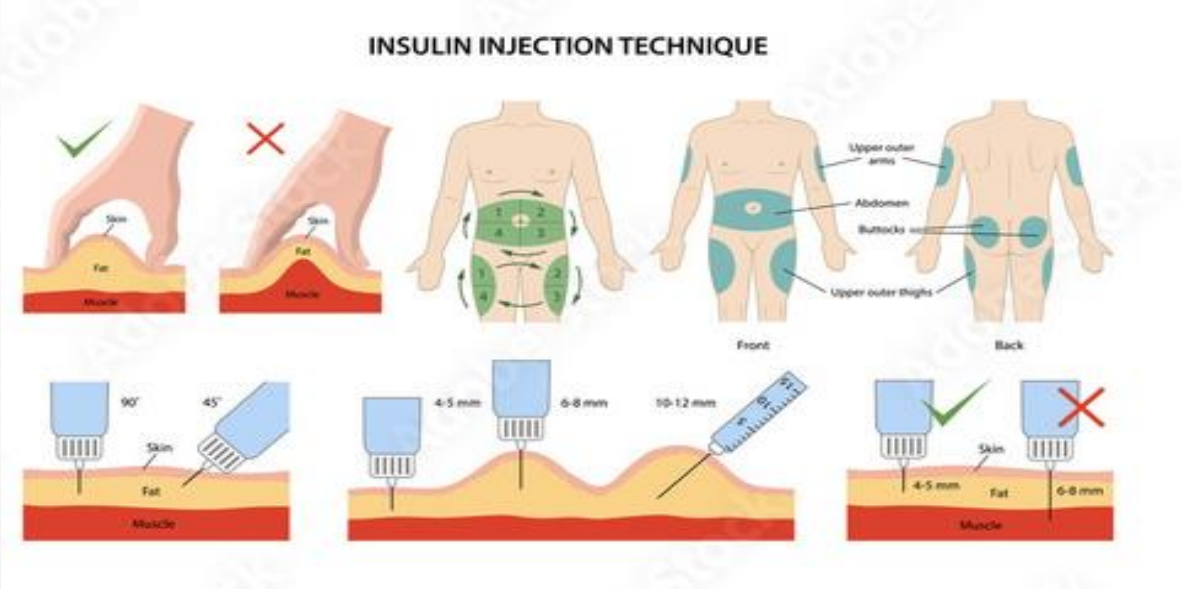
What should be the appropriate needle length?

- Sarita CHAN
- NC (DM) / KWC-PMH

- 27 Nov 2021



- IM injection increase insulin absorption
- Consistent delivery of insulin in SC tissue reduce glucose variability
- Needle length & way of insertion are key factors
- Knowledge of subcutaneous fat thickness is essential for the use of appropriate needle length

Needle Length (2014)

Insulin Syringe

- Adult and children using an 8mm needle should lift a skin fold and inject at 45 to 90 degree angle to the skin surface (IIA)

Pen Needle

- The desired length of pen needle should be individually defined within the range of 4, 5 or 6 mm (IIA)

Needle Length (2021)

Insulin Syringe

- The desired needle length of insulin syringe should be the shortest available needle 6mm (IIA)

Pen Needle

- The desired length of pen needle should be individually defined within the range of 4 or 5 mm needle (IIA)

Hirsch L, Byron K, Gibney M. Intramuscular risk at insulin injection sites-measurement of the distance from skin to muscle and rationale for shorter-length needles for subcutaneous insulin therapy. Diabetes Technol Ther. 2014;16:867-873.



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DTT
Diabetes Technology & Therapeutics

ORIGINAL ARTICLE

Intramuscular Risk at Insulin Injection Sites—Measurement of the Distance from Skin to Muscle and Rationale for Shorter-Length Needles for Subcutaneous Insulin Therapy

Laurence Hirsch, MD, Karen Byron, MS, and Michael Gibney, RN, MA

Abstract

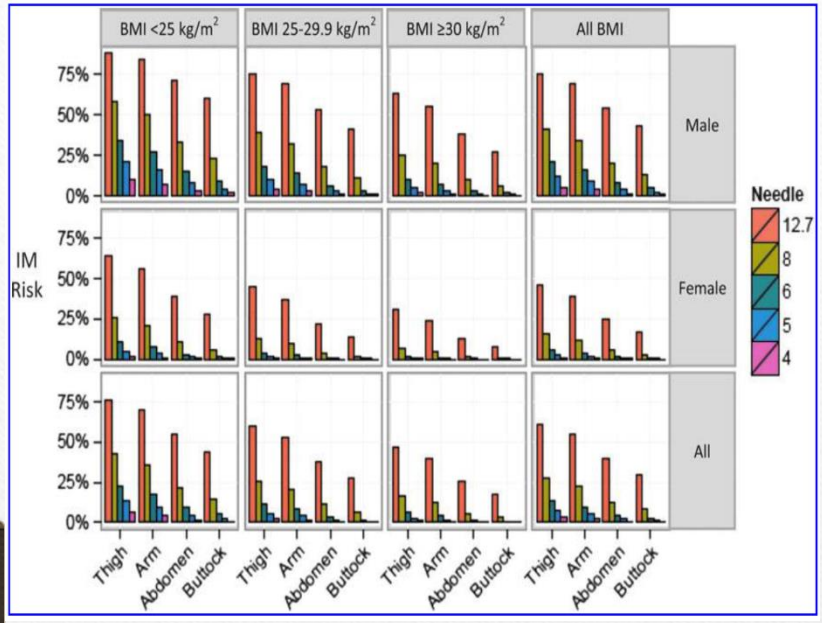
Background: Intramuscular (IM) injection can increase insulin absorption, causing hypoglycemia. Available needle lengths today are 4–12.7 mm for pens and 6–12.7 mm for syringes. We describe the distance (*D*) from skin surface to muscle fascia at injection sites for subcutaneous (SC) insulin therapy and recommend needle lengths to reduce IM injection risk.

- An observational study (Cat II)
- N=341 diabetes adults
- Rainier Clinical Research Center, Renton, WA; and Diablo Clinical Research, Walnut Creek, CA ((US)
- Measured skin and SC fat thicknesses by ultrasound at the abdomen, arm, thigh, and buttock & estimate IM risk by using different needle length
- BMI: 19–65kg/m2
- Paired ST & SCT: 1208
- 4-12.7mm needle length, no skin lift
- ST is consistent <0.6mm

TABLE 2. DISTANCE FROM SKIN SURFACE TO MUSCLE FASCIA, BY BODY SITE FOR INSULIN INJECTION

Site	Number	Median (95% CI) (mm)	Minimum (mm)	Maximum (mm)
Thigh	338	10.9 (10.3, 11.6)	2.9	33.0
Arm	311	12.0 (11.3, 12.7)	4.1	43.8
Abdomen	309	14.7 (13.9, 15.6)	4.8	47.0
Buttock	250	16.9 (15.9, 18.1)	4.5	41.8

- Minimum skin to muscle fascia was < 3 mm at the thigh and < 5 elsewhere
- Difference of median ~6.0mm
- Maximum SCT 33-42 mm



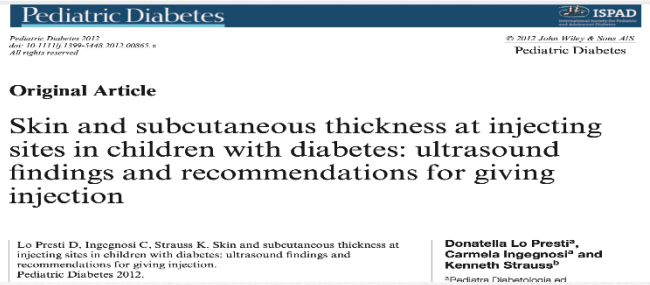
- Gender, BMI & body site affect the SC fat thickness
- Subjects with a BMI of <25kg/m2 have an approximately two- to fourfold greater IM risk compared with obese subjects at any injection site, regardless of needle length
- IM risk in men > women
- Estimated risk of IM by 4mm needle <1% in women & <5% in men

TABLE 3. ESTIMATED INTRAMUSCULAR INJECTION RISK BY BODY SITE, NEEDLE LENGTH, AND INJECTION ANGLE

Needle length, injection angle	*Thigh (n=338)*	*Arm (n=311)*	*Abdomen (n=309)*	*Buttock (n=250)*
4 mm				
90°	1.6%	1.0%	0.3%	0.1%
45°	NA	NA	NA	NA
5 mm				
90°	4.7%	3.1%	1.1%	0.5%
45°	NA	NA	NA	NA
6 mm				
90°	10.0%	7.0%	2.8%	1.3%
45°	2.2%	1.3%	0.4%	0.2%
8 mm				
90°	25%	19.5%	9.7%	5.5%
45°	8.0%	5.5%	2.1%	1.0%
12.7 mm				
90°	63%	55%	38%	26.9%
45°	34%	27%	14.6%	8.8%

- IM risk highest at the thigh & lowest at the buttock
- IM risk varies directly with needle length at each site
- IM injection risk is substantially reduced with a 45° insertion angle

Lo Presti D, Ingegnosi C, Strauss K. Skin and subcutaneous thickness at injecting sites in children with diabetes: ultrasound findings and recommendations for giving injection. Pediatric Diabetes 2012 (Cat II)



Pediatric Diabetes

ISPAD

Pediatric Diabetes 2012: doi: 10.1111/j.1399-5448.2012.00865.x
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Pediatric Diabetes

Original Article

Skin and subcutaneous thickness at injecting sites in children with diabetes: ultrasound findings and recommendations for giving injection

Lo Presti D, Ingegnosi C, Strauss K. Skin and subcutaneous thickness at injecting sites in children with diabetes: ultrasound findings and recommendations for giving injection. Pediatric Diabetes 2012.

Donatella Lo Prestiª, Carmela Ingegnosiª and Kenneth Straussᵇ

ªPediatra Diabetologia ed

- An observational study (Cat II)
- Studied the distance from surface to muscle in children
- 101 children with type 1 diabetes
- 3 groups: age: 2–6, 7–13, & 14–17 yr
- Measured the thickness of skin and subcutaneous (SC) tissue by ultrasound in all injection sites
- Skin thickness varied from 1.58 mm in the arm of the youngest children to 2.29 mm in the buttocks of the adolescents
- Greater variability for the thickness of skin and SC overall

Table 2. Values of skin thickness in pediatric subgroups and adults from another similar study (14)

	Pediatric study results			
Skin thickness (mm ± SD)	2–6 yr	7–13 yr	14–17 yr	Adults*
Arm	1.58 ± 0.23	1.71 ± 0.29	1.92 ± 0.42	2.23 ± 0.44
Thigh	1.71 ± 0.25	1.89 ± 0.30	2.14 ± 0.35	1.87 ± 0.39
Abdomen	1.71 ± 0.27	2.07 ± 0.31	2.18 ± 0.50	2.15 ± 0.42
Buttocks	1.97 ± 0.27	2.11 ± 0.35	2.29 ± 0.41	2.41 ± 0.48

*Values from another study (14).

Table 3. Skin + SC thickness in pediatric subgroups

Skin + SC thickness (mm ± SD)	2–6 yr	7–13 yr	14–17 yr
Arm	4.89 ± 1.47	6.02 ± 1.86	6.31 ± 1.94
Thigh	6.05 ± 2.44	7.36 ± 2.31	7.49 ± 2.10
Abdomen	6.12 ± 3.47	7.98 ± 3.40	7.75 ± 2.91
Buttocks	6.53 ± 2.26	8.73 ± 3.18	8.12 ± 2.81

SC, subcutaneous.

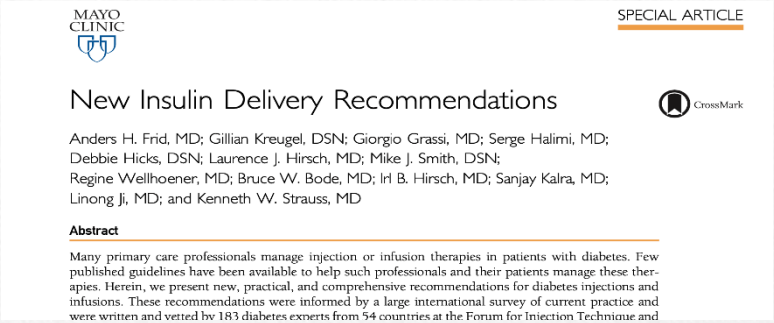
- Skin surface to muscle distances were <4mm in nearly 10% of children, especially in the 2–6 yr group.
- Rate of IM injections using the 4-mm pen needle when a pinch-up is not used was 20.2%. IM injections rate doubles when using the 5-mm needle
- The safest needle for all children is the 4-mm pen needle. It should be used with a pinched skin fold when used in children aged 2–6 yr

Table 4. The estimated incidence of SC and IM injections by age groups

Expected injection destinations through 90° insertion			
Needle lengths (mm)	SC	IM	Percentage of IM injections (%)
	Age 2–6 yr (total n = 248)		
4	198	50	20.2
5	134	114	46.0
6	83	165	66.5
8	40	208	83.9
12.7	7	241	97.2
	Age 7–13 yr (total n = 392)		
4	374	18	4.6
5	320	72	18.4
6	243	149	38.0
8	136	256	65.3
12.7	24	368	93.9
	Age 14–17 yr (total n = 168)		
4	164	4	2.4
5	141	27	16.1
6	110	58	34.5
8	57	111	66.1
12.7	6	162	96.4

IM, intramuscular; SC, subcutaneous.

Frid A H, Kreugel G, Grassi G, Halimi S, Hicks FD, Hirsch L J, Smith M J, Wellhoener R, Bode B W, Hirsch I B, Kalra S, Ji L and Strauss W. New Insulin Delivery Recommendations. Mayo Clin Proc 2016. 91(9):1231-1255


MAYO CLINIC

SPECIAL ARTICLE

New Insulin Delivery Recommendations

CrossMark

Anders H. Frid, MD; Gillian Kreugel, DSN; Giorgio Grassi, MD; Serge Halimi, MD; Debbie Hicks, DSN; Laurence J. Hirsch, MD; Mike J. Smith, DSN; Regine Wellhoener, MD; Bruce W. Bode, MD; Irl B. Hirsch, MD; Sanjay Kalra, MD; Linong Ji, MD; and Kenneth W. Strauss, MD

Abstract

Many primary care professionals manage injection or infusion therapies in patients with diabetes. Few published guidelines have been available to help such professionals and their patients manage these therapies. Herein, we present new, practical, and comprehensive recommendations for diabetes injections and infusions. These recommendations were informed by a large international survey of current practice and were written and vetted by 183 diabetes experts from 54 countries at the Forum for Injection Technique and

- Recommendation (Cat III)
- Reviews the most recent studies in the field and complement and extend the injection recommendations published in 2010
- Publications were identified using Medline, EMBASE, PubMed, and Cochrane Controlled Trials. The search was focused on the period between January 2008 and December 2015
- Recommendations were based on the results of the 4th Injection Technique Questionnaire (ITQ) survey, from 2014 to 2015, including 13,289 insulin injecting patients with diabetes from 42 countries
- Reviewed by 183 diabetes experts from 54 countries at the Forum for Injection Technique and Therapy: Expert Recommendations (FITTER) workshop held in Rome in 2015

Skin Thickness

- The skin thickness varies from approximately 1.25 to 3.25 mm in 90% of individuals and averages approximately 2.0 to 2.5 mm. Studies have included both healthy volunteers and persons with diabetes, across age groups, sexes, body mass indexes (BMIs), and geographic locations

SC Thickness

- SC fat thickness increases in direct proportion to BMI; women, on average, have an approximately 5-mm greater SC fat thickness than men at the same BMI; and abdomen and buttocks have thicker SC fat layers than thighs and arms in the same individual.
- Children aged 0 to 2 years have higher BMIs and more SC tissue than preschool children
- Preschool children (2-6 years old) are usually at the thinnest point
- School-age children (7-13 years old) slowly gain SC tissue

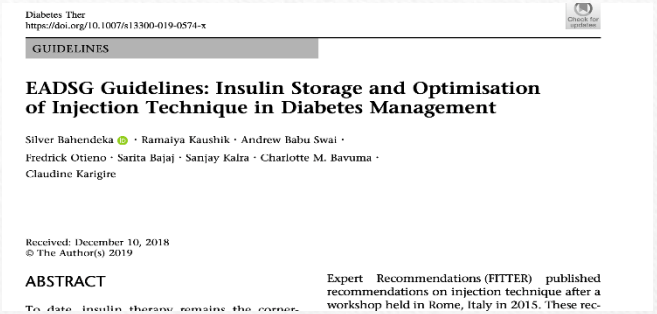
Summary of recent studies on 4 and 5 mm needles

- Needle length ≥8mm for adults & ≥6mm for children are too long for SC injection
- Hirsch conducted RCT to compare a 4 mm pen needle to 5 & 8 mm needles found that 4 mm needle was shown to be safe and efficacious in adult patients of all sizes and less pain
- Miwa compared 4mm with 6mm and Nagai compared 4mm to 5mm, found similar results
- Birkebaek compared the 4 mm with the 6 mm pen needle in lean subjects, both children and adults, with diabetes. 4 mm led to fewer IM injections with equivalent levels of leakage compared to the 6 mm needle
- Lo Presti measured the skin and SC thickness at various injection sites in children and adolescents with diabetes (ages 2-17) and concluded that the safest injecting alternative for all ages is the 4 mm needle. A 4 mm needle is long enough to penetrate the skin but sufficiently short to avoid reaching the muscle in the vast majority of children
- If insert a 4 mm needle at a 45 °, the penetration depth is approximately 2.8 mm

Recommendations

- The 4-mm needle is considered the safest pen needle for adults and children regardless of age, sex, ethnicity, or BMI
- Very young children (6 years old) and very thin adults should use the 4-mm needle by lifting a skinfold and inserting at 90°
- Children using the 5-mm pen needle should inject using a lifted skinfold.
- The safest currently available syringe needle is 6 mm in length. Lifted skinfold is required for children, adolescents, or slim adults
- Injecting at a 45° angle using a 6-mm needle is an acceptable substitute for lifting a skinfold, net penetration of a 45° injection using the 6-mm needle is approximately 4 mm

Bahendeka S, Kaushik R, Swai A B, .Otieno F, Bajaj S, Kalra S, Bavuma C M, & Karigire C EADSG Guidelines: Insulin Storage and Optimisation of Injection Technique in Diabetes Management (2019) Diabetes Ther



Diabetes Ther
https://doi.org/10.1007/s13300-019-0574-x

GUIDELINES

EADSG Guidelines: Insulin Storage and Optimisation of Injection Technique in Diabetes Management

Silver Bahendeka · Ramaiya Kaushik · Andrew Babu Swai · Fredrick Otieno · Sarita Bajaj · Sanjay Kalra · Charlotte M. Bavuma · Claudine Karigire

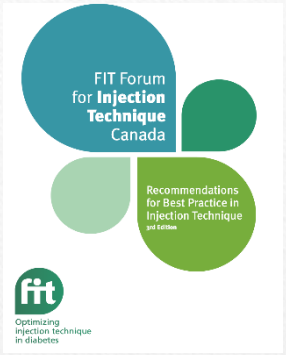
Received: December 10, 2018
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ABSTRACT

Expert Recommendations (FITTER) published recommendations on injection technique after a workshop held in Rome, Italy in 2015. These rec-

- Recommendation (Cat III)
- The East Africa Diabetes Study Group based on the Forum for Injection Technique and Therapy Expert Recommendations (FITTER) published recommendations on injection technique in 2015, further to seek consensus on insulin therapy within the East African region
- Literature search on injection technique and preservation of insulin was done using Medline, PubMed and the Index African Health Journals Database between 2010 and 2018.
- Keywords: injection, insulin, "insulin therapy", "subcutaneous injections", "injection technique", "insulin infusion", "insulin storage", "insulin transportation", "cold chain" and Africa
- The workshop comprised of health care professionals, experts in diabetes care and patients on insulin therapy. The final recommendations and consensus guidelines presented in this paper.
- A 4-mm needle is available for pens and a 6-mm needle is available for syringes; are suitable for all people with no pinching. Pinching may be necessary for some individuals with thin skin when using the 6- mm needles. **Grade A**

Berard L, Desrochers F, Hagerty D, MacNeill G & Roscoe R. Fit Forum for Injection Technique Canada 2017. Recommendations for Best Practice Injection Technique 3rd Edition

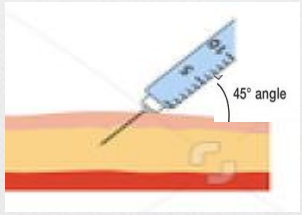


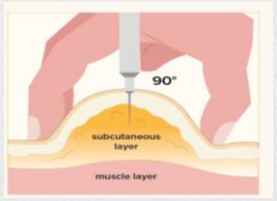
- Recommendation (Cat III)
- Current research across a wide range of BMIs (19 to 65 kg/m2) supports the use of 4-mm pen needles to avoid the risk of intramuscular injection
- A recent study demonstrated that a 4-mm pen needle provides equivalent A1C control to 8-mm and 12-mm pen needles in obese people who are taking large doses of insulin
- 4-mm, 5-mm and 6-mm pen needles are suitable for all people with diabetes, regardless of BMI; 6-mm needle length insulin syringe is recommended
- The use of a 6-mm needle is recommended with or without a skin lift, depending on the site and amount of subcutaneous tissue.
- 4mm pen needles should be used for all children and young people regardless of age, gender or BMI
- Very young children (< 6-years) and extremely thin adults (BMI<19) should use the 4mm needle by lifting a skin

Conclusion - Needle Length

Insulin Syringe

- The desired needle length of insulin syringe should be the shortest available needle 6mm (IIA)





Pen Needle

- The desired length of pen needle should be individually defined within the range of 4 or 5 mm needle (IIA)

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The End

Thank you

Q&A

