44,142,178, 179,180,181,182,183,184, 185,186,84,187,188,189,190, 191,192,193) A 2

2 Patients should be encouraged by education and guidance not to inject into areas of lipohypertrophy until the next examination by an HCP. Advise using larger injection areas and do not reuse needles. (186,194,195,196,197) A 2

3 Switching injections from lipohypertrophic to normal tissue often requires a decrease in the dose of insulin injected. The amount of change varies from one individual to another and should be guided by frequent blood glucose measurements. (71,73,186,194,196) A 1

6.0 Injection Issues

6.1 Bleeding and Bruising

1 Patients should be reassured that local bleeding and bruising do not have adverse clinical consequences for the absorption of insulin or for overall diabetes management. Fig 13 (198) A 2

2 If bleeding and/or bruising are frequent or excessive, injection technique should be carefully assessed but this may be due to multiple factors that would need further investigation. A 3

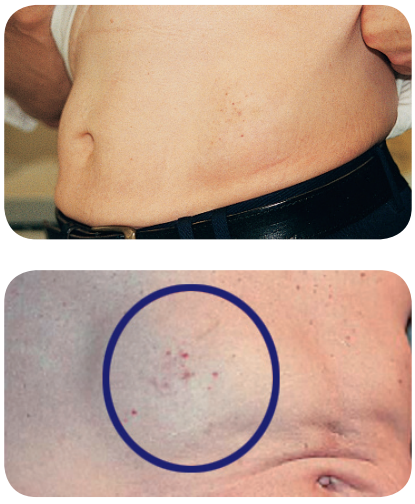


Figure 13: Cluster of injection punctures.

6.2 Leakage at Cartridge and Pen Needle (PN) Connection

1 Ensure that the pen needle(PN) is International Organization for Standardization (ISO) certified compatible with the insulin pen. A 3

2 Position the PN along the axis of the pen before screwing or snapping it on. A 3

3 Pierce straight through the septum of the cartridge. A 3

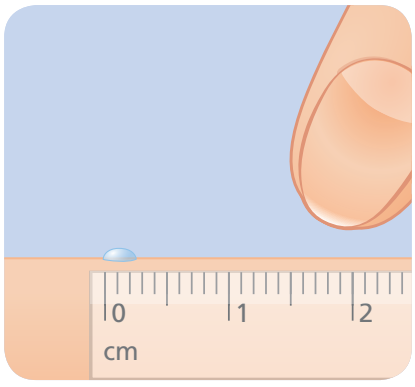


Figure 14:: A small amount of skin leakage can be ignored.

6.3 Skin Leakage

1 A small amount of skin leakage (little pearl of liquid at injection site) can be ignored. It is almost always clinically insignificant. (157,199,200) A 1

2 Use needles with thin-wall or extra thin-wall technology. (31,199,200,201) A 1

3 Count to 10 after the plunger is fully depressed before removing the needle from the skin. This allows enough time for the injected medication to spread out through the tissue planes and/or to cause the tissue to expand and stretch. (157,199,200) A 2

4 For patients who report frequent skin leakage, a direct observation of their self-injection is important to detect possible technique-related issues that can be modified. (157,199,200) A 2

A STRONGLY RECOMMENDED
B RECOMMENDED
C UNRESOLVED ISSUE

1 At least one rigorously performed study, peer-reviewed and published
2 At least one observational, epidemiologic or population-based study.
3 Consensus expert opinion based on extensive patient experience.

7.0 Pregnancy

7.1 Pregnant Women

1 The abdomen is a safe site for insulin administration in pregnancy. Given the thinning in abdominal fat from uterine expansion, pregnant women with diabetes (of any type) should use a 4 mm pen needle. B 3

2 First trimester: Women should be reassured that no change in insulin site or technique is needed. B 3

3 Second trimester: Lateral parts of the abdomen can be used to inject insulin, staying away from the skin overlying the foetus. Insulin can be injected over the entire abdomen as long as properly raised skinfolds are used B 3

4 Third Trimester: Injections can be given into the lateral abdomen as long as they are made into properly raised skinfolds. B 3

5 Apprehensive patients may use the thigh, upper arm, or buttock instead of the abdomen. B 3

Figure 15. Recommended injection sites during the third trimester of pregnancy

8.0 Technology

8.1 Needle Inner Diameter

1 High flow rate needles (extra-thin wall) needles have been shown to be appropriate for all injecting patients. Their obstruction, bending and breakage rates are the same as for conventional quality needles (extremely low), and they offer distinct flow advantages. Fig 15 A 3

2 Needles with 5 bevel technology have been shown to require less pressure to insert and to be more comfortable to use. (242)

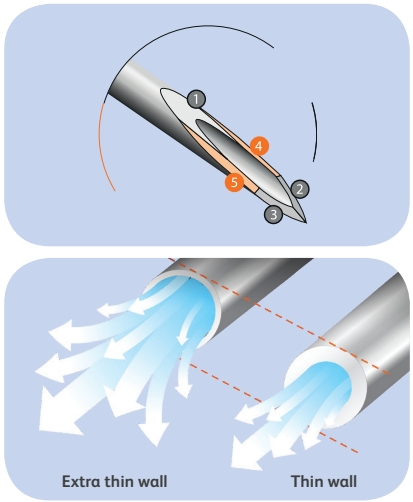


Figure 16: thin inner diameter needle v thick walled needle.

8.2 Insulin Infusion Sets (IIS) for Continuous Subcutaneous Insulin Infusion (CSII)

1 Population studies suggest that CSII cannulae should be changed every 48–72 hours in order to minimise infusion site adverse events and potential metabolic deterioration. (203,204,20,206) A 1

2 All CSII patients should be taught to rotate infusion sites along the same principles that injecting patients are taught to rotate injection sites. (183,207) A 1

3 Any CSII patients with unexplained glucose variability including frequent hypoglycaemia/hyperglycaemia should have infusion sites checked for lipohypertrophy, nodules, scarring, inflammation or other skin and subcutaneous (SC) conditions that could affect insulin flow or absorption. (207) A 1

4 All CSII patients should have their infusion sites checked frequently or at least annually for lipohypertrophy by an HCP. (205,208) A 1

5 If lipohypertrophy is suspected, the patient should be instructed to stop infusing into these lesions and to insert the cannula into healthy tissue. (71,145,186,194,195,196,197) A 1

6 Silent occlusion of insulin flow should be suspected in any patient with unexplained glucose variability or unexplained hyperglycaemia. (203,208,209,210,211) B 2

7 If silent occlusion or flow interuptions are suspected CSII patients should be considered for alternative cannulae. (203,205,209,212) A 1

8 All CSII patients should be considered for the shortest needle/cannula available, along the same principles as insulin injectors, to minimise the risk of intramuscular (IM) infusion. (212) B 2

A STRONGLY RECOMMENDED
B RECOMMENDED
C UNRESOLVED ISSUE

1 At least one rigorously performed study, peer-reviewed and published
2 At least one observational, epidemiologic or population-based study.
3 Consensus expert opinion based on extensive patient experience.

8.0 Technology

9 The smallest diameter needle/ cannula should be considered in CSII patients to reduce pain and the occurrence of insertion failure. (212) B 2

10 Angled insertion sets should be considered in CSII patients who experience infusion site complications with perpendicular (ninety degree) infusion sets. B 3

11 All CSII patients who experience a hypersensitivity reaction to cannula material or adhesive should be considered for alternative options (alternative sets, tapes or skin barriers). A 3

12 All CSII patients who are lean, muscular or active and have a high probability of the cannula or tubing being dislodged may benefit from an angled infusion set (30-45 degree). (213) C 3

13 All CSII patients who have difficulty inserting their infusion set manually for any reason should insert their infusion sets with the assistance of a mechanical insertion device. (213) C 3

14 All CSII patients who become pregnant may require adjustments to their infusion sets, site locations and frequency of site changes. B 3

9.0 Safety

9.1 Needlestick Injuries/ Blood-borne Infection Risk

1 Safety-engineered devices play a critical role in protecting injectors, pump users and downstream workers, for example refuse workers, cleaners and porters. Nurses and other HCPs must receive appropriate education and training in how to minimize risk, by following optimal techniques, using available safety devices and wearing protective clothing (e.g., gloves). (214) A 1

2 Safety-engineered devices should be considered first-line choice if injections are given by a third party. Pen and syringes with needles used in these settings should have protective mechanisms for all needles and sharp ends of the delivery device. (215,216,217,218,219, 220,221,222,223,224) A 2

3 The use of safety-engineered devices should be considered for certain autonomous home-injecting patients with diabetes (e.g. those known to be seropositive for Human Immunodeficiency Virus (HIV), Hepatitis B Virus (HBV) and Hepatitis C Virus (HCV), children injecting at school, care homes and prisons). (216,225,226,227) B 2

4 Patients with small children at home and/or sub-optimal sharps disposal options should also consider using safety-engineered devices. (215,217,218,220,221,228) B 2

5 HCPs should be involved in the selection, trial and choice of devices used in their health care setting. Evaluation prior to adoption should include key specialists (e.g. experienced end users, infection prevention and control and occupational health). (229,215) A 1

6 Health care settings where insulin pens are used must follow a strict one-patient / one-pen policy. (230) A 2

7 The optimal safety-engineered device should provide protection for patients, care-givers and all others who may come in contact with the sharp device. (215,216,217,218,219,22 0,221,222,223, 224) A 1

8 Manufacturers must investigate all reported needlestick injuries (NSI) to determine if they are related to a device failure. A 3

A STRONGLY RECOMMENDED
B RECOMMENDED
C UNRESOLVED ISSUE

1 At least one rigorously performed study, peer-reviewed and published
2 At least one observational, epidemiologic or population-based study.
3 Consensus expert opinion based on extensive patient experience.

9.0 Safety

9 The use of shorter needles (e.g. 4 mm pen needles) without a skin fold is recommended to minimize the the risk of needlestick injury (NSI) through a skin-fold. (93,102,130,231) A 2

10 If a lifted skin fold is used, the patient should ensure that finger and thumb are approximately 2.5cm (1 inch) apart and should make the injection in the centre of the fold thus minimizing through-skinfold NSI risk. (231) A 2

11 NSI awareness campaigns should be carried out regularly and should include all persons in potential contact with medical sharps. (217,218,219,220,232,233) A 1

12 Needle recapping should not be done and manufacturers should design safety-engineered devices which make recaping impossible. Fig16 and Fig 17 (215,217,218,220,221) A 1

13 Hospitals and other settings must report of NSI and near misses and establish a 'no blame' culture. Central review of all NSI/near misses must take place regularly to allow for policy change and assess educational needs. (215,217,218,220,221) A 1

14 Review and evaluation of the effectiveness of education and training and of compliance to guidelines must be performed at regular intervals. A reporting system for non-compliance must be put in place. (215,216,217,218,219,220,221,222,223,224) A 2

15 Attention must be paid to the use of safety-engineered devices. If they are used incorrectly or not activated, they provide no additional risk reduction over conventional (non-safety) devices (may lead to dosing errors). (215,216,217,218,219,220,221,222,223,224) A 1

Figure 17: Safety syringe

Figure 18: Safety pen needle

9.0 Safety

16 Sharps containers must be easily accessible at the point of care beside the patient, prior to the injection or infusion. Containers should bear the warning, 'Needles can seriously damage the health of others. Please ensure safe disposal' or similar. Fig 18 (215,217,218,220,221,228) A 2

17 While Hepatitis B Virus (HBV) vaccination should be population-wide, the minimum standard is its mandatory offering by the employer to all workers exposed to sharps. Vaccination status should be reviewed annually. (234) A 1

18 First aid information 'what to do in the event of a NSI' should be readily available. All workers in possible contact with sharps should be aware of local safety and disposal regulations. Legal, societal and health related consequences of non-compliance should be reviewed. (135) A 2

19 Safe disposal should be taught to patients, care-givers and all others who may come in contact with the sharp device from the beginning of injection or infusion therapy and reinforced throughout. (136) A 2

20 Potential adverse events of NSIs should be emphasized to the patients' family, caregivers and service providers (e.g. refuse collectors and cleaners). A 3

21 Under no circumstance should sharps material be disposed of into the public refuse or rubbish system. A 3

Figure 19: Sharps container

References

1 De Coninck C., Frid A., Gaspar R., Hicks D., Hirsch L., Kreugel G., Liersch J., Letondeur C., Sauvanet J-P., Tubiana N., Strauss K. Results and analysis of the 2008-2009 Insulin Injection Technique Questionnaire survey. Journal of Diabetes 2 (2010) 168-179

2 Diabetes facts and stats revised :November 2015, Next Review May 2016 Diabetes UK https://www.diabetes.org.uk/Documents/Position%20statements/Diabetes%20UK%20Facts%20and%20Stats_Dec%202015.pdf

3 Kostev Insulin Therapy in Type 2 Diabetes: A Reflection Upon the State of the Art Today, and the Potential Journeys yet to Come The American Journal of Medicine Volume 127, Issue 10, Supplement, October 2014, Pages S39–S48

4 About type 1 Diabetes .2015 : https://jdrf.org.uk/about-type-1-diabetes/

5 Blanco M,. Hernández M.T., Strauss K,. Amaya M. Prevalence and risk factors of lipohypertrophy in insulin-injecting patients with diabetes. Diabetes & Metabolism 39 (2013) 445–453

6 Giorgio Grassi, MD, Paola Scuntero, RN , Rosalba Trepiccioni, RN,Francesca Marubbi, PhD, Kenneth Strauss, MD. Optimizing insulin injection technique and its effect on blood glucose control. Journal of Clinical & Translational Endocrinology. Journal of Clinical & Translational Endocrinology. 2014. 1: p145-150

7 Meece J. Dispelling myths and removing barriers about insulin in type 2 diabetes. Diabetes Educator 2006;32:9S-18S.

8 Davis SN, Renda SM. Psychological insulin resistance: overcoming barriers to starting insulin therapy. Diabetes Educator 2006;32:146S-152S.

9 Karlegärd M, Eldholm S, Lindblad B, Sigström L. Stickrädsla hos barn och ungdomar med diabetes (Fear of injection in children and adolescents with diabetes). Sv Läkaresällskapets Handlingar Hygiea 2001;110:301(32P).

10 Cocoman A, Barron C. Administering subcutaneous injections to children: what does the evidence say? Journal Child Young People Nurs 2008;2:84-89.

11 Zambanini A, Newson RB, Maisey M, Feher MD. Injection related anxiety in insulin-treated diabetes. Diab Res Clin Pract 1999;46:239-46.

12 Polonsky WH, Fisher L, Guzman S, Villa-Caballero L, Edelman SV. Psychological insulin resistance in patients with type 2 diabetes: the scope of the problem. Diabetes Care. 2005;28(10):2543-5.

13 Brady KA, Avner JR, Khine H. Perception and attitude of providers towards pain and anxiety associated with pediatric vaccine injection. Clinical Pediatrics. 2011;50(2):140-143.

14 Larkin ME, Capasso VA, Chen C, et al. Measuring psychological insulin resistance: barriers to insulin use. Diabetes Educat. 2008; 34(3):511-17.

15 Mollema ED, Snoek FJ, Heine RJ. Assessment of perceived barriers in self-care of insulin-requiring diabetic patients. Patient Educ Counsel. 1996;29(3):277-81.

16 Mollema ED, Snoek FJ, Ader HJ, et al. Insulin-treated diabetes patients with fear of self-injecting or fear of self-testing: psychological comorbidity and general well-being. J Psychosom Res. 2001;51(5):665-72.

17 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 Oct;33(10):2178-80.

18 Polonsky WH, Jackson R. What's so tough about taking insulin? Addressing the problem of psychological insulin resistance in type 2 diabetes. Clin Diab. 2004;22(3):147-150.

19 Reach G. Patient non-adherence and healthcare-provider inertia are clinical myopia. Diab Metab 2008;34:382-385.

20 Genev NM, Flack JR, Hoskins PL, et al. Diabetes education; whose priorities are met? Diab Med 1992; 9: 475-479.

21 Davidson M. No need for the needle (at first). Diabetes Care 2008;31:2070-2071.

22 Hofman, Paul. Personal Communication.

23 Pergallo-Dittko, V. Rethinking subcutaneous injection technique. Amer J Nursing. 1997, 97(5):71-72.

24 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.

25 Hanas SR, Carlsson S, Frid A, Ludvigsson J. Unchanged insulin absorption after 4 days´use of subcutaneous indwelling catheters for insulin injections. Diabetes Care 1997;20:487-490.

26 Hanas R, Adolfsson P, Elfvin-Akesson K, Hammaren L, Ilvered R, Jansson I, Johansson C, et al. Indwelling catheters used from the onset of diabetes decrease injection pain and pre-injection anxiety. J Pediatr 2002;140:315-20.

27 Burdick P, Cooper S, Horner B, Cobry E, McFann K, Chase HP. Use of a subcutaneous injection port to improve glycemic control in children with type 1 diabetes. Pediatr Diab 2009;10:116-9.

28 Klonoff DC The pen is mightier than the needle (and syringe). Diab Tech Ther 2001;3:631-3.

29 Bohannon NJ. Insulin delivery using pen devices. Simple-to-use tools may help young and old alike. Postgrad Med 1999;106:57-58.

30 Bärtsch U, Comtesse C, Wetekam B. Insulin pens for treatment of diabetes (article in German). Ther Umsch 2006;63:398-404.

31 Aronson R, Gibney MA, Oza K, Bérubé J, Kassler-Taub K, Hirsch L. Insulin pen needles: effects of extra-thin wall needle technology on preference, confidence, and other patient ratings. Clin Ther. 2013 Jul;35(7):923-933.

32 Le Floch JP, Herbreteau C, Lange F, Perlemuter L. Biologic material in needles and cartridges after insulin injection with a pen in diabetic patients. Diabetes Care 1998;21:1502-1504.

33 Ginsberg BH. Parkes JL, Sparacino C. The kinetics of insulin administration by insulin pens. Horm Metab Research 1994;26:584-587.

34 American Diabetes Association: Insulin administration (Position Statement). Diabetes Care 20 (Suppl. 1):S46–S49, 1997

35 Ruggiero L, Glasgow RE, Dryfoos JM, Rossi JS, Prochaska JO, Tracy Orleans C, Prokhorov AV, Rossi SR, Greene GW, Reed GR, Kelly K, Chobanian L, Johnson S: Diabetes self-management: self-re ported recommendations and patterns in a large population. Diabetes Care 20:568–576, 1997

36 Ginsberg BH, Parkes JL, Sparacino C: The kinetics of insulin delivery by pens in full thickness pigskin (Abstract). Diabetes 4 2 (Suppl. 1):206A, 1993

37 Fleming DR, Jacober SJ, Vandenberg MA, Fitzgerald JT, Grunberger G: The safety of injecting insulin through clothing. Diabetes Care 20:244–247, 1997

38 Rathod M, Saravolatz L, Pohlod D, Whitehouse FJ, Goldman H: Evaluation of the sterility and stability of insulin from multidose vials used for prolonged periods. I n f e c t Control 6:491–494, 1985

39 Goldstein S, Moerman EJ, Soeldner JS: Diabetes mellitus and genetic pre diabetes :decreased replicative capacity of culture skin fiboblasts. J Clin Invest63:358–370, 1979

40 Kohn RR, Hamlin CR: Genetic effects on aging collagen with special reference to diabetes mellitus. Birth Defects 14:387 –401 ,1978

41 Hunt LM, Valenzuela MA, Pugh JA: NIDDM patients' fears and hopes about insulin therapy. Diabetes Care20:292–298, 1997

42 Lelie PN, Zaaijer HL, Cuypers HT: Risk of virus transmission by tissue, blood, and plasma products. Transplant Pro c28:2939, 1996

43 Collins BJ, Spence BK, Richardson SG, Hunter J, Nelson JK: Safety of reusing disposable plastic insulin syringes. Lance t i:559–561, 1983

44 Vardar B, Kizilci S. Incidence of lipohypertrophy in diabetic patients and a study of influencing factors. Diab Res Clin Pract 2007;77:231-6.

45 Overland J, Molyneaux L, Tewari S, Fatouros R, Melville P, Foote D, Wu T, Yue D K. Lipohypertrophy: does it matter in daily life? A study using acontinuous glucose monitoring system. Diabetes, Obesity and Metabolism. 2009;11:460–463.

46 Famulla S, et. al. Lipohypertrophy Leads to Blunted, More Variable Insulin Absorption and Action in Patients with Type 1 Diabetes. Diabetes. 2015; 64 (suppl1). Poster presented at ADA meeting, Boston, MA. June 2015.

47 Davis ED, Chesnaky P. Site rotation. Taking insulin. Diabetes Forecast. 1992;45(3):54-56..

48 Joy SV. Clinical pearls and strategies to optimize patient outcomes. Diabetes Educator 2008;34:54S-59S.

49 Heinemann L, Hompesch M, Kapitza C, Harvey NG, Ginsberg BH, Pettis RJ. Intradermal insulin lispro application with a new microneedle delivery system led to a substantially more rapid insulin absorption than subcutaneous injection. Diabetologia 2006;49:755, abstract 1014.

50 DiMatteo RM, DiNicola DD, eds. Achieving patient compliance. The psychology of medical practitioner´s role. Oxford: Pergamon Press Inc. 1982, 233-256.

51 Seyoum B, Abdulkadir J. Systematic inspection of insulin injection sites for local complications related to incorrect injection technique. Trop Doct 1996;26:159-161.

52 Ariza-Andraca CR, Altamirano-Bustamante E, Frati-Munari AC, Altamirano-Bustamante P, Graef-Sanchez A. Delayed insulin absorption due to subcutaneous edema. Arch Invest Med 1991;22:229-233.

53 Vaag A, Damgaard Pedersen K, Lauritzen M, Hildebrandt P, Beck-Nielsen H. Intramuscular versus subcutaneous injection of unmodified insulin; consequences for blood glucose control in patients with type 1 diabetes mellitus. Diabetic Med. 1990;7(4): 335-342.

54 Hildebrandt P. Subcutaneous absorption of insulin in insulin-dependent diabetic patients. Influences of species, physico-chemical properties of insulin and physiological factors. Dan Med Bull. 1991;38(4):337-346.

55 Zehrer C, Hansen R, Bantle J. Reducing blood glucose variability by use of abdominal insulin injection sites. Diabetes Educator 1985;16:474-477.

56 Frid A, Gunnarsson R, Güntner P, Linde B. Effects of accidental intramuscular injection on insulin absorption in IDDM. Diabetes Care 1988;11:41-45.

57 Hofman PL, Derraik JG, Pinto TE, et al. Defining the ideal injection techniques when using 5-mm needles in children and adults. Diabetes Care. 2010 Sep;33(9):1940-4.

58 Birkebaek N, Solvig J, Hansen B, Jorgensen C, Smedegaard J, Christiansen J. 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;22: e65.

59 De Meijer PHEM, Lutterman JA, van Lier HJJ, van´t Laar A. The variability of the absorption of subcutaneously injected insulin; effect of injection technique and relation with brittleness. Diabetic Med 1990;7: 499-505.

60 Baron AD, Kim D, Weyer C. Novel peptides under development for the treatment of type 1 and type 2 diabetes mellitus. Curr Drug Targets 2002;2:63-82.

61 Gorman KC. Good hygiene versus alcohol swabs before insulin injections (Letter). Diabetes Care 1993;16:960-961.

62 Danish Nurses Organization. Evidence-based Clinical Guidelines for Injection of Insulin for Adults with Diabetes Mellitus, 2nd edition, December 2006.

63 Association for Diabetes care Professionals (EADV). Guideline: The Administration of Insulin with the Insulin Pen. September 2008.

64 McCarthy JA, Covarrubias B, Sink P. Is the traditional alcohol wipe necessary before an insulin injection? Dogma disputed (Letter). Diabetes Care 1993;16:402.

65 Swahn Å. Erfarenheter av 94000 osterilt givna insulininjektioner (Experiences from 94000 insulin injections given without skin swab). Sv Läkaresällskapets Handlingar Hygiea 1982;92:160(30).

66 Fujikura J, Fujimoto M, Yasue S, et.al. Insulin-induced lipohypertrophy: report of a case with histopathology. Endocr J. 2005 Oct;52(5):623-8.

67 Fernqvist-Forbes E, Linde B. Insulin absorption, glucose homeostasis, and lipolysis in IDDM during mental stress. Diabetes Care. 1991 Nov;14(11):1006-12.

68 Schuler G, Pelz K, Kerp L. Is the reuse of needles for insulin injection systems associated with a higher risk of cutaneous complications? Diab Res Clin Pract 1992;16:209-212.

69 Franzen I, J. Ludvigsson. Specific instructions gave reduction of lipomas and improved metabolic control in diabetic children. Diabetologia. 1997;40, Supplement 1: A615 (1997).

70 Johansson U, Amsberg S, Hannerz L, Wredling R, Adamson U, Arnqvist HJ, Lins P. Impaired Absorption of insulin Aspart from Lipohypertrophic Injection Sites. Diabetes Care 2005;28:2025-2027.

71 Saez-de Ibarra L, Gallego F. Factors related to lipohypertrophy in insulin-treated diabetic patients; role of educational intervention. Pract Diab Int 1998;15:9-11.

72 Young RJ, Hannan WJ, Frier BM, Steel JM, et al. Diabetic lipohypertrophy delays insulin absorption. Diabetes Care 1984;7:479-480.

73 Chowdhury TA, Escudier V. Poor glycaemic control caused by insulin induced lipohypertrophy. Brit Med J 2003;327:383-384.

74 Johansson UB. Impaired absorption of insulin aspart from lipohypertrophic injection sites. Diabetes Care 2005;28:2025-7.

75 Overland J, Molyneaux L, Tewari S., et al. Lipohypertrophy : Does it matter in daily life? A study using a continuous glucose monitoring system. Diab, Obes Metab 2009;11:460-3.

76 Frid A, Linden B. Computed tomography of injection sites in patients with diabetes mellitus. Injection and Absorption of Insulin. Stockholm : Thesis, 1992.

77 Tandon N, Kalra S, Balhara YS, Baruah MP, Chadha M, Chandalia HB, Chowdhury S, Jothydev K, Kumar PK, MadhuS, Mithal A, Modi S, Pitale S, Sahay R, Shukla R, Sundaram A, Unnikrishnan AG, Wangnoo SK. Forum for Injection Technique (FIT), India: The Indian recommendations 2.0, for best practice in Insulin Injection Technique, 2015. Indian J Endocr Metab 2015;19:317-31.

78 Gentile S, Agrusta M, Guarino G, Carbone L, Cavallaro V, Carucci I, Strollo F. Metabolic consequences of incorrect insulin administration techniques in aging subjects with diabetes. Acta Diabetol. 2011 Jun;48(2):121-5. doi: 10.1007/s00592-009-0172-x. Epub 2010 Jan 21.

79 King L. Subcutaneous insulin injection technique. Nurs Stand. 2003;17:45-52.

80 Jehle PM, Micheler C, Jehle DR, Breitig D, Boehm BO. Inadequate suspension of neutral protamine Hagendorn (NPH) insulin in pens. Lancet 1999;354:1604-1607.

81 Brown A, Steel JM, Duncan C, Duncun A, McBain AM. An assessment of the adequacy of suspension of insulin in pen injectors. Diab Med 2004;21:604-608.

82 Nath C. Mixing insulin: shake, rattle or roll? Nursing 2002;32:10.

83 Springs MH. Shake, rattle, or roll?..."Challenging traditional insulin injection practices" Am J Nursing 1999;99:14.

84 Ter Braak EW, Woodworth JR, Bianchi R, et al. Injection site effects on the pharmacokinetics and glucodynamics of insulin lispro and regular insulin. Diabetes Care. 1996;19(12):1437-1440.

85 Kaiser P, Maxeiner S, Weise A, Nolden F, Borck A, Forst T, Pfützner A. Assessment of the mixing efficiency of neutral protamine Hagedorn cartridges. J Diabetes Sci Technol. 2010 May 1;4(3):652-7.

86 Kawasaki E, Asakura T, Karasawa H, Yohkoh N. Examination of the Suspensibility of Insulin Suspensions in Clinical Use. (in Japanese only) J Japan Diab Soc. 2012;55(10):753-760.

87 Diabetes UK. Insulin Storage. Available: https://www.diabetes.org.uk/Guide-to-diabetes/Teens/Me-and-my-diabetes/Getting-my-glucose-right/Insulin/Storage/ Accessed June 15, 2016

88 Independent Diabetes Trust http://www.iddt.org/about/living-with-diabetes/storing-insulin Accessed June June 15, 2016

89 Ahern J, Mazur ML. Site rotation. Diabetes Forecast 2001;54:66-68.

90 Perriello G, Torlone E, Di Santo S, Fanelli C, De Feo P, Santusanio F, et al. Effect of storage temperature on pharmacokinetics and pharmadynamics of insulin mixtures injected subcutaneously in subjects with type 1 (insulin-dependent) diabetes mellitus. Diabetologia 1988;31:811 -815.

91 Becker D. Individualized insulin therapy in children and adolescents with type 1 diabetes. Acta Paediatr. 1998;87(Suppl 425):S20-S24.

92 Uzun S, Inanc N, Azal S. Determining optimal needle length for subcutaneous insulin injection. J Diab Nursing. 2001;5(10):83-87.

93 Hirsch L, Klaff L, Bailey T, Gibney M, Albanese J, Qu S, Kassler-Taub K. Comparative glycemic control, safety and patient ratings for a new 4 mm\32G insulin pen needle in adults with diabetes Curr Med ResOpin 2010;26(6):1531–1541.

94 Laurent A, Mistretta F, Bottigioli D, 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(34):6423-30.

95 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;37:377-340.

96 Miwa T, Itoh R, Kobayashi T, et al. Comparison of the effects of a new 32-gauge 4-mm pen needle and a 32-gauge 6-mm pen needle on glycemic control, safety, and patient ratings in Japanese adults with diabetes. Diab Tech Ther. 2012 Dec;14(12):1084-90.

97 Nagai Y, Ohshige T, Arai K, Kobayashi H, Sada Y, Ohmori S. Comparison between shorter straight and thinner microtapered insulin injection needles. Diab Tech Ther. 2013;15(7):550-555.

98 Hirose T, Ogihara T, Tozaka S, Kanderian S, Watada H. Identification and comparison of insulin pharmacokinetics injected with a new 4-mm needle vs 6- and 8-mm needles accounting for endogenous insulin and C-peptide secretion kinetics in non-diabetic adult males. J Diab Invest. 2013 May 6;4(3):287-96.

99 Bergenstal RM, Strock ES, Peremislov D, et al. Safety and efficacy of insulin therapy delivered via a 4mm pen needle in obese patients with diabetes. Mayo Clin Proc. 2015;90(3):329-338.

100 Tubiana-Rufi N, Belarbi N, Du Pasquier-Fediaevsky L, et al. Short needles (8 mm) reduce the risk of intramuscular injections in children with type 1 diabetes. Diabetes Care. 1999;22(10):1621-1625.

101 Kreugel G, Keers JC, Kerstens MN, Wolffenbuttel BH. Randomized trial on the influence of the length of two insulin pen needles on glycemic control and patient preference in obese patients with diabetes. Diabetes Technol Ther. 2011;13(7):737-741.

102 Schwartz S, Hassman D, Shelmet J, et al. A multicenter, open-label, randomized, two-period crossover trial comparing glycemic control, satisfaction, and preference achieved with a 31 gauge x 6mm needle versus a 29 gauge x 12.7mm needle in obese patients with diabetes mellitus. Clin Ther. 2004;26(10):1663-1678.

103 Hildebrandt P. Skinfold thickness, local subcutaneous blood flow and insulin absorption in diabetic patients. Acta Physiol Scand. 1991;603:41-45.

104 Hofman PL, Lawton SA, Peart JM, et al. An angled insertion technique using 6-mm needles markedly reduces the risk of intramuscular injections in children and adolescents. Diabet Med. 2007 Dec;24(12):1400-

105 Polak M, Beregszaszi M, Belarbi N, et al. Subcutaneous or intra-muscular injections of insulin in children: Are we injecting where we think we are? Diabetes Care. 1996;19(12):1434-1436.

106 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.

107 Owens DR, Coates PA, Luzio SD, Tinbergen JP, Kurzhals R. Pharmacokinetics of 125I-labeled insulin glargine (HOE 901) in healthy men: comparison with NPH insulin and the influence of different subcutaneous injection sites. Diabetes Care 2000;23:813-9.

108 Thow JC, Johnson AB, Fulcher G, Home PD. Different absorption of Isophane (NPH) insulin from subcutaneous and intramuscular sites suggests a need to reassess recommended insulin injection technique. Diabet Med 1990: 7: 600–602.

109 Kolendorf K, Bojsen J, Deekert T. Clinical factors influencing the absorption of 125 I-NPH insulin in diabetic patients. Horm Metab Res 1983: 15: 274–278.

110 Hildebrandt P, Sestoft L, Nielsen SL.The absorption of subcutaneously injected short-acting soluble insulin: influence of injection technique and concentration. Diabetes Care 1983: 6: 459–462.

111 Matsumura M, Monden Y, Nakatani T et al. Improvement of glycemic control by reeducation in insulin injection technique. Diabetes 2007: 56: Abstract 0157-OR.

112 Thow JC, Home PD. Insulin injection technique: depth of injection is important. Br Med J 1990: 301: 3–4.

113 Lasagni C, Seidenari S. Echographic assessment of age-dependent variations of skin thickness. Skin Res Technol 1995: 1: 81–85.

114 Swindle LD, Thomas SG, Freeman M, Delaney PM. View of normal human skin in vivo as observed using fluorescent fiber-optic confocal microscopic imaging. J Invest Dermatol 2003: 121: 706–712.

115 Huzaira M,Rius F, RajadhyakshaM,Anderson RR, Gonz´alez S. Topographic variations in normal skin, as viewed by in vivo reflectance confocal microscopy. J Invest Dermatol 2001: 116: 846–852.

116 Tan CY, Statham B, Marks R, Payne PA. Skin thickness measured by pulsed ultrasound: its reproducibility, validation and variability. Br J Dermatol 1982: 106: 657–667.

117 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.CurrMed ResOpin 2010: 26: 1519–1530.

118 Birkebaek NH, Johansen A, Slovig J. Cutis/subcutis thickness at insulin injection sites and localization of simulated insulin boluses in children with type 1diabetes mellitus: need for individualization of injection technique? Diabet Med 1998: 15: 965–971.

119 Frid A, Lind´en B. Where do lean diabetics inject their insulin? A study using computed tomography. Br Med J 1986: 292: 1638.

120 Burbridge BE. Computed tomographic measurement of gluteal subcutaneous fat thickness in reference to failure of gluteal intramuscular injections. Can Assoc Radiol J 2007: 58: 72–75.

121 Seidenari S, Giusti G, Bertoni L, Magnoni C, Pellacani G. Thickness and echogenicity of the skin in children as assessed by 20-MHz ultrasound. Dermatology 2000: 201: 218–222.

122 Smith CP, Sargent MA, Wilson BP, Price DA. Subcutaneous or intramuscular insulin injections. Arch Dis Child 1991: 66: 879–882.

123 Cash CJC, Berman LH, Treece GM, Gee AH, Prager RW. Two- and three-dimensional ultrasound in the development of a needle-free injection system. Br J Radiol 2004: 77: 236–242.

124 Schou AJ, Thomsen K, Plomgaard AM, Wolthers OD. Methodological aspects of high-frequency ultrasound of skin in children. Skin Res Technol 2004: 10: 200–206.

125 Poland GA, Borrud A, Jacobson RM et al. Determination of deltoid fat pad thickness, implications for needle length in adult immunization. JAMA 1997:277: 1709–1711.

126 Ploin D, Schwarzenbach F, Dubray C et al. Echographic measurement of skin thickness in sites suitable for intradermal vaccine injection in infants and children. Vaccine 2011: 29: 8438–8442.

127 Tubiana-Rufi N, Belarbi N, Du Pasquier-Fediaevsky L et al. Reduction of the risk of intra-muscular insulin injection with the 8mm length needles in thin diabetic children. Diabetologia 1998: 41 (Suppl. 1): A 247.

128 Tafeit E, M¨oller R, Jurimae T, Sudi K, Wallner SJ. Subcutaneous adipose tissue topography (SATTop) development in children and young adults. Coll Antropol 2007: 31: 395–402.

129 Birkebaek NH, Solvig J, Hansen B, Jorgensen 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. doi: 10.2337/dc08-0977.

130 Strauss K, Hannet I, McGonigle J et al. Ultrashort (5mm) insulin needles: trial results and clinical recommendations. Pract Diab Int. 1999: 16: 22–25..

131 Kreugel G, Beijer HJM, Kerstens MN, ter Maaten JC, Sluiter WJ, Boot BS. Influence of needle size for SC insulin administration on metabolic control and patient acceptance. Eur Diabetes Nurs 2007: 4: 1–5.

132 Misnikova I, Dreval A, Gubkina V, Rusanova E. The risk of repeated use of insulin pen needles in patients with diabetes mellitus. J Diabetology. 2011, 1:1-5.

133 Thomas DR, Fischer RG, Nicholas WC, Beghe C, Hatten KW, Thomas JN. Disposable insulin syringe reuse and aseptic practices in diabetic patients. J Gen Intern Med. 1989;4(2):97-100.

134 Puder J, Atar M, Muller B, Pavan M, Keller U. Using insulin pen needles up to five times does not affect needle tip shape nor increase pain intensity. Diab Res Clin Pract. 2005;67(2):119–123.

135 Hirsch L, Ji L, Sun Z, Li Q, et al. Lipohypertrophy – Prevalence, risk factors and clinical characteristics of insulin-requiring patients in China. Diabetes Technol Ther. 2015;17(Suppl 1):A57-A58

136 Bantle JP, Weber MS, Rao SM, Chattopadhyay MK, Robertson RP. Rotation of the anatomic regions used for insulin injections and day-to-day variability of plasma glucose in type 1 diabetic subjects. JAMA. 1990;263(13):1802-1806.

137 Fitter4Diabetes website. http://www.fitter4diabetes.com. Accessed June 7, 2016.

138 Diagrams courtesy of Lourdes Saez-de Ibarra and Ruth Gaspar, Diabetes Nurses and Specialist Educators from La Paz Hospital, Madrid, Spain

139 Lumber T. Tips for site rotation. When it comes to insulin. where you inject is just as important as how much and when. Diabetes Forecast 2004;57:68-70.

140 Thatcher G. Insulin injections. The case against random rotation. Am J Nursing 1985;85:690-692.

141 Nielsen BB, Musaeus L, Gæde P.. Attention to injection technique is associated with a lower frequency of lipohypertrophy in insulin treated type 2 diabetic patients. Abstract European Association for the Study of Diabetes, Barcelona, Spain, 1998.

142 Teft G. Lipohypertrophy: patient awareness and implications for practice. J Diab Nursing 2002;6:20-23.

143 Ampudia-Blasco J, Girbes J, Carmena R. A case of lipoatrophy with insulin glargine. Diabetes Care 2005;28: 2983.

144 De Villiers FP. Lipohypertrophy - a complication of insulin injections. S Afr Med J 2005;95:858-9.

145 Hauner H, Stockamp B, Haastert B. Prevalence of lipohypertrophy in insulin-treated diabetic patients and predisposing factors. Exp Clin Endocrinol Diabetes 1996;104:106-10.

146 Dejgaard A, Murmann C. Air bubbles in insulin pens. The Lancet 1989;334:871.

147 Annersten M, Frid A. Insulin pens dribble from the tip of the needle after injection. Pract Diab Int 2000;17:109-111.

148 Byetta Pen User Manual. Eli Lilly and Company, 2007.

149 Jamal R, Ross SA, Parkes JL, Pardo S, Ginsberg BH. Role of injection technique in use of insulin pens: prospective evaluation of a 31-gauge, 8mm insulin pen needle. Endocr Pract 1999;5:245-50.

150 Chantelau E. Heinemann L, Ross D. Air Bubbles in insulin pens. Lancet 1989;334:387-388.

151 Strauss K. Insulin injection techniques: Report from the 1st International Insulin Injection Technique Workshop, Strasbourg, France—June 1997. Pract Diab Int 1998 ;15:16-20.

152 Chantelau E, Lee DM, Hemmann DM, Zipfel U, Echterhoff S. What makes insulin injections painful? Brit Med J 1991;303: 26-27.

153 Maljaars C. Scherpe studie naalden voor eenmalig gebruik [Sharp study needles for single use] Diabetes and Levery 2002;4:36-37.

154 Torrance T. An unexpected hazard of insulin injection. Pract Diab Int 2002;19:63.

155 Asakura T, et al A step to prevent blood in the cartridge of an insulin pen. (in Japanese only) Progress in Medicine 2003;23(11):3066-3071.

156 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;9:2217-22.

157 Broadway CA. Prevention of insulin leakage after subcutaneous injection, Diabetes Educator 1991;17:90.

158 Asakura T, Seino H, Kageyama M, Yohkoh N. Technical Study of Injection Force of Insulin Injectors: At which Angle to Push the Button. (Japanese only) Progress in Medicine 2009;29:1851-1856.

159 Asakura T. Comparison of Clinically Relevant Technical Attributes of Five Insulin Injection Pens. Journal Diabetes Science and Technology 2011; 5(5):1203-1209.

160 Karges B, Boehm BO, Karges W. Early hypoglycaemia after accidental intramuscular injection of insulin glargine. Diabetic Medicine 2005;22:1444-45.

161 Personal Communication: Anders Frid. Data on file: Novo Nordisk.

162 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.

163 Vaag A, Handberg A, Laritzen M et al. Variation in absorption of NPH insulin due to intramuscular injection. Diabetes Care 1990;13:74-76.

164 Frid A, Lindén B. Intraregional differences in the absorption of unmodified insulin from the abdominal wall. Diabetic Med 1992;9:236-239.

165 Annersten M, Willman A. Performing subcutaneous injections: a literature review. Worldv Evid-Based Nu 2005; 2:122-130.

166 Frid A Linde B. Clinically important differences in insulin absorption from the abdomen in IDDM. Diabetes Res Clin Pr 1993;21:137-141.

167 Henriksen JE, Djurhuus MS, Vaag A, Thye-Ronn P, Knudsen D. Hother-Nielsen O, Beck-Nielsen H. 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.

168 Henriksen JE, Vaag A, Hansen IR, Lauritzen M, Djurhuus MS, Beck-Nielsen H. Absorption of NPH (isophane) insulin in resting diabetic patients; evidence for subcutaneous injection in the thigh as preferred site. Diabetic Medicine 1991;8:453-457.

169 Bantle JP, Neal L, Frankamp LM. Effects of the anatomical region used for insulin injections on glycaemia in type 1 diabetes subjects. Diabetes Care 1993;16:1592-1597.

170 Kølendorf K, Bojsen J, Deckert T. Clinical factors influencing the absorption of 125 I-NPH insulin in diabetic patients. Horm Metab Research 1983;15:274-278.

171 Mudaliar SR, Lindberg FA, Joyce M, Beerdsen P, Strange P, Lin A, Henry RR. Insulin aspart (B28 asp-insulin): a fast-acting analog of human insulin: absorption kinetics and action profile compared with regular human insulin in healthy nondiabetic subjects. Diabetes Care 1999;22:1501-6.

172 Rave K, Heise T, Weyer C, Herrnberger J, Bender R, Hirschberger S, Heinemann L. Intramuscular versus subcutaneous injection of soluble and lispro insulin: comparison of metabolic effects in healthy subjects. Diab Med 1998;15:747-51.

173 Frid A. Fat thickness and insulin administration, what do we know? Infusystems Int2006;5:17-19.

174 Guerci B, Sauvanet JP. Subcutaneous insulin: pharmacokinetic variability and glycemic variability. Diabetes Metab 2005;31:4S7-4S24.

175 Braakter EW, Woodworth JR, Bianchi R. Cermele B. Erkelens DW. Thijssen JH, Kurtz D. Injection site effects on the pharmacokinetics and glucodynamics of insulin lispro and regular insulin. Diabetes Care 1996;19:1437-1440.

176 Lippert WC, Wall EJ. Optimal intramuscular needle-penetration depth. Pediatrics 2008;122:e556-e563.

177 Calara F, Taylor K, Han J, Zabala E, Carr EM, Wintle M, Fineman M. A randomized, open-label, crossover study examining the effect of injection site on bioavailability of exenatide (synthetic exendin-4). Clin Ther 2005;27:210-5.

178 Babiker A, Datta V. Lipoatrophy with insulin analogues in type I diabetes. Arch Dis Child. 2011 Jan;96(1):101-2.

179 Swelheim HT, Westerlaken C, van Pinxteren-Nagler E, Bocca G. Lipoatrophy in a girl with type 1 diabetes: beneficial effects of treatment with a glucocorticoid added to an insulin analog. Diabetes Care. 2012 Mar;35(3):e22.

180 Breznik V, Kokol R, Luzar B, Miljkovi J. Insulin-induced localized lipoatrophy. Acta Dermatovenerol Alp Pannonica Adriat. 2013 Dec;22(4):83-5.

181 Arranz A, Andia V, López-Guzmán A. A case of lipoatrophy with Lispro insulin without insulin pump therapy. Diabetes Care. 2004 Feb;27(2):625-6.

182 Conwell LS, Pope E, Artiles AM, Mohanta A, Daneman A, Daneman D. Dermatological complications of continuous subcutaneous insulin infusion in children and adolescents. J Pediatr. 2008;152(5):622-628.

183 Pickup J, Yemane N, Brackenridge A, Pender S. Nonmetabolic Complications of Continuous Subcutaneous Insulin Infusion: A Patient Survey. Diab Tech Therap. 2014; 16(3):145-9.

184 Raile K, Noelle V, Landgraf R, Schwarz HP. Insulin antibodies are associated with lipoatrophy but also with lipohypertrophy in children and adolescents with type 1 diabetes. Exp Clin Endocrinol Diab. 2001;109(8):393–6.

185 Qifu Li, Linong Ji, Zilin Sun, et al. Lipohypertrophy (LH) prevalence varies widely between Chinese cities - need for consistent LH diagnostic methods. Abstract at 2015 American Diabetes Association annual meeting in Boston, USA.

186 Famulla S, Hövelmann U, Fischer A, et al. Lipohypertrophy (LHT) leads to blunted, more variable insulin absorption and action in patients with type 1 diabetes (T1DM). Abstract at 2015 American Diabetes Association annual meeting in Boston, USA.

187 Heinemann L, Hirsch L, Hovorka R. Lipohypertrophy and the artificial pancreas: is this an issue? J Diabetes Sci Technol, 2014 Sep;8(5):915-7. Published online 16 June 2014 at http://dst.sagepub.com/content/early/2014/06/16/1932296814538941 Accessed 09 June 2016.

188 Holstein A, Stege H, Kovacs P. Lipoatrophy associated with the use of insulin analogues: a new case associated with the use of insulin glargine and review of the literature. Expert Opin Drug Saf. 2010 Mar;9(2):225-31.

189 Del Olmo MI, Campos V, Abellán P, Merino-Torres JF, Piñón F. A case of lipoatrophy with insulin detemir. Diabetes Res Clin Pract. 2008 Apr;80(1):e20-1.

190 Ji L, Li Q, Wei G. Lipohypertrophy - prevalence, risk factors and clinical characteristics of insulin-requiring patients in China. Abstract, EASD Vienna 2014, Tracking Number: A-14-747.

191 Hirsch, Irl – personal communication, October 24, 2016.

192 Sun Z, Li Q, Ji L, Qin G, et al. Lipohypertrophy: Prevalence, risk factors, clinical characteristics, and economic burden of insulin-requiring patients in China. Poster, EASD Stockholm, 2015. Diabetologia 2015;58(Suppl 1):S438-9.

193 Grassi G, Scuntero P, Trepiccioni R, et al. Optimizing insulin injection technique and its effect on blood glucose control. J Clin Translat Endo. 2014;1: 145-150. This is an open access article under the CC BY-NC-ND license (http://creativecommons.org/licenses/by-nc-nd/3.0/). Accessed 09 June 2016.

194 Hovelmann U, Famulla S, Hermanski L, et al. Insulin injection into regions with lipohypertrophy (LHT) worsens postprandial (PP) blood glucose (BG) versus injections into normal adipose tissue (NAT). Abstract at 2015 American Diabetes Association annual meeting in Boston, USA.

195 Hambridge K. The management of lipohypertrophy in diabetes care. Br J Nurs 2007;16:520-524.

196 Jansà M, Colungo C, Vidal M. Actualización sobre técnicas y sistemas de administración de la insulina (II). [Update on insulin administration techniques and devices (II)]. Av Diabetol 2008;24:255-269.

197 Hambridge K. The management of lipohypertrophy in diabetes care. Br J Nurs. 2007;16(9):520-524.

198 Kahara T, Kawara S, Shimizu A, Hisada A, Noto Y, Kida H. Subcutaneous hematoma due to frequent insulin injections in a single site. Intern Med. 2004;43(2):148-149.

199 Wittmann A, Köver J, Kralj N, et al. Insulin leakage value in relation to pen needle length and administered dose after subcutaneous injection. Diabetes Technol Ther. 2010 Aug;12(8):587-90.

200 Van Doorn LG, Alberda A, Lytzen L. Insulin leakage and pain perception with NovoFine 6 mm and NovoFine 12 mm needle lengths in patients with type 1 or type 2 diabetes. Diabetic Medicine. 1998;1:S50.

201 Siegmund T, Blankenfeld H, Schumm-Draeger PM. Comparison of usability and patient preference for insulin pen needles produced with different production techniques: "thin-wall" needles compared to "regular-wall" needles: an open-label study. Diabetes Technol Ther. 2009 Aug;11(8):523-8.

202 Heise T, Nosek L, Dellweg S, et.al. Impact of injection speed and volume on perceived pain during subcutaneous injections into the abdomen and thigh: a single-centre, randomized controlled trial. Diabetes Obes Metab. 2014 Oct;16(10):971-6.

203 Hirsch L. Continuous subcutaneous insulin infusion (CSII) sets: reduced flow interruptions with a novel catheter set. Diabetes. 2015;64(Suppl 1):A274-A275. Presented ADA 2015.

204 Schmid V, Hohberg C, Borchert M, Forst T, Pfützner A. Pilot study for assessment of optimal frequency for changing catheters in insulin pump therapy—trouble starts on day 3. J Diabetes Sci Technol. 2010;4(4): 976-982.

205 Renard, E, Guerci B, Leguerrier AM, Boizel R; Accu-Chek FlexLink Study Group. Lower rate of initial failures and reduced occurrence of adverse events with a new catheter model for continuous subcutaneous insulin infusion: prospective, two-period, observational, multicenter study. Diabetes Technol Ther. 2010;12(10): 769-773.

206 Thethi TK, Rao A, Kawji H, Mallik T, Yau CL, Christians U, Fonseca V. Consequences of delayed pump infusion line change in patients with type 1 diabetes mellitus treated with continuous subcutaneous insulin infusion. J Diabetes Complications. 2010;24(2):73-8.

207 Pickup JC, Keen H, Parsons JA, Alberti KG. Continuous subcutaneous insulin infusion: an approach to achieving normoglycaemia. Br Med J. 1978;1(6107):204-207.

208 McVey E, Keith S, Herr JK, Sutter D, Pettis RJ. Evaluation of intradermal and subcutaneous infusion set performance under 24-hour basal and bolus conditions. J Diabetes Sci Technol. 2015 Aug 27;9(6):1282-91. doi: 10.1177/1932296815598327.

209 Van Bon AC, Bode BW, Sert-Langeron C, DeVries JH, Charpentier G. Insulin glulisine compared to insulin aspart and to insulin lispro administered by continuous subcutaneous insulin infusion in patients with type 1 diabetes: a randomized controlled trial. Diabetes Technol Ther. 2011;13(6):607-14.

210 Heinemann L, Krinelke L. Insulin infusion set: the Achilles heel of continuous subcutaneous insulin infusion. J Diabetes Sci Technol. 2012;6(4):954-64.

211 Thethi TK, Rao A, Kawji H, Mallik T, Yau CL, Christians U, Fonseca V. Consequences of delayed pump infusion line change in patients with type 1 diabetes mellitus treated with continuous subcutaneous insulin infusion. J Diabetes Complications. 2010;24(2):73-8.

212 Bolick N. Performance qualification of a novel subcutaneous insulin infusion set using medical imaging. Diabetes. 2015;64(Suppl 1):A278. Presented 2015 at the American Diabetes Association annual meeting, Boston, USA.

213 American Association of Diabetes Educators. Insulin Pump Therapy: Best practices in choosing and using infusion devices. 2011.

214 Jagger J et al. The impact of U.S. policies to protect healthcare workers from bloodborne pathogens: The critical role of safety-engineered devices. J Infect Pub Health 2008;1:62-71.

215 Adams D, Elliott TSJ. A comparative user evaluation of three needle protective devices. Br J Nurs 2003;12:470–474.

216 Occupational Safety and Health Administration. Occupational exposure to bloodborne pathogens: needlesticks and other sharps injuries; finale rule. Federal Register. 2001; 66(12): 5317-5325.

217 Pugliese G, Germanson TP, Bartley J, Luca J, Lamerato L, Cox J, Jagger J. Evaluating sharps safety devices: Meeting OSHA's intent. Infect Control Hosp Epidem. 2001; 22(7): 456-458.

218 EU Commission for Employment, Social Affairs and Inclusion, New legislation to reduce injuries for 3.5 million healthcare workers in Europe, 8th March 2010.

219 Article 3.2 says that where risk cannot be eliminated the employer shall take appropriate measures to minimise the risks. Appropriate measures to minimise the risks would include the provision by employers of safer needle devices. (Cf. NHS Employers, Implementation advice on sharps agreement, 12th October 2010)

220 The Directive specifically requires: 'eliminating the unnecessary use of sharps by implementing changes in practice and on the basis of the results of the risk assessment, providing medical devices incorporating safety-engineered protection mechanisms.' Council Directive 2010/32/EU, Official Journal of the European Union, L134/71 and Council Directive 2010/32/EU, Official Journal of the European Union, L134/69.

221 World Health Organization. WHO guideline on the use of safety-engineered syringes for intramuscular, intradermal and subcutaneous injections in health-care settings. 2015

222 Cullen BL, Genasi F, Symington I, Bagg J, McCreaddie M, Taylor A, Henry M, Hutchinson SJ, Goldberg D. Potential for reported needle stick injury prevention among healthcare workers in NHS Scotland through safety device usage and improvement of guideline adherence: an expert panel assessment. J Hosp Infect. 2006;63(4): 445-451.

223 Meryl H. Mendelson, Bao Ying Lin-Chen, Lori Finkelstein-Blond, Eileen Bailey, Gene Kogan. Evaluation of a Safety IV Catheter (IVC) (Becton Dickinson, INSYTE™ AUTOGUARD™) : Final Report Eleventh Annual Scientific Meeting Society for Healthcare Epidemiology of America, 2001 SHEA, Toronto, Canada.

224 Bossi AC, Veronesi G, Poerio CS, et.al. A prospective study for introducing insulin pens and safety needles in a hospital setting. The SANITHY (SAfety Needles and Insulin pens in Treviglio Hospital-ItalY) Study. CurDiab Reviews. 2016;12:1-8.

225 Jagger J, Perry J, Gomaa A, Phillips EK. The impact of U.S. policies to protect healthcare workers from bloodborne pathogens: The critical role of safety-engineered devices. J Inf Pub Health. 2008;1(2):62-71.

226 NACO (National AIDS Control Organization) guidelines from India. Accessible at http://www.naco.gov.in/NACO/. Accessed 8 June 2016.

227 Kiss P, de Meester M, Braeckman L. Needlestick injuries in nursing homes: the prominent role of insulin pens. Inf Control Hosp Epid. 2008;29(12):1192-1194.

228 The Health and Safety Executive, Health and Safety (Sharp Instruments in Healthcare) Regulations 2013 : Guidance for employers and employees

229 Adams, D. Safety-engineered needle devices: evaluation prior to introduction is essential. Journal of Hospital Medicine 2011

230 Melissa K. Schaefer MK, Kossover RA, Perz JF. Sharing insulin pens: Are you putting patients at risk? Diabetes Care. 2013;36(11):e188-189.

231 WISE recommendations to ensure the safety of injections in diabetes. Diabetes Metab. 2012;38 (Suppl 1):S2-8. doi: 10.1016/S1262-3636(12)70975-8.

232 Lee JM, Botteman MF, Nicklasson L, Cobden D, Pashos CL. Needlestick injury in acute care nurses caring for patients with diabetes mellitus: a retrospective study. Curr Med Res Opin. 2005;21(5):741-7.

233 Paton N. Why we must stop needlestick injuries. Nurs Times. 2006;102(40):16-8

234 Vos D, Gotz HM, Richardus JH. Needlestick injury and accidental exposure to blood: The need for improving the hepatitis B vaccination grade among health care workers outside the hospital. Am J Infect Control 2006;34:610-2.

235 Workman RGN. Safe injection techniques. Prim Hlth C 2000;10:43-50.

236 Bain A, Graham A. How do patients dispose of syringes? Pract Diab Int 1998;15:19-21.

237 Ignore these ones - they were in original but no longer in document.

238 Diamond S, Matok I. Pharmacists' anticipated pain compared to experienced pain associated with insulin pen injection and fingertip. Can J Diab. 2011;35(3):282-286.

239 Jorgensen JT, Romsing J, Rasmussen M, Moller-Sonnergaard J, Vang L, Musaeus L. Pain assessment of subcutaneous injections. Ann Pharmacother. 1996;30(7-8):729 -732.

240 Egekvist H, Bjerring P, Arendt-Nielson L. Pain and mechanical injury to human skin following needle insertions. Euro J Pain. 1999;3(1):41-49.

241 Arendt-Nielsen L, Egekvist H, Bjerring P. Pain following controlled cutaneous insertion of needles with different diameters. Somatosens Mot Res. 2006;23(1-2):37-43.

242 Hirsch L, Gibney M, Berube J, Manocchio J. The impact of a modified needle tip geometry on penetration force well as acceptability, preference and perceived pain in subjects with diabetes. J Diabetes Sci Technol. 2012, 1;6(2):328-35.

243 Rubin RR, Peyrot M, Kruger DF, Travis LB. Barriers to insulin injection therapy: patient and health care provider perspectives. Diabetes Educ. 2009;35(6):1014-1022.

244 Lee DM. How painful is intensive insulin therapy? Z Gesamte Inn Med. 1992 Jun;47(6):266-9.

245 Rubino A, McQuay LJ, Gough SC, et al. Delayed initiation of subcutaneous insulin therapy after failure of oral glucose-lowering agents in patients with type 2 diabetes: a population-based analysis in the UK. Diabet Med 2007;24(12):1412-8.

246 Karter AJ, Subramanian U, Saha C, Crosson JC, Parker MM, Swain BE, Moffet HH, Marrero DG. Barriers to insulin initiation: the translating research into action for diabetes insulin starts project. Diabetes Care. 2010 Apr;33(4):733-5.

247 Fu A, Qiu Y, Radican L. Impact of fear of insulin or fear of injection on treatment outcomes of patients with diabetes. Cur Med Res Opinion. 2009; 25(6):1413–1420.

248 Goebel-Fabbri AE, Fikkan J, Franko DL, et al. Insulin restriction and associated morbidity and mortality in women with type 1 diabetes. Diabetes Care. 2008;31(3):415-9.

249 Bienvenu OJ, Eaton WW. The epidemiology of blood-injection- injury phobia. Psychol Med. 1998;28(5):1129-36.

250 Johansson U-B, Amsberg S, Hannerz L, Wredling R, Adamson U Arnquist HJ, Lins P-E. Impaired absortion of insulin aspart from lipohypertrophic injection sites. Diabetes Care. 2005;28:2025- 2027.

251 Bossi AC, Ansah EO. Bent needles: another problem in glycaemic control . Diabetes Care. 2008 Oct;31(10):e70. doi: 10.2337/dc08-0932

252 Lee JM, Botteman MF, Nicklasson L, Cobden D, Pashos CL. Needlestick injury in acute care nurses caring for patients with diabetes mellitus: a retrospective study. Curr Med Res Opin. 2005;21(5):741-7.

253 Rapid Response Report reference: National Patient Safety Agency (2010) Safer administration of insulin. NHS, London. Available at: http://bit.ly/2bmZKu7 (accessed 08.09.16)

254 Melzack R, Wall PD. Pain mechanisms: a new theory. Science 1965;150(3699):971–9. NB:

255 Nan Deng, Xiaoyi Zhang, Fangfang Zhao,Ya Wang,Hong He. Prevalence of lipohypertrophy in insulin-treated diabetes patients: A systematic reviewand meta-analysis. J Diabetes Investig 2018; 9: 536–543

256 Ji L, Sun Z, Li Q, Qin G, Wei Z, Liu J, Chandran AB, Hirsch LJ. Lipohypertrophy in China: Prevalence, Risk Factors, Insulin Consumption, and Clinical Impact. Diabetes Technol Ther. 2017 Jan;19(1):61-67. doi: 10.1089/dia.2016.0334.

257 Trung. Improving injection technique - reference required. (put this in cyan)

Endorsements

"Diabetes UK both welcomes and supports the FIT initiative.

Good injection technique leads to good blood glucose control which is vital in preventing the long term complications of diabetes. As so many people with diabetes are now being prescribed injectable medication, this is a timely and important enterprise which will bring great benefit to them. "

Simon O'Neill, Director of Health Intelligence. DIABETES UK

"Advances in the treatment of diabetes have led to an increase in the number of injectable therapies available. Correct technique is of paramount importance in order to ensure the benefits of injectable therapies such as insulin and GLP-1s. The Forum for Injectable Therapy (FIT) provides comprehensive evidenced based guidelines to improve the process and education of self-injection technique for people with diabetes. As a company committed to improving the care of patients with diabetes, Lilly UK welcomes the FIT initiative as an important step in supporting diabetes care in the United Kingdom. "

Ian Dane, Senior Director, Eli Lilly & Company

"Novo Nordisk fully endorse the FIT initiative. The benefits of modern injectable medications for the treatment of diabetes can only be fully realised through the use of correct injection technique. Novo Nordisk believes it is imperative that Healthcare Professionals understand the importance of good injection technique and convey this to people with diabetes under their care. FIT is a superb initiative, from leading professionals in the diabetes care, which will make a big difference in this area. "

Sara Norcross, Marketing Director Diabetes, Novo Nordisk UK

"Safe and effective injection techniques are a vital component of managing diabetes and reducing the risk of complications and FIT guidelines provide practical advice to help people with diabetes administer the correct dose in the safest way. This is a great initiative which DRWF is happy to support by sharing these messages through our Diabetes Wellness Network and as part of our Diabetes Wellness educational event programme."

Sarah Tutton, Chief Executive, Diabetes Research and Wellness Foundation

"We are proud to endorse the Forum for Injection Technique (FIT) initiative and share its mission to support people with diabetes in their use of injectable therapies through evidence-based best practice recommendations. Sanofi continuously strives to improve care for people with diabetes through our range of treatments and partnership programs. At the core of our approach is education, which why we support key initiatives such as Insulin Safety Week, to raise awareness of insulin safety. We look forward to continuing to work alongside FIT and industry partners to increase knowledge in this area, for the benefit of people living with diabetes."

Jason Bonnett – Head of Diabetes Marketing, Sanofi

SANOFI

"Becton Dickinson has been supporting the ground breaking and inspirational work of the Forum for Injection Technique for over 8 years. The new 5th Edition of The UK Injection and Infusion Technique Recommendations follows the Worldwide FITTER Congress held recently in Rome 2015. During this worldwide event which included 183 participants from 54 countries, delegates reviewed results data from a worldwide injection technique survey, and this wealth of new data provided the evidence to help formulate the best practice recommendations you will find in this UK 5th Edition.

Our BD mission; 'Improving the quality of daily life for people with diabetes, through access to innovative solutions' is incredibly important to all who work at BD, and BD is proud to endorse the dedicated expert work that FIT UK undertakes. BD welcomes the publication of the 5th Edition of The UK Injection and Infusion Technique Recommendations and commends the FIT Board and all the dedicated clinicians from all over the UK for their great achievement."

Theresa Shapland, Country Business Leader Diabetes Care BD

BD

"Evidence-based practice is fundamental to ensuring the highest standard of care is offered to all our patients living with diabetes. Pharmacists and Pharmacy technicians are involved in patient-centered, multidisciplinary teams. The FIT Guidance details how we can expand our knowledge, support our peers as well as educate our patients and their carers in safe, evidence based injection technique for injectable therapies used in diabetes care."

Dr. Graham Stretch, President of Primary Care Pharmacy Association

PCPA Primary care Pharmacy Association www.pcpa.org.uk

Endorsed by co-chairs

Victoria Ruszala and Hannah Beba on behalf of UKCPA Diabetes and Endocrinology group.

UKCPA CLINICAL PHARMACY ASSOCIATION

Diabetes Specialist Nurse Forum UK

THE UK INJECTION AND INFUSION TECHNIQUE RECOMMENDATIONS
5th Edition Contributors 2019

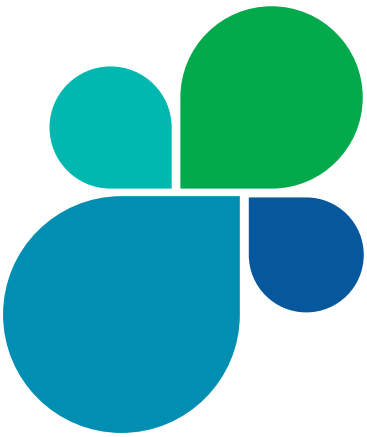
FIT UK is committed to supporting the implementation of the recommendations and developing them further as new evidence emerges. We welcome any comments, suggestions and active participation in ensuring that the updated recommendations remain relevant and useful for now and in the future.

FIT Board members:

- Amanda Epps
- Bethany Kelly
- Helen Kilminster
- Prof (Dr) Mahendra Patel
- Adrian Long
- Dr. Patrick Holmes
- Zoe Sherwood

Abbreviations

BMI	Body Mass Index (kg/m)
CBT	Cognitive Behavioural Therapy
cm	centimetre
CSII	Continuous Subcutaneous Insulin Infusion
GLP-1 receptor agonist	Glucagon-like peptide-1 receptor agonist
HbA1c	N-(1-deoxy)-fructosyl-haemoglobin , glycated haemoglobin
HBV	Hepatitis B Virus
HCB	Hepatitis C Virus
HCP(s)	Healthcare Professional(s)
HIV	Human Immunodeficiency Virus
IIS	Insulin Infusion Set
IM	Intramuscular
ISO Certified	International Organization for Standardisation Certified
IT	Injection Technique
LH	Lipohypertrophy, Lipo
m	metre
mm	millimetre
NPH	Neutral pH suspension of crystalline insulin, protamine and zinc
NSI	Needlestick Injury
PN	Pen Needle
S C	Subcutaneous
T1DM	Type 1 Diabetes Mellitus
T2DM	Type 2 Diabetes Mellitus
US	ultrasound



fit odc™

Optimising
Diabetes Care

www.fit4diabetes.com