ADEA Clinical Recommendations

Subcutaneous Injection Technique for Insulin and Glucagon-like Peptide 1
Foreword

Correct injection technique is paramount for optimal control of diabetes, and the following recommendations are based on the latest research in the delivery of injected diabetes medicines, especially insulin. There is always a fear associated with injections, and the ultimate aim is to improve the ease, comfort, and accuracy of insulin delivery. Diabetes educators are very aware of these fears and concerns when teaching clients, their families, carers and other health professionals how to inject insulin or glucagon-like peptide-1. Some 20 years ago insulin pen devices were first made available in Australia and have since revolutionized the way insulin is injected. Since that time, many new and innovative devices have been developed, which has assisted many people with diabetes to become more receptive and confident to self-inject. Insulin syringes and pen needles are available in different dimensions and lengths, and research has been carried out to identify which needle size, technique and site, would result in optimal absorption of injectable diabetes medicines. Expert panels throughout the world have reviewed such studies and developed best practice clinical guidelines that address the many components of education and assessment required to teach and support people injecting diabetes medicines. As with any process of clinical review, changes to established practice occur.

The ADEA Clinical Recommendations for Subcutaneous Injection Technique for Insulin and Glucagon-like Peptide-1 identifies a number of broad clinical issues including optimal needle length and angle of needle insertion for children/adolescents and adults of varying anatomical size. These clinical recommendations reinforce the importance of documenting the process of teaching and reviewing injection technique.

Correct injection technique using the appropriate size needle is not only important for glycaemic control, it has a direct impact on client self confidence and acceptance of injectable medicines. On behalf of the ADEA Clinical Practice Committee who was pivotal in their development, I hope these clinical recommendations become a useful working document assisting all diabetes educators to reflect on their current practice and promote the use of evidence based practice when using injectable diabetes medicines.

Nuala Harkin
ADEA President
Definition of Terms

GLP-1 Mimetic

At the time of this report only one GLP-1 mimetic agent is available in Australia, exenatide. This GLP-1 mimetic can only be administrated using a disposable pen device which requires a subcutaneous injection technique using the same principles of subcutaneous insulin injection technique.

Lipoatrophy

Lipoatrophy is the breakdown of subcutaneous fat tissue resulting from repeated insulin injections at the same anatomical site. A depression or sunken look to the affected can be observed.

Lipohypertrophy

Lipohypertrophy is an area of thickened subcutaneous tissue resulting from repeated injections of insulin using syringes and pen devices into an area of tissue where a non-rotation technique of injection sites is not employed. Lipohypertrophy may not be detected by visual inspection. However, when palpated the affected area cannot be pinched together. Lipohypertrophy can further exacerbate the problems associated with insulin absorption. Insulin injected into areas of lipohypertrophy may cause delayed insulin absorption and could thus contribute to erratic blood glucose levels.

Skin fold lift

A skin fold lift is made using the thumb and index or middle finger to gently lift subcutaneous tissue away from the muscle layer to reduce the risk of administering the medicine intramuscularly. With shorter needles, often the creation of a skin fold lift is not required.
Acknowledgments

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This project was undertaken by the ADEA Clinical Practice Committee.

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The ADEA wishes to acknowledge the work of The Third Injection Technique Workshop in Athens (TITAN) for its published guidelines titled ‘New injection recommendations for patients with diabetes’. In addition, a literature search, review and grading was undertaken to identify any additional studies since the publication of the TITAN recommendations in September 2010. We would like to thank Lhawang Ugyel from ADEA National Office for this contribution.
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ADEA Clinical Recommendations for Subcutaneous Injection Technique for Insulin and Glucagon-Like Peptide 1

The Australian Diabetes Educators Association (ADEA) promotes the use of evidence and consensus based practice within all aspects of diabetes education and care, including when using injectable diabetes medicines. The ADEA recognises that incomplete and/or inaccurate instruction and education on injectable medicines and injection technique can result in diabetes medicines designed to be administered into subcutaneous tissue, being injected intramuscularly. This may cause an alteration in the action of the medication and an increased risk of pain or discomfort, bruising or bleeding at the injection site, as well as the person with diabetes being at risk of experiencing a serious adverse event from an alteration in the onset and action of the medicine.

These clinical recommendations address the injection technique for pen devices and syringes for insulin and glucagon-like 1 peptide (GLP-1) mimetic. This document does not address the administration of glucagon which is normally administered intramuscularly except in children aged less than 5 years of age, nor does it focus on technical issues associated with continuous subcutaneous insulin infusion devices (CSII).

The ADEA wishes to acknowledge the work of The Third Injection Technique Workshop in Athens (TITAN) for its published guidelines titled ‘new injection recommendations for patients with diabetes’. In addition, a literature search, review and grading was undertaken to identify any additional studies since the publication of the TITAN recommendations in September 2010.
The ADEA recommends:

- People with diabetes, their relevant family members, carers and health care providers receive quality education and instruction that encompasses contemporary evidence and consensus based principles of injection technique from diabetes educators.
- Diabetes educators should document all components of assessment and education for the administration of injectable diabetes medicines including the psychological status of the patient when initiating insulin therapy, site of delivery, site rotation, whether using a skin fold lift technique is required, the size and angle of insertion of the needle used, pen device assembly and priming as per individual manufacturers’ instructions, duration injecting device is kept in situ following the administration of the medicine and safe disposal of sharps and injecting materials.
- Shorter length needles 4, 5 and 6mm are generally recommended for both children/adolescents and adults including obese patients and have been shown to provide equivalent glycaemic control as needles of 8 and 12.7mm length. A 45 degree angle should be used when administering insulin with a syringe when using a needle length ≥8mm.
- Injectable diabetes medicines should not be administered in areas of scarring or hypertrophy or through clothing and diabetes educators need to be aware of the factors that can affect efficacy of injected medicines.
- Different diabetes injectable medicines have specific recommendations in relation to the preferred site of injection.
- The size and angle of insertion of the needle used to inject a diabetes medicine is consonant to the age and size of the person with diabetes, the amount of subcutaneous and muscle tissue mass available at the injection site and use of a lifted skin fold where appropriate.
- All people receiving education and instruction about injectable diabetes medicines are taught the correct technique for lifting a skin fold.
- Regular reviewing of injection technique and injection site inspection are undertaken and documented by diabetes educators and are considered as integral to the assessment for all people with diabetes requiring injectable diabetes medicines.
- As part of quality improvement, management activities and risk reduction strategies, regular review of health care providers’ knowledge and skills pertaining to injecting diabetes medicines is undertaken by diabetes educators. Appropriate policies and procedures should be developed for health care facilities and education strategies and programs implemented and evaluated to ensure compliance.
- Additional consideration should be afforded to issues that include the priming of pen devices, re-suspension of cloudy insulin, duration pen devices are left in situ following delivery of medicine, disinfection of skin and the washing of hands prior to injecting, injection location in pregnancy, insulin leakage, when to remove pen needles and where additional information can be sought.
Purpose of clinical recommendations

The purpose of these clinical recommendations is to:

- Outline the considerations required when determining the site for injecting a diabetes medicine, the size and insertion angle of needles to be used, and whether the technique of lifting a skin fold lift as part of injecting is required.
- Identify factors that can affect the efficacy of the medicine injected and the degree of discomfort experienced by the person with diabetes.
- Highlight that the review of injection technique and injection site inspections are integral to the assessment of the diabetes self-management skills for the person with diabetes.
- Focus on the need to teach and evaluate the understanding and application of the principles that underpin correct injection techniques and factors that effect the efficacy of pharmacological actions to all people: the person with diabetes, family members, carers and health care providers directly engaged in the administration of injectable diabetes medicines.
- Reinforce the importance of documentation of assessment and teaching activities involved with injectable diabetes medicines.
- Minimise adverse outcomes.

Background

The instruction of correct injection technique is a core function for diabetes educators. Education in correct injection technique undertaken by diabetes educators is provided to people with diabetes, their family members, carers and to other health care providers. People with diabetes requiring insulin therapy may require four or more injections each day. For the purpose of this document, injectable diabetes medicines include insulin and glucagon-like peptide 1 (GLP-1) mimetic. In the future, other classes of agents to treat diabetes may also be administered subcutaneously or intramuscularly.

With an increase in the number of new medicines and pen devices released, a number of key overarching principles exist. These principles address issues such as the amount of subcutaneous or muscle tissue available at a potential injection site, the length and angle of needle to be inserted and the use of a skin fold lift as part of the injection process. Incomplete and/or inaccurate instruction on injection technique can result in diabetes medicines administered incorrectly and may cause an alteration in the action of the medication and an increased risk of pain or discomfort, bruising or bleeding at the site to the person with diabetes.

Fundamentally, insulin and GLP-1 mimetic agents are designed to be administered subcutaneously in order to attain the most consistent efficacy of their pharmacological actions. Glucagon has been developed to be injected into muscle tissue to maximise its effects on blood glucose levels, and although it can be administered in children under the age of 5 years subcutaneously, will not be addressed by these clinical recommendations.
Studies identified by the TITAN recommendations highlight that people with diabetes may not receive essential information pertaining to administration of diabetes medicines that include:

- The injecting regimen.
- 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 use of skin fold lifting).
- Injection complications and how to avoid them.
- Optimal needle lengths.
- Safe disposal of sharps.

Clinical recommendations

**People with diabetes, their relevant family members, carers and health care providers receive quality education and instruction that encompasses contemporary evidence and consensus based principles of injection technique from diabetes educators.**

Educating the person with diabetes, family members, carers or health care providers is a dynamic process. A number of issues need to be identified, addressed and evaluated including:

- The person’s readiness and ability to learn.
- The person’s understanding of the diabetes disease process.
- Physical or psychosocial factors affecting the ability to inject.
- Type of device best suited to the individual.
- The level of mastery and confidence.
- Willingness to undertake other aspects of diabetes self-management related to injectable diabetes medicines.

Diabetes educators should document all components of assessment and education for the administration of injectable diabetes medicines including the psychological status of the patient when initiating insulin therapy, site of delivery, site rotation, whether using a skin fold lift technique is required, the size and angle of insertion of the needle used, pen device assembly and priming as per individual manufacturers’ instructions, duration injecting device is kept insitu following the administration of the medicine and safe disposal of sharps and injecting materials.

The entire process of education must be documented. Formal and regular review of any pre-existing injection knowledge and self-care practices should also be undertaken and documented where the person is already using injectable medicines. Knowledge and competency are assessed against education outcomes and documented.

Traditionally pen needles have been recommended to be used at a 90 degree angle. In cases where there is insufficient adipose tissue for the needle length to ensure that a subcutaneous injection will occur, administration using a 45 degree angle maybe required and therefore will need to be documented by the diabetes educator. Shorter-length needles may be used at a 90 degree angle.
Shorter length needles 4, 5 and 6mm are generally recommended for both children/adolescents and adults including obese patients and have been shown to provide equivalent glycaemic control as needles of 8 and 12.7mm length. A 45 degree angle should be used when administering insulin with a syringe when using a needle length ≥8mm.

Insulin syringes currently available in Australia range in needle length of 8mm, 12mm, 12.7mm and 13mm.\(^3\) To ensure that insulin is not inadvertently administered intramuscularly, the use of a 45 degree to inject should be adopted for all syringes. There are additional considerations with the use of syringes when drawing up insulin and removing air bubbles.

Unlike pen devices, a syringe can be removed following the completion of injecting without waiting ten seconds.\(^4\) Different manufacturers produce syringe needles with varying widths; 29 gauge, 30 gauge and 31 gauge. The finer the gauge (higher the number), the smaller the diameter which may be helpful for patients experiencing discomfort during injecting.\(^5\)

**Injectable diabetes medicines should not be administered in areas of scarring or hypertrophy or through clothing and diabetes educators need to be aware of the factors than can effect efficacy of injected medicines.**

Lipohypertrophy and lipoatrophy can occur when older and less purified insulin preparations are used, not rotating the sites of injecting by either repeatedly injecting in the same spot or using an area that is too small for effective rotation, or reusing needles. Such areas of tissue can be detected both visually and by palpation and can affect the absorption of insulin, which in turn can affect glycaemic control.\(^2\) Any area of lipohypertrophy, inflammation, oedema or infection should be avoided as an injection site until resolved.\(^5\)

People with diabetes, their carers and health care providers should be taught an easy-to-follow rotation regimen with successive injections should be spaced at least 1cm from each other. The rotation regimen used by individual person with diabetes should be documented by the diabetes educator. When switching from previously used areas of lipohypertrophy to non-affected areas, a reduced insulin dose may need to be considered in conjunction with increased blood glucose testing.\(^5\)

Injecting through clothing means that neither the person injecting cannot see the injection process fully nor employ a skin fold lift if required, increasing the risk of a transdermal (intramuscular) injection and therefore is not recommended.\(^6\)

Patients should be instructed on how to self-examine their injection sites.\(^5\)

**Different diabetes injectable medicines have specific recommendations in relation to the preferred site of injection.**

Rapid-acting insulin analogues can be given at any recommended injection site without significant effect on absorption rates.\(^7\) Long-acting insulin analogues may also be injected at any recommended injection site, but should not be injected intramuscularly due to risk of severe hypoglycaemia.\(^8\) The thigh and buttocks are the preferred site for NPH due to a slower absorption rate (and reduced risk of nocturnal hypoglycaemia),\(^9\) and the abdomen
preferred for faster absorbing of regular human insulin. Basal analogue insulin injected subcutaneously into the thigh followed by vigorous exercise has not shown any increased rate of absorption.

In elderly people with diabetes, the absorption rate of regular human insulin is slower and therefore will not produce a rapid post prandial effect. Pending further studies, long-acting insulin analogues and GLP-1 mimetic agents should be administered in current established locations such as the abdomen or where sufficient fatty tissue is available – the outer thighs. When injecting rapid and long-acting analogue insulin, each injection should be administered within a different site, even if injected at different times during the day. Massaging the injection site either before or after injecting could increase the rate of absorption of insulin and therefore is not generally recommended.

The size and insertion angle of the needle used to inject a diabetes medicine is consonant to the age and size of the person with diabetes, the amount of subcutaneous and muscle tissue mass available at the injection site and use of a lifted skin fold where appropriate.

Several studies have identified that the thickness of subcutaneous tissue varies considerably according to age, body site, gender and body mass index (BMI). The thickness of the skin (epidermis and dermis), however does not vary greatly and is usually 1.9 – 2.4mm in thickness regardless of site, age, ethnic background, gender or BMI and rarely more than 3.0mm. Therefore people with a larger BMI do not necessarily need to use a longer needle. The absorption of regular insulin has been shown to be the same whether injected deep into subcutaneous fat with a long needle, or superficially with a short needle. There is no medical reason for the use of needles greater than 8mm in length for any adult with diabetes regardless of their BMI; for children, needles longer than 6mm are generally not recommended, unless using a syringe with an 8mm needle. If a person with diabetes wishes to continue using needles greater than 8mm in length, they should lift a skin fold or inject at a 45 degree angle to avoid inadvertently injecting into muscle. Adults should use 4, 5 or 6mm needles using a 90 degree angle (especially the 4mm length), and rarely require the use of a skin fold lift. Very slim people with diabetes and children should use 4 or 5mm needles, may require a skin fold lift, especially with 5mm needles. Further research is needed with respect to 4mm needles. Very slim people using 6mm needles should use either a skin fold lift or inject on a 45 degree angle.
### Children

<table>
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<th>Needle size</th>
<th>Degree of injection angle</th>
<th>Use of skinfold</th>
</tr>
</thead>
<tbody>
<tr>
<td>4mm</td>
<td>90</td>
<td>May</td>
</tr>
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<td>5mm</td>
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<td>6mm</td>
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<tr>
<td>8mm*</td>
<td>45</td>
<td>Yes</td>
</tr>
<tr>
<td>&gt;12mm^</td>
<td>45</td>
<td>Yes</td>
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</table>

* use for syringe only, preferable to use shorter needles when using pen needles

^ needle length discouraged in children

### Very slim adults

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<th>Needle size</th>
<th>Degree of injection angle</th>
<th>Use of skinfold</th>
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</thead>
<tbody>
<tr>
<td>4mm</td>
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<tr>
<td>8mm</td>
<td>45</td>
<td>Yes</td>
</tr>
<tr>
<td>&gt;12mm*</td>
<td>45</td>
<td>Yes</td>
</tr>
</tbody>
</table>

*use of syringe only and discouraged
### Adults of normal weight

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<td>Rarely</td>
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</tr>
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<td>6mm</td>
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<td>Yes</td>
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<td>8mm</td>
<td>45</td>
<td>Yes</td>
</tr>
<tr>
<td>&gt;12mm*</td>
<td>45</td>
<td>Yes</td>
</tr>
</tbody>
</table>

*not generally recommended

### Adults who are overweight or obese

<table>
<thead>
<tr>
<th>Needle size</th>
<th>Degree of injection angle</th>
<th>Use of skinfold</th>
</tr>
</thead>
<tbody>
<tr>
<td>4mm</td>
<td>90</td>
<td>No</td>
</tr>
<tr>
<td>5mm</td>
<td>90</td>
<td>No</td>
</tr>
<tr>
<td>6mm</td>
<td>90</td>
<td>No</td>
</tr>
<tr>
<td>8mm</td>
<td>45 - 90</td>
<td>No</td>
</tr>
<tr>
<td>&gt;12mm*</td>
<td>45</td>
<td>No</td>
</tr>
</tbody>
</table>

*not generally recommended

All people receiving education and instruction about injectable diabetes medicines are taught the correct technique for lifting a skin fold.

Prior to injecting, the injection site should be examined to determine whether lifting a skin fold is required in terms of the needle length employed. A skin fold lift is made using the thumb and index or middle finger that lifts subcutaneous tissue away from the muscle layer and reduces the risk of administering medicines intramuscularly. This process should be done gently to avoid harsh handling of the area to minimise potential cause for skin blanching or pain, or inadvertently also lifting up muscle tissue. All people with diabetes,
their family members, carers and health care providers should be taught the correct technique for lifting a skin fold.

**Regular reviewing of injection technique and injection sites is undertaken and documented by diabetes educators and is considered as integral to the assessment for all people with diabetes requiring injectable diabetes medicines.**

This review should include the visual assessment and palpation of injection sites. Signs of bleeding and bruising maybe due to intramuscular administration. TITAN recommends review of injection sites and technique with each visit if possible and at the very least annually.\(^2^4\) If blood glucose results recorded indicate a high variability without obvious explanation, review of injection sites and technique should form the basis of clinical enquiry.

**As part of quality improvement, management activities and risk reduction strategies, regular review of health care providers’ knowledge and skills pertaining to injecting diabetes medicines is undertaken by diabetes educators. Appropriate policies and procedures should be developed for health care facilities and education strategies and programs implemented and evaluated to ensure compliance.**

Syringes and pen needles are single use only. Recapping of needles should only be undertaken by the person with diabetes administering their own medicine. Needle stick injuries are common among health care providers, particularly when infection prevention procedures are not adhered to. Family members, carers and health care providers should not recap needles. Organisations should protect the person with diabetes, the public and staff from blood-borne pathogens by ensuring their specific infection prevention policies reflect best-practice and their employees receive the training and have access to the equipment to practice in accordance with these policies.\(^2^5\) If the person with diabetes is unable to remove the pen needle from their injecting device (regardless of whether they are able to self-administer), health care providers should instead administer insulin using a syringe (note there is no provision to use a syringe for exenatide).\(^2^6\) Retractable pen needles and syringes are available, with only one syringe manufacturer with National Diabetes Services Scheme subsidy at the time this document was developed.\(^3\) Some health care facilities use specific sharps disposal containers that allow the safe unscrewing of a pen device needle to occur within the defines of the container.

Under no circumstance should pen device needles and syringes be directly disposed into public rubbish. Rather all injectable diabetes medicines sharps must be discarded into an approved sharps container and taken to an approved sharps waste disposal agency, for example, the local council or shire.

Pen devices and cartridges are for single person use only and should never be shared due to the risk of cross contamination, even if a fresh pen needle is used for each injection.\(^2^7\)
Additional considerations

Differences in pen devices pertaining to priming

Manufacturers of pen devices for insulin and GLP-1 mimetics differ with respect to whether a priming process is required at the commencement of a new device or as part of every injection. Diabetes educators need to be cognisant of these individual differences in manufacturers’ instructions for the preparations of injection devices.

Re-suspension of insulin

Cloudy insulin (NPH and pre-mixed insulins) must be resuspended according to individual manufacturers’ instructions prior to every injection: this generally means gently tipping of the vial or pen 10 to 20 times.

Time pen device is left insitu following injection

As with priming of pen devices, the duration of time a pen device is left insitu following injecting varies between different manufacturers, but is usually at least 10 seconds. However counting past ten seconds maybe necessary for higher doses of insulin to minimise insulin backflow/leakage. 4

Disinfection of skin prior to injection

Use of alcohol swabs to prepare the skin prior to injection is usually not required, however the application of soap and water to an injection site if unclean should occur. 2

Washing of hands prior to injecting

Hands should be clean prior to injecting a diabetes medicine. 5

Injection location during pregnancy

Pregnant women with diabetes should administer all injections into the abdomen using a raised skin fold, but avoiding areas close to the umbilicus during the third trimester is recommended. 28

Insulin leakage

Studies in people with type 1 and type 2 diabetes using 4, 5, and 6mm needles indicate that needle length size does not impact on insulin leakage at the injection site and measured leakage is very small as a percentage of the injected dose. 4, 18, 21, 22

Removal of the pen needle

When using a pen device, the pen needle should be removed from the device immediately after administering the diabetes medicine. Pen needles left attached can allow for the contents of the pen device to leak out or allow air bubbles to enter the cartridge chamber leading to inaccurate dosing of subsequent injections. 4, 29 An additional consideration to
remove the pen needle after use is microbe contamination, present after a single use and amplified after repeated use. \(^{30}\)

**Awareness of risk of using incorrect injection needle length occur at NDSS outlets and sub-agents**

Two documents currently exist on line to assist NDSS outlets and sub-agents in the awareness and risk of incorrect needle length. \(^{31,32}\)
References


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