FIT SOUTH AFRICA PROVIDES EVIDENCE BASED BEST PRACTICE INFORMATION

- PEOPLE LIVING WITH DIABETES
- USING INJECTABLE THERAPIES
- TO ACHIEVE THE BEST POSSIBLE HEALTH OUTCOMES
- BY ENSURING THAT THE CORRECT DOSE IS DELIVERED
  - IN THE CORRECT INJECTION SITE,
  - USING THE CORRECT TECHNIQUE,
  - EVERY TIME,

THROUGH PROFESSIONAL PATIENT EDUCATION, ACCESSIBLE SUPPORT AND RESEARCH

FIT OBJECTIVES

- Identify the injection techniques currently being used in practice amongst South African Healthcare Professionals (HCPs) and people living with diabetes.
- Raise awareness of existing and emerging research related to injection technique and the impact thereof on health outcomes.
- Facilitate opportunities in which best practice can be discussed, developed, implemented, and evaluated throughout South Africa.
The results of an international survey \cite{1,2} led to an increasing awareness of problems associated with inadequate injection techniques. Since the publication of the International FIT guidelines, it was felt that there was a great opportunity for recommendations that best suit local needs in South Africa.

The South African FIT initiative has been developed to assist with ongoing injection technique concerns.

Following the precedence set by the United Kingdom FIT\textsuperscript{®}, as well as other international injection technique guidelines \cite{3,4,5,6,7}, this document has been created to promote best practice in injection technique for everyone involved in diabetes care. \cite{5,7,8}

A meeting of leading experts in diabetes education was held to identify areas of priority in injection technique.

The three leading priorities were:

1. To ensure subcutaneous (SC) injection and avoid intramuscular (IM) injection.
2. To ensure healthy injection sites.
3. To provide clear and concise instruction for healthcare professionals and patients regarding injection techniques.

Using these priorities as a framework, this best practice document was developed and reviewed by the South African FIT board. It has also been reviewed by the diabetes education experts and, where evidence did not exist, expert opinion has guided the recommendation.

A South African injection practice survey will be conducted, following the publication of the first recommendations, and analysis of this data will guide future recommendations.

**NEED FOR SOUTH AFRICAN GUIDELINES:**
For many South Africans living with diabetes who are dependent on insulin for glucose control, appropriate injection technique is an important part of diabetes management.

**While insulin is prescribed, the appropriate administration device and needles are frequently not specified on the prescription. The choice of device and needles (needle length and gauge) are often left to the discretion of the pharmacist.**

Appropriate injection technique recommendations are crucial for the success of insulin therapy. These recommendations will:

- provide a framework for healthcare professionals,
- help guide rational management decisions, and
- prevent the use of outdated or dangerous practice.

Guidelines giving evidence based recommendations are also an important element in assisting the National Department of Health and healthcare funders to provide and fund diabetes care at an acceptable level. A national guideline removes ignorance and holds all stakeholders accountable.

This document will be distributed to all healthcare professionals involved in injection therapy for diabetes.

The development of FIT and the subsequent South African recommendations for injection technique have been supported by Becton Dickinson (BD) South Africa and endorsed by pharmaceutical companies whose therapies include subcutaneous injections of insulin and GLP-1 receptor agonists.
MATERIAL AND METHODS

An international group of individuals who have a special interest and expert knowledge in injection technique (Athens 2009) lead the review of available evidence and decided that for the strength of a recommendation the following scale would be used:

<table>
<thead>
<tr>
<th>ABC Scale: Strength of recommendation:</th>
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<tbody>
<tr>
<td>A  STRONGLY RECOMMENDED</td>
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<td>B  RECOMMENDED</td>
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<td>C  UNRESOLVED ISSUE</td>
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<th>123 Scale : Scientific support:</th>
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<tr>
<td>1  At least one randomised controlled study</td>
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<tr>
<td>2  At least one non-randomised study (or non-controlled or epidemiologic) study</td>
</tr>
<tr>
<td>3  Consensus expert opinion based on extensive patient experience</td>
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Each recommendation is followed by both a letter and number (i.e. A1). The letter indicates the weight a recommendation should have in daily practice, and the number, the level of evidence in support of the recommendation. The most relevant publications bearing on a recommendation are used. There are relatively few randomised clinical trials in the field of injection technique 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 opinion of the group of experts.

These recommendations apply to the majority of people with diabetes using injectable therapy, but there will inevitably be individuals in specific cases where therapy must be based on the judgement of the healthcare provider.

The New Injection Recommendations for Patients with Diabetes: Diabetes & Metabolism 2010. Vol 36, were used as primary source for these recommendations and we thank the editors of Diabetes and Metabolism for permission to use material from this article.
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1.1 ADULTS

Few prospective studies have been published, but the theme of psychological insulin resistance (for both patients and HCPs) is being increasingly debated.\(^{[9-14]}\)

Very few adults have true needle phobia (a fear of needles), but many have anxiety about injecting, especially at the beginning of therapy.\(^{[9,10]}\)

This anxiety can be somewhat relieved, starting at the time of diagnosis, by the demonstration of a self-injection of saline/diluent by the HCP and then by the patient.

However, even experienced patients may view injections with a degree of regret and loathing.\(^{[11,12]}\)

RECOMMENDATIONS:

- Using descriptions, pictures and stories, that the patient can identify with. HCPs should show how insulin injections can enhance both the duration and quality of life.\(^{[14]}\) \(\text{GRADE} \; 2\)

- In adults, as in all age groups, pen therapy may have psychological advantages over syringe therapy.\(^{[14,18-20]}\) \(\text{GRADE} \; 2\)

- HCPs should prepare all newly-diagnosed patients with type 2 diabetes for possible insulin therapy in the future by explaining the natural, progressive nature of the disease. Pointing out that it includes insulin therapy and making clear that insulin treatment is not a sign of patient failure.\(^{[13]}\) \(\text{GRADE} \; 3\)

- Both the short- and long-term advantages of good glucose management should be emphasised. Finding the right combination of therapies for good glucose management should be the objective, rather than trying to minimise the number of agents used.\(^{[14,15]}\) \(\text{GRADE} \; 3\)

- HCPs should consider their own perceptions of insulin therapy and avoid using any terms such as “we may need to put you on the needle” —even casually—which imply that this kind of therapy is a sign of failure, a punishment or even a threat.\(^{[16,17]}\) \(\text{GRADE} \; 3\)
PREPARING FOR INJECTION

1. PSYCHOLOGICAL CHALLENGES OF INJECTIONS

ADOLESCENTS AND CHILDREN

For the purpose of these recommendations, adolescence is defined as puberty to 18 years of age.

HCPs should recognise that many adolescents struggle with issues surrounding insulin and most are reluctant to inject in front of peers. There is a greater tendency among adolescents to skip injections, often because of simple forgetfulness, peer pressure, rebellion, pain, etc. [17]

Some adolescents associate insulin with weight gain and HCPs need to be aware that skipping injections may be used as a method of losing weight (especially for girls).

OBSERVATIONS:

- Adolescents must be reassured that no-one manages diabetes perfectly all the time and that slip-ups do occur, as long as they do not become routine, are not signs of failure.
- Adolescents should be given a sense of control for e.g. flexible injection schedule for weekends and holidays.
- Be mindful of anxiety of weight gain and skipping injections, while monitoring blood glucose levels and finding unexplained weight loss.
- All patients, but especially adolescents, should be encouraged to discuss their feelings about injecting, particularly their frustrations and struggles.

CHILDREN - RECOMMENDATIONS:

- Younger children may be helped with distraction techniques (not trickery) or play therapy (e.g. injecting into a stuffed animal). Older children respond better to cognitive behavioural therapies (CBT). [22] 2
- CBT includes relaxation training, guided imagery, graded exposure, active behavioural rehearsal, modelling and reinforcement as well as incentive scheduling. [22] 2
- Children have a lower threshold for pain than adults and sometimes find injecting uncomfortable. HCPs should ask about pain, since many young patients will not bring it up spontaneously. [23,24] 2
- Use of indwelling catheters and injection ports at the beginning of therapy can help reduce fear of injections and associated pain, and may improve compliance to multiple daily injections. [25-39] 5
Studies have shown that not all patients receive education about injecting and those who do receive education, not all essential aspects are covered.\cite{1,11,12}

Critical aspects include:
- the insulin or drug regime
- the choice and management of the devices used
- the choice, care and self-examination of injection sites
- proper injection techniques (including site rotation, injection angle and possible use of skin-folds)
- injection complications and how to avoid them
- optimal needle length
- safe disposal of used needles. \cite{15-18, 30-33}

In consultation with the patient, decisions regarding injections should be made. The HCP should provide expertise and advise.

There is evidence that group education by a trained educator leads to greater compliance and lower HbA1c values.\cite{34}

1.2 THERAPEUTIC EDUCATION

**RECOMMENDATIONS:**

- The HCP should spend time exploring patients’ (and caregivers’) anxieties about the injecting process and insulin itself. \cite{16,32} 3

- At the beginning of injection therapy (and every year) the HCP should discuss each of the essential topics and ensure this information has been fully understood. 3

- Enquiries should be made about the patient’s injection practices and the patient’s injection technique should be observed. Injection sites should be palpated and inspected if possible at each visit, but at least every year. \cite{30,40,41} 3

- A management process should be implemented to ensure that correct injection technique is regularly practiced and documented in the patient’s record. 3

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1 **PREPARING FOR INJECTION**
2 INJECTION RECOMMENDATIONS

2.1 SELECTION

2.1.1 INJECTION SITES

Recent evidence concludes that skin thickness (epidermis and dermis) of most adults, regardless of age, Body Mass Index (BMI), gender or race is relatively consistent and varies on average from 1.9 to 2.4 mm. [35-38]

The thickness of the subcutaneous tissue has a much wider variance and is related to gender, body site and BMI. [35,36,39-42]

Subcutaneous thickness (in mm) for male and female adults. Means (in bold) and ranges (in parenthesis) reflects the results from a number of ultrasound-based studies. [35,36,39-44]

**RECOMMENDATIONS:**

To avoid IM injections and facilitate ease of self-injection:

1. Abdomen, thighs and buttocks are the recommended injection sites for adults. [7,36]  2

2. The abdomen offers the most consistent absorption. [5,45]  2

3. The arm is not a preferred site for self-injection because of a greater potential for IM injection. [4,7,40,43,46]  2
INJECTION RECOMMENDATIONS

2.1.2. INJECTION SITE CARE

RECOMMENDATIONS:

- The site should be inspected and palpated by the individual prior to injection. [5,47] 2

- Sites showing signs of lipohypertrophy, inflammation, oedema and/or infection should be avoided until the problem has been resolved. [46,48,49,50-53] 2

- Prior to the injection the site should be cleansed with soap and water if necessary. [55] 3

- Injections should be given into a clean site using clean hands. [54] 2

- Disinfection of the site is not usually required but alcohol swabs may be used in the hospital or home care setting for immobile clients. If alcohol is used, let the site dry completely before the injection. [5-56-66] 2

- Cleaning the cartridge or vial with an alcohol swab may be required (e.g. hospital setting). [58] 3
2.1 SELECTION

2.1.3 ROTATION OF SITES

Site rotation is essential to avoid lipohypertrophy and to ensure consistent absorption of the medication. [51,52,62,65,142]

Correct injection site rotation appears to be the critical factor in preventing lipohypertrophy which is associated with reduction in glucose variability, hypoglycaemia, insulin consumption and costs. [51,52,62,66,142]

**RECOMMENDATIONS:**

1. To prevent lipohypertrophy and maintain consistent absorption, patients should be taught a “personalised” predictable rotation for their injection sites. [67,68,80]

2. One pattern with proven effectiveness involves dividing the injection site into quadrants (or halves when using thighs and buttock), using one quadrant per week and always rotating clockwise. [67] 3

3. Injections within any quadrant or half should be spaced at least 1cm apart from each other in order to avoid repeat tissue trauma. [67] 3

4. Rotation of injection sites should be discussed at each patient visit. 3
2 INJECTION RECOMMENDATIONS

2.2 PHYSICAL ASPECTS OF INSULIN

2.2.1 TEMPERATURE OF INSULIN

- The absorption of insulin is unaffected by temperature. [69,70]

- Insulin at room temperature results in less irritation, burning or pain when injected. Cloudy suspensions are also easier to resuspend if at room temperature. [6,7,14,71,72]

- Consider alternative methods of keeping insulin cool when refrigeration is unavailable.

2.2.2 STORAGE OF INSULIN

- Store insulin in a refrigerator (2 - 8 °C) for prolonged periods.

- Insulin should never be frozen or be exposed to temperatures >30 °C, because the efficacy will be affected.

- Once insulin is opened it should not be used for longer than 28 days.

- In the interest of safety and optimum glucose control, all insulin should be used before it’s expiry date.

- Never use expired insulin.

2.2.3 ABSORPTION OF INSULIN

Factors affecting Absorption:

- Re-suspension of cloudy insulin:

  - When using cloudy insulin (i.e. NPH and pre-mixed insulin) the vial, cartridge or pen device should first be gently rolled 10 times then tipped (not shaken) 10 times, and finally visually checked to ensure the suspension has a consistently milky white appearance. [6,18,55,62,72-76]
- **Volume of injection:**
  - Insulin injections above 50 units per dose should preferably be halved into two separate injections. The larger the doses the more delayed the action of NPH, short acting human insulin and rapid acting analog insulin. [7,69,77-79]
  - Larger doses of insulin are associated with more leakage and potentially more discomfort. [7,69,77-79]
  - The time-action profile of long-acting products is not affected by the volume of injection.

- **Other Factors:**
  - Massaging the injection site is not recommended (as it increases the absorption rate). [6,7,69,80,81]
  - Higher skin temperature such as in or after a sauna or hot bath can also increase absorption rate. [4,83]
  - Injecting into an exercising limb may accelerate absorption of insulin and result in a quicker decrease of blood glucose values. [71,84]
  - Glucagon-like peptide-1 (GLP-1) receptor agonists are absorbed at similar rates from each of the usual injection sites (abdomen, arm and thigh). [7,57,85,103]

### Factors involving absorption from different sites:

- **Intramuscular injection:**
  - IM injection of all human insulin, rapid-acting analogues and long-acting analogues should be avoided. Accelerated absorption may result in glycaemic variability and hypoglycaemia. [84,86-89]

- **Injection site:**
  - Insulin is absorbed fastest from the abdomen. [7,69,72,90-96]
  - The upper arm and lateral side of the thigh (not near the knee), have moderate absorption rates. [7,71-73]
  - The buttock is the slowest absorbed site and may be preferred if slow absorption is desired. [71-73,82,87]

- **Damaged Skin:**
  - Damaged skin (surgical scars, lipohypertrophy as described in section 3) should be avoided when injecting insulin and GLP-1 agents. [7,69,73,74,80]

2.2.5 **Insulin Analogues and GLP-1 agents**

Few studies directly mention optimal injection techniques for these newer agents.

The recommendations below have been extracted from studies addressing their safety, efficacy or pharmacokinetic performance.
2.2.4 Human insulins:

Soluble human insulin (e.g. regular insulin) is more slowly absorbed than rapid-acting analogues. Older acting agents - such as NPH, are considered to be intermediate acting. Pharmacologic action is the same but the pharmacokinetics result in a peak of insulin which can result in hypoglycaemia.

**RECOMMENDATIONS for human insulins:**

- IM injection of NPH should be avoided as rapid absorption can lead to serious hypoglycaemia. \([104,89]\) \(\text{STRONGLY RECOMMENDED}\)

- The thigh and buttocks are preferred injection sites when using NPH as the basal insulin, since absorption is slowest from these sites: if possible NPH should rather be given at bedtime than at dinner to reduce the risk of nocturnal hypoglycaemia. \([42,105]\) \(\text{RECOMMENDED}\)

- The abdomen is the preferred site for soluble human insulin (regular) as absorption is fastest. \([68,90-92,106,107]\) \(\text{RECOMMENDED}\)

- The absorption of soluble human insulin in the elderly can be slow and should preferably not be used when a rapid effect is required. \([69,95]\) \(\text{UNRESOLVED ISSUE}\)

**RECOMMENDATIONS for premixed insulins:**

- Regular/NPH mix should be given in the abdomen in the morning (to increase the speed of absorption of the short-acting insulin) in order to address post-breakfast glycaemic excursion. \([108]\) \(\text{STRONGLY RECOMMENDED}\)

- Any mix containing NPH should be given in the thigh or buttock in the evening as this leads to slower absorption and decreases the risk of nocturnal hypoglycaemia. \([105,109]\) \(\text{RECOMMENDED}\)
2.2.5 Insulin Analogues and GLP-1 agents

Few studies directly mention optimal injection techniques for these agents.

The recommendations below have been extracted from studies addressing their safety, efficacy or pharmacokinetic performance.

**RECOMMENDATIONS:**

- Rapid-acting insulin analogues may be given at any of the injection sites, as absorption rates do not appear to be site specific. [86,87,94,98,99]

- IM injection of long-acting analogues must be avoided due to the risk of severe hypoglycaemia. Patients engaging in athletic activities after injecting long-acting analogues should also be warned about hypoglycaemia. [84,102]

- GLP-1 agents may be given at any of the injection sites because action does not appear to be site specific. [103]

- Rapid-acting analogues should not be given IM (although studies have shown that absorption rates are similar from fat tissue and resting muscle). Absorption from working muscle has not however been studied. [86-88]

- Long-acting insulin analogues can be injected in any of the usual injecting sites. [100,101]

- Patients who inject GLP-1 agents should follow the recommendations already established for insulin injections with regards to needle length and site rotation. [45]
INJECTION RECOMMENDATIONS

2.3 ADMINISTRATION

Injectable devices for delivering insulin

2.3.1 SYRINGES AND VIALS

There are parts of the world where significant numbers of patients still use syringes as their primary injecting device. Even in South Africa where pens are still frequently used for most home injections, syringes are still often used in health care settings.

There is NO medical rationale for using syringes with detachable needles for injecting insulin. Permanently attached needle syringes offer better dose accuracy and smaller dead space. [110]

INJECTION DEVICE VERIFICATION - OBSERVATIONS

Check list for the prescription:
- Clearly state the choice of injection device, needle length and gauge, and type of insulin syringe specified in the prescription.
- Ensure that the pharmacist dispenses the prescribed insulin - check for:
  - Name and type of Insulin
  - Expiry date

Check list for insulin:
- Prior to use, the insulin should be examined to ensure there are no changes in the insulin (clumping, frosting altered colour or clarity).
- Clear insulin must be clear.
- Cloudy insulin should be cloudy.
- Proper resuspension of cloudy insulin is essential to ensure proper absorption.
- Correct suspension technique has to be regularly evaluated by the HCP.

RECOMMENDATIONS:

- The use of 8 mm needle is recommended: [35]
  - 12.7 mm needles are not recommended due to increased risk of intramuscular injection. [35] [35]

- Syringes should be used only once and disposed of in an approved sharps container. [5,21,47,60,62,111,112] [2]

- Choose the correct size syringe based on the amount of insulin to be given (volume: U-30, U-50, or U-100 syringes) and length of needle. [3]
2.3.2 PEN DEVICES

Obstruction of insulin flow in pens is rare, but when it happens, it can have serious consequences. Monitor movement of the rubber plunger within the pen.

For specific pen instructions, please refer to the manual for the device.

RECOMMENDATIONS:

- Pen devices should be primed prior to the first dose (pen with the needle pointing upwards) until a flow of insulin at the needle tip can be seen. Once flow is confirmed, the desired dose should be dialled and the injection administered. [19,113]

- After pushing the thumb button in completely, allow 10 seconds to pass before withdrawing the needle in order to prevent leakage of medication, counting past 10 seconds may be necessary for higher doses. [74,79,114,117]

- Pen devices with a dose window should be checked at the end of each injection, “0” should be visible when the dose has been completely injected. If a number other than “0” is seen, it indicates that the full dose of insulin has not been given, and a reason should be looked for. If the cartridge is empty, replace the cartridge, prime the needle and administer the remainder of the dose.

- Pen devices and cartridges are to be used by a single person only, and should never be shared due to the risk of cross contamination. [20,58]

- Needles should be safely disposed of immediately after use. This prevents the entry of air (or other contaminants) into the cartridge as well as the leakage of medication out of the cartridge, which can interfere with subsequent dose accuracy. [42,79,114,115,118]

- Only use pen needles once. [5,21,47,60,62,111,112]

- Always keep a spare syringe or a second pen available in case of pen breakage or malfunction.

- Priming with each injection is not required for the GLP-1 agents.

- Priming with each injection for newer disposable pens is not required. (please refer to specific injection pen instruction).
2.3.3 PEN NEEDLES

The objective of injection with insulin or GLP-1 agents is to reliably deliver the medication into the subcutaneous space, without leakage or discomfort. To achieve this goal the correct needle length should be selected.

Clinical studies have reported equal efficacy, safety and tolerability of shorter needles (4 mm) in comparison to longer ones. [119]

Choose the right needle:
- **Gauge:** 30, 31, 32g
  - (Higher gauge = smaller needle diameter).

- **Length 4, 5, 6 or 8 mm**
  - (12.7 mm may increase risk of intramuscular injection).

- 4, 5 or 6 mm needles are suitable for all people with diabetes regardless of BMI.

- **A skin-fold may not be required particularly if using a 4 mm needle.** [35,79,85,95,119-123]

- Research supports the use of needles length 8 mm and shorter. [121,124,136]

- Insulin therapy should preferably be initiated with shorter length needles. [79,122,124]

Injections with shorter needle lengths (4, 5 or 6 mm) should be given, at 90 degrees to the skin surface.
INJECTION RECOMMENDATIONS

RECOMMENDATIONS: - Needle Length:

Children and Adolescents

- Children and adolescents should use 4 mm, 5 mm or 6 mm needles. [35,85,87,88,119,127-133]  

- In slender children a skin-fold is required when injecting into limb sites, especially when using a 5 mm or 6 mm needle. [73,85]  

- If only an 8 mm needle is available, a skin-fold should be used. Inject at 45 degrees. [134-136]  

- There is no clinical reason for using needles longer than 6 mm in children and adolescents. [96]  

Adults

- Adults, including obese patients, can use 4 mm, 5 mm or 6 mm length. [35,79,85,119,120,122,127,137]  

- Injections with shorter needles (4 mm, 5 mm or 6 mm) should be given in adults at 90 degrees to the skin surface. [35,79,85,119,122,123,126,137]  

- To prevent possible IM injections when injecting into limbs, or slender abdomens, even 4 mm and 5 mm needles may warrant use of a skin-fold. Injections with 6 mm needles should be used either with a skin-fold or a 45 degree angle. [85,121,122,138]  

- There is no clinical reason for recommending needles of more than 8 mm in adults [121,124,136]  

- Patients already using needles ≥ 8 mm should preferably move to a shorter needle or lift a skin-fold and/or inject at 45 degrees to avoid injection into a muscle. [121,138]  

Optimising Injection Technique in Diabetes Management

Recommendations for Best Practice in Injection Technique
2.3.4 NEEDLE REUSE
- A South African perspective

Most insulin needles [pen needles/syringes] are only approved for single use and should therefore only be used once.

Realistically, reuse of insulin needles amongst adults and children, irrespective of whether they are pen or syringe needle units, is common practice throughout the world.

The reuse of insulin needles may be thought to provide an initial cost saving benefit to diabetic funders and medical aids. [60,66,139-141]

At present, very little high quality research has been done to conclusively establish the safety of reusing insulin injection needles.

The risk of complications due to reuse of insulin injection needles/syringes seems to be low in most cases, [60] however, there is evidence that needle reuse is related to an increased risk of lipohypertrophy. (Lipohypertrophy is associated with glucose variability and unexplained hypoglycaemia.) Research shows a clear trend towards an increased incidence of lipohypertrophy the more times a needle is reused. This was greater when the needle was reused more than five times. [142]

Reused needles are seldom contaminated, although the plastic connection of the needle attachment that comes in contact with the skin is often contaminated. Despite this contamination, skin infections seldom occur. [60,66,143]

In a study using 8 mm insulin pen needles, the decline in the needle reliability was not significant when the needles were reused up to five times. This reuse did not relate to increased pain or unpleasantness in patients. [144,145]

While there is insufficient evidence to unequivocally support reusing insulin needles, it is recommended that needles/syringes are only used once, and should certainly not be used more than five times before being safely discarded. [142]

![Fig. 13](image_url)
2 INJECTION RECOMMENDATIONS

RECOMMENDATIONS:

• When taking into account access and cost to diabetes care it is accepted that in some cases individuals will reuse needles. In these circumstances it is recommended that a patient should not use needles/syringes more than 5 times. \[142\] C 3

• Keep needles capped, clean between uses and stored in a clean, safe closed container. Please note that re-capping by a third party is strictly prohibited due to risk of needle stick injury (NSI) and consequent infection risk. C 3

• Care should be taken to prevent contamination of needles. It should not touch anything except the rubber top of the vial (in the case of using syringe needle units) and the skin when injecting. C 3

• No attempt should be made to clean the needle. C 3

• If any doubt exists that the needle may be contaminated, it should be discarded. C 3
2.4 DISPOSAL

2.4.1 DISPOSAL OF INJECTION MATERIAL/SHARPS

Every country has its own regulations regarding the disposal of contaminated biologic waste.

The Health Care Waste Summit (2009) recognised the problem with sharps disposal in South Africa. [175]

Options for discarding a used needle, in order of preference, are:

- Deposit needles into a container especially made for used needles/syringes.
- Deposit into another puncture-proof container such as a plastic bottle.

Options for final disposal of the container, in order of preference, are to take it:

- to a Health Care facility (e.g. hospital);
- to another healthcare provider (e.g. laboratory, pharmacist, doctor’s office).

All stakeholders (patients, HCPs, pharmacists, community officials and manufacturers) are responsible (both professionally and financially) for ensuring proper disposal of used sharps.

- Patients need to know the correct procedure for disposal of needles. Patients need to be informed of the procedure once started on injectable therapy and should be periodically reminded of the procedure. [147]  

- Patients should also understand the potential risks of careless needle disposal (e.g. needle stick injuries) to their family, as well as to other people (e.g. refuse collectors and cleaners) who may come into contact with their used needles.

- Where available, a needle-clipping device should be used. It can be kept in the patient kit and used many times before being discarded safely.

- Under no circumstance should needles (often referred to as ‘sharps’) be discarded in public rubbish bins or with household refuse.

RECOMMENDATIONS:

- All HCPs and patients need to know their local regulations about disposing of needles. There are legal and social consequences of irresponsible needle disposal. [146]  

At least one randomised controlled study
At least one non-randomised study (or non-controlled or epidemiologic) study
Consensus expert opinion based on extensive patient experience
Insulin and GLP-1 injections must be given into the subcutaneous tissue.

Patients should be advised by their trained HCP in the correct injection techniques. [5,8,35]

3.1 LIFTED SKIN FOLDS

- Skin-folds are used when the distance from skin surface to the muscle is less than the length of the needle.
  - On the abdomen and thigh: this is relatively easy (except in very thin or tense abdomens).
  - On the buttocks: this is more difficult to do and seldom needed.
  - On the arm: it is virtually impossible to do correctly when self-injecting.
- A proper skin-fold is made with the thumb and index finger (possibly with the addition of the middle finger) by lifting the skin.
- Using the whole hand increases the risk of lifting muscle with the SC tissue and can lead to IM injections. [39]

The optimal sequence should be:

1. Create skin-fold.
2. Inject insulin slowly at 90 degree angle to surface of skin-fold.
3. Leave the needle in the skin for 10 seconds after the plunger is fully depressed (when injecting with a pen).
4. Withdraw needle from the skin.
5. Release skin-fold.
6. Dispose of needle safely.

All patients should be taught the correct technique for lifting a skin-fold from the very beginning of their insulin/drug therapy. [3]

The skin-fold should not be squeezed so tightly that it causes skin blanching or pain. [3]

Fig. 16

Proper injection technique for subcutaneous absorption of insulin and GLP-1.

4 mm pen needle, NO skin lift.

8 mm pen needle, WITH skin-fold.

RECOMMENDATIONS:

- Each injection site should be examined and a decision made as to whether lifting a skin-fold is required or not. The needle length should be taken into account. [3]
INJECTION TECHNIQUE RECOMMENDATIONS

3.2 SYRINGE AND VIAL

1. Gather your supplies, including your pen, insulin and pen needles. Inject into a clean injection site using clean hands (alcohol is not required).

2. If you are taking cloudy insulin, inspect the contents for any changes such as crystallization, frosting or precipitation. Roll the bottle between your hands until it is uniformly cloudy. Never shake a bottle of insulin.

3. Wipe the top of the insulin bottle with an alcohol swab.

4. Draw air into the syringe equal to the dose of insulin you wish to take.

5. Pierce the rubber stopper of the insulin vial in the middle at a 90 degrees angle and push the air in. Avoid touching the metal rim on the bottle with the needle tip.

6. Holding the bottle upside down slowly and steadily draw the dose into the syringe. The syringe and the vial should be turned back over. Holding the syringe by the barrel, the needle should be carefully removed straight out of the bottle.

7. Choose your injection site. (Injection into the back of your own arm is not recommended)

8. Rotate BETWEEN injection sites.

9. Gently pinch up the area of the skin between your thumb and the index finger. Push the needle through the skin at a 90 degree angle, inject the insulin. Thin individuals and children may need to inject at a 45 degree angle.

10. Push plunger in completely. Count to 10 slowly. (you may have to count past 10 for larger doses)

11. Withdraw the needle from the skin and release the skin-fold.

12. Use the syringe only ONCE. Dispose of it into an approved sharps container.
INJECTION TECHNIQUE RECOMMENDATIONS

3.3 PEN DEVICES

1. Inject into a clean injection site using clean hands. (alcohol is not required)

2. Gather your supplies, including your pen, insulin and pen needles. If your pen is not pre-loaded, load your insulin cartridge into your pen.

3. If you are using cloudy insulin, mix by rolling it 10 times and tipping it 10 times to ensure that it is a milky white consistency. (clear insulin does not need to be mixed)

4. Attach your pen needle and remove both the outer and inner caps.

5. Choose your injection site. (Injection into the back of your own arm is not recommended)

6. Prime your pen. Dial up 2 units and depress the plunger while holding the pen needle pointing up. If drops come out, your pen needle is primed, if not, repeat the steps until drops come out of the top of the pen. (GLP-1 pens only need to be primed the 1st time you use them)

7. Rotate BETWEEN injection sites. Use a different quadrant each week and then rotate clockwise.

8. Push down the thumb button completely. Count to 10 slowly. (you may have to count past 10 seconds for larger doses)

9. Dial your dose and insert pen needle into skin at a 90 degree angle. (Perform a skin-fold if necessary)

10. Remove pen needle and dispose of it in an approved sharps container.

11. Withdraw the needle from the skin and release skin-fold, if appropriate.

12. Replace pen cap.
3 INJECTION TECHNIQUE RECOMMENDATIONS

3.4 ASPECTS FOR CONSIDERATION

3.4.1 LIPOHYPERTROPHY

Lipohypertrophy is the most common abnormality found at injection sites. [150]

- These areas are identified as thickened or ‘rubbery’ lesions [8,151] that feel firm when palpated. [33,65,142,152]

- Although the exact cause has not been substantiated, increased areas of lipohypertrophy are associated with:
  - lack of proper rotation of injection sites,
  - use of non-purified insulin,
  - repeated injection into a small (less than postage stamp) area,
  - reuse of needles. [4,8,62-64,142,150,153]

- The resulting effect has shown:
  - repeated unexplained hypoglycaemia and glucose variability
  - a decrease in the rate of insulin absorption,
  - inconsistent insulin absorption
  - unsightly lumps
  - increased use of insulin (TDD) [41,48,51,52,65,142]

- Patients may prefer the lipohypertrophic sites because these areas have limited nerve innervation and are relatively painless [53,83,142]

- Higher HbA1C levels have been reported with patients injecting into lipohypertrophic sites. [2,52] Both pen and syringe devices, all needle lengths and gauges as well as insulin pump cannula have been associated with lipohypertrophy. [8]

3.4.2 PAIN

Patient compliance in insulin therapy is seldom affected by pain. Pain due to insulin injection is infrequent, unless the needle irritates the nerve endings. Some patients may exhibit needle phobia or increased sensitivity to pain due to past experiences. Correct injection technique can minimise and even avoid injection associated pain. [8,148,149]

- Use new, clean needles (sharp, dry and the right length) for each injection. [148,149] 2
- Use short needles with a fine gauge. [148,149] 2
- Insert the needle at 90 degrees to the skin. 2
- In large doses, consider dose splitting. [8,148,149] 2
- Injections currently being used should be kept at room temperature. [8,148] 2
- Inject slowly and ensure that the thumb button/plunger are completely depressed. [148] 2

Fig. 19

On the LEFT side, normal skin can be pinched tightly together. On the RIGHT side, lipohypertrophic lesions cannot be pinched tightly together.

Fig. 20

Making two ink marks at opposite edges of the lipohypertrophy (at the junctions between normal and fatty tissue) will allow the lesion to be measured and its size recorded for long-term follow-up.
**RECOMMENDATIONS: Lipohypertrophy**

- The best current preventative and therapeutic strategies for lipohypertrophy include:
  - Rotation of injection sites with each injection,
  - Using larger injection sites with each injection,
  - Non-reuse of needles, avoid the reuse of needles
  - Use good quality insulin or insulin analogues. ([56,63,64,142,150,153,156])

- Injection sites should be inspected at every visit. Patients should be taught to inspect their own sites and taught what to look for. ([33,150])

- Patients should not inject into areas of lipohypertrophy until the site returns to normal (this may take months or even years). ([154,155])

- Switching injections from lipohypertrophy to normal tissue may require a decrease of the dose of insulin injected from one individual to another and should be guided by frequent blood glucose measurements. ([50,155])

- Mark and measure lipohypertrophy lesion and keep a record of them.
3.4 ASPECTS FOR CONSIDERATION CONTINUED

3.4.3 BLEEDING AND BRUISING

Occasional bleeding or bruising may occur due to needle choice.

A change in needle length or other injection parameters does not alter the frequency of bleeding or bruising.

However, clinical studies have reported that shorter needles are associated with less frequent bleeding and bruising incidents. [8,35]

Bleeding and bruising appear to have no adverse clinical consequences for the absorption or action of injectable therapies. [8]

**OBSERVATIONS:**

- If bruising occurs repeatedly, revising the injection technique with the patient is recommended.
- Sites with bleeding and bruising should be avoided until fully recovered.
- Reassure patients that bleeding and bruising do not have adverse effects on the absorption of insulin or compromise overall diabetes management.
- To prevent bleeding and bruising, avoid injecting into visible blood vessels and hair roots.
4 ADDITIONAL RECOMMENDATIONS

4.1 PAEDIATRIC

- Thickness of Subcutaneous Fat

Many children and adolescents may be emaciated at the time of diagnosis. Thin children and especially teenage boys have minimal subcutaneous adipose mass. These factors can make it challenging to administer insulin into subcutaneous fatty tissue.

RECOMMENDATIONS:
- Insulin Pens are the injection devices of choice due to shorter needle size, 4.5 or 6 mm. [133] 2
- A 4 mm needle can be inserted at a 90 degree angle without a skin-fold in most children and adolescents. [73,116,117,130,131] 1
- If the child or adolescent is lean, 5 and 6 mm needles may require a 45 degree angled injection with a skin-fold. [73,116,117,130,131] 1
- Use the amount of subcutaneous fat thickness at each of the injection sites to guide the choice of needle length and technique required. [22] 1

- Sites

Small children have a smaller surface area at injection sites. Adolescents often do not adequately adhere to a site rotation plan with resultant lipohypertrophy.

Barriers to the use the of multiple sites are:
- fear that new sites will be painful,
- comfort with their existing routine. [157,158] 1

RECOMMENDATIONS:
- Advise parents and children about the need for a proper system of site rotation. Parents need to be firm about not injecting into “favourite spots”. 1
- For a child who self-injects, supervision may be required to ensure adequate site rotation. 1

- Self-Injection

The age at which children can self-inject is more related to developmental maturity than chronological age. Most children over the age of 10 years can either give their own injection or assist with injecting. [159]

RECOMMENDATIONS:
- When self-injecting, young children should share the responsibility with their parents and self-inject under supervision. [22,159] 2
4 ADDITIONAL RECOMMENDATIONS

4.1 PAEDIATRIC CONTINUED

- Needle Anxiety and Pain
  Needle fear is common in both children with diabetes and their parents. Younger children report more fear and pain. Parent or guardian’s attitude is important for the child’s acceptance of injections. [25,160,161]

**RECOMMENDATIONS:**
- Children have a lower threshold for pain than adults and sometimes find injection uncomfortable. The HCP should ask about pain as many children may not mention it by themselves. [23,24] 2
- Younger children may be helped by: [22] 2
  - Distraction therapy as long as it does not involve trickery. Examples of distraction include injecting while watching a favourite show, blowing bubbles, looking for hidden objects in a book etc. 2
- Older children and adolescents may be helped by cognitive behavioural therapy: [22]
  - Relaxation training
  - Guided imagery
  - Graded exposure
  - Active behavioural rehearsal
  - Modelling and reinforcement
- Play therapy e.g. injecting a favourite stuffed toy. 2

- Insulin Under and Overdosing
  Intentional under and overdosing of insulin is common in children and adolescents and can lead to severe hypoglycaemia or diabetic ketoacidosis. [162-164]

**RECOMMENDATIONS:**
- If insulin dose manipulation is suspected or confirmed, encourage parents to be more involved in insulin administration. [165] 2
- If omission or overdosing is an ongoing problem, parents should be advised to supervise, or inject, the insulin. 3

4.2 PREGNANCY

There is limited research published regarding insulin injection during pregnancy. Recommendations are based on a study using routine foetal ultrasonography to assess the subcutaneous fat patterns of pregnant women (weeks 16 to 38) [167] and expert opinion from practitioners. [166]

**RECOMMENDATIONS:**
- Pregnant women with any type of diabetes who continue to inject into the abdomen should:
  - give all injections using a raised skin-fold. [166] 2
  - avoid using abdominal sites around the umbilicus during the last trimester. 3
- inject into abdominal flanks with a raised skin-fold. 3

- Give all injections using a raised skin-fold. [166] 2
4.3 ELDERLY

Safety is a major consideration in injection therapy. Impairment in dexterity, cognition, vision, and hearing are common in elderly patients. Elderly patients should be assisted by a caregiver and the importance of injection technique as well as the prevention and treatment of hypoglycaemia should be emphasised. [148]

Education and treatment approaches for this population are challenged by physical changes such as:
• Loss of muscle strength and reduced dexterity
• A decrease in skin integrity
• A decrease in subcutaneous tissue
• Changes in memory, sight, and hearing

The approach with elderly patients needs to be highly individualised, integrating all aspects of their life including physical and social realms. [168,169]

RECOMMENDATIONS:
• Individual, standard assessments should be carried out for cognitive and functional abilities. [125,168] 2
• An appropriate treatment plan can then be drawn up. [125,169] 2
• Using pre-mixed insulin in the elderly provides greater accuracy of the insulin dose compared to self-mixed insulin. [170,171] 2
• Pen use (including memory pens and other assistive devices), is recommended. [19] 2
• Involve and educate family members/friends for support and safety. [169,172] 2
• In elderly patients with little subcutaneous adipose tissue particular care is needed when lifting the skin. [42] 2
• All training regarding injection therapy should include follow up demonstrations. [125] 2
• Observe an elderly patient during injection to see if physical capabilities (vision, dexterity) is adequate. [125,126] 2
Missed insulin therapy in Type 1 diabetics can be life-threatening. Planning for adverse events such as:

- natural disasters
- travel delays
- pump failure

is essential and should include precautionary steps to be taken if a such a problem / disaster occurs.

**RECOMMENDATIONS:**

- Educate patients about the importance of contingency planning. [176]  

- Keep supplies for 30 days in a disaster or contingency kit. [176]

- The contingency kit should be personalised for each patient.

- The contingency kit should be kept in a safe, known spot, ready for use.
HEALTHCARE RECOMMENDATIONS

5.1 INSTITUTIONAL CARE

The safety of patients and HCPs living and working in medical and long-term care facilities is the primary consideration for review of injection technique. Every day activities potentially put HCP’s at risk of serious infections with more than 30 potentially dangerous pathogens, including hepatitis B (HBV), hepatitis C (HCV) and human immunodeficiency virus (HIV), through injuries with contaminated needles and lancets. [178]

- Risks

Sharp devices represent a risk for the transmission of blood borne pathogens to the user in the event of a needle stick injury (NSI) or muco-cutaneous blood exposure. [179] The risk can also extend to related medical workers (technical and kitchen personal, rubbish removers and the general public) if they receive an accidental NSI or muco-cutaneous blood exposure involving infectious material. [180]

Studies report that the incidence of NSI among HCP’s giving injections to patients with diabetes or drawing blood with lancets is just as high or higher than workers in other departments. [181]

The prevalence of HBV, HCV and HIV patients with diabetes is reported to be as high, or higher, than in healthy individuals or in patients with other disease states. [182,183,184]

**RECOMMENDATIONS:**

**Injection Technique:**
- Very young children, the elderly or extremely thin or muscular adults may require the use of a lifted skin fold whilst injecting. HCP’s or Carers may have to assist with the injection, safety mechanisms will not protect against a NSI through a lifted skin fold. [73,85,119,132]
- The use of shorter needles (e.g. 4 mm pen needles) may be used in patients WITHOUT a skin fold making the risk of NSI less. [73,85]

**Device:**
- Any health care setting which uses insulin pens must follow a strict one patient / one pen policy. [185]
- When pens are used, the optimal safety device must protect against a sharps injury from both ends (e.g. the patient end and the non-patient end that goes into the cartridge. [187]
- When syringes are used, safety engineered syringes with a protective mechanism which is integrated with the syringe should be used. [187]
### TEN BEST PRACTICE RECOMMENDATIONS

<table>
<thead>
<tr>
<th>Description</th>
<th>Recommendation</th>
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<tbody>
<tr>
<td><strong>Needle Length</strong></td>
<td>1. For all children and adolescents a 4, 5 or 6 mm needle should be used.</td>
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<td></td>
<td>2. Adults, including obese patients, can use 4, 5 and 6 mm needle length.</td>
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<tr>
<td><strong>Site Rotation</strong></td>
<td>3. An easy-to-follow injection site rotation scheme should be taught to the</td>
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<td>patients from the onset of injection therapy.</td>
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<tr>
<td><strong>Needle/Syringe Hygiene</strong></td>
<td>4. Ideally do not reuse needles.</td>
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<tr>
<td><strong>Lipohypertrophy</strong></td>
<td>5. Injection site should be inspected at every visit. Patients should be</td>
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<td>taught to inspect their own sites and should also be given training on how</td>
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<td></td>
<td>to detect lipohypertrophy.</td>
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<td></td>
<td>6. The best current strategies to prevent and treat lipohypertrophy are to</td>
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<td></td>
<td>rotate the injection sites with each injection, using larger injection areas</td>
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<tr>
<td></td>
<td>and non-reuse of needles.</td>
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<tr>
<td><strong>Injection Sites</strong></td>
<td>7. Injection should be given at a clean site with clean hands.</td>
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<td></td>
<td>8. Prior to the injection, the site has to be palpated for lipohypertrophy</td>
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<td>and inspected for wounds, bruises or blisters. If the injection site shows</td>
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<td>any signs of these, then a different site should be selected until the</td>
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<td>problem has been resolved.</td>
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<tr>
<td><strong>Safety Issues</strong></td>
<td>9. Safety needles should be recommended whenever there is a risk for a</td>
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<td>contaminated needle stick injury.</td>
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</table>
Optimising Injection Technique in Diabetes Management

Recommendations for Best Practice in Injection Technique

Optimising Injection Technique in Diabetes Management

Recommendations for Best Practice in Injection Technique

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