

# Nursing Innovations: Painless IM Injection

Hanan Mohammed Mohammed<sup>1,3</sup>, Abeer El-Said Hassane<sup>2,3</sup>,  
Asmaa Hamdi Mohammed<sup>1</sup>

<sup>1</sup>Assistant Professor of Medical-Surgical Nursing Department, Faculty of Nursing, Ain Shams University, Egypt

<sup>2</sup>Lecturer of Medical-Surgical Nursing, Medical Surgical Department, Faculty of Nursing, Menoufia University, Egypt

<sup>3</sup>Nursing Department, Applied Medical Sciences College, Al-Baha University, Kingdom of Saudi Arabia

Corresponding Author: Dr. Abeer El-Said Hassane

Email: [ahmedzaki\\_56@yahoo.com](mailto:ahmedzaki_56@yahoo.com)

---

**Abstract:** Pain caused by some therapeutic and nursing procedures has been a major concern of health care providers. Pain resulting from IM injection should not be underestimated, because in the light of fact that a painful injection might affect serious apprehension of injection, which may lead a patient to postpone looking medical help as well as, it can harm the nurse-patient relationship. Decreasing patients' pain is critical for all nurses in the light of numerous reasons. Administration of medications is a responsibility of the professional nurse. Intramuscular (IM) injections are a widespread and painful part of routine health care. Moreover, injection pain is a common complaint of patients especially chronic patients who are experiencing repeated injection that let them escape, sometimes faint, to keep away from visiting the physician, or even refuse essential treatments. Pain is the most common reason for self deferral from injections by the inpatient and outpatient clients in the hospital. Providing pain relief is considered a most basic human right, so it is the responsibility of the nurse to use most effective approach to pain control. However, good injection techniques can make the experience relatively painless for the patient. Over the years, clinicians have tried to explore various methods to reduce pain, including the pain of injections. Nurses play a greater role in minimizing the pain and discomfort during any invasive procedure. Nurses have the responsibility to educate patients related to various aspects and keep themselves updated. Various teaching strategies are used to increase knowledge, such as lecturing, demonstration, discussion and self-education. These methods of self-education have an advantage over the others as the learner can educate himself at his own pace and it also stresses on rereading.

**Abbreviations:** IM, Intramuscular; WHO, World Health Organization.

**Keywords:** Intramuscular injection; Intramuscular Injections pain; Intramuscular injection pain Complications; Nursing Innovations; Helfer skin tapping technique, Z- track technique.

---

## 1. INTRODUCTION

Pain is an unpleasant sensory and emotional experience associated with actual or potential tissue damage [1]. Pain originating from IM injection should not be underestimated, because a painful injection might cause the patient to develop a severe fear of injection, known as needle anxiety or needle phobia. Needle anxiety not only affects patient quality of life but also can delay future medical care requests [2]. Some patient characteristics as age, gender and body mass index can affect on feeling of injection pain. Some studies reported that old patients felt less discomfort than younger ones during IM injection. Another study reported that age does not affect injection pain. Some studies reported that women experience more pain during IM injection but another found that pain intensity for men was higher than for women. Nevertheless, the study results related to the effect of BMI on injection pain are not consistent [3, 4 and 5].

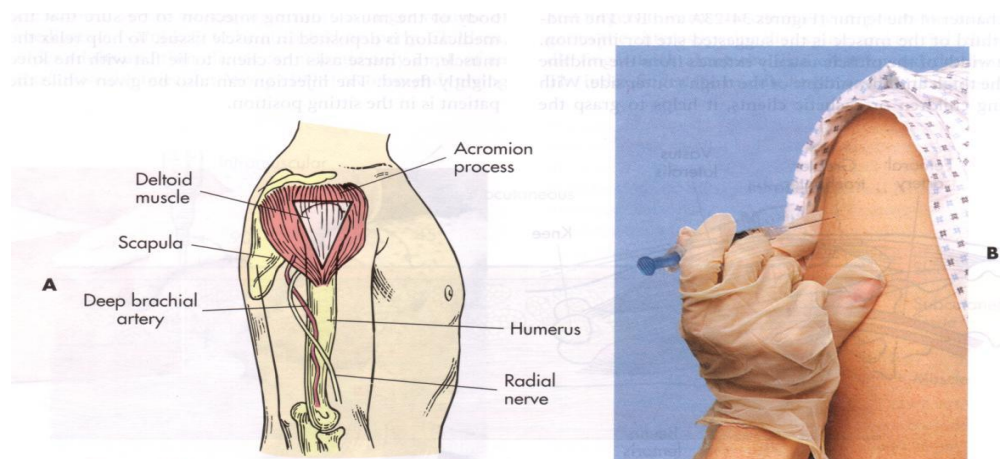
Nurse's care for patients in many settings and situations in which interventions are provided to promote comfort. Comfort is a concept central to the nursing. A variety of nursing theorist refers to comfort as a basic patient need for which nursing care is delivered. The comfort is the umbrella under which pain and pain management options are viewed [6]. The important cause of patients discomfort in nursing care settings is procedural pain especially during invasive procedure. Nurses play a greater role in minimizing the pain and discomfort during any invasive procedure as Intra muscular injection by helping the client to assume a proper position and by implementation of different physical, psychological interventions [7].

About 16 billion Intramuscular (IM) injections administered annually throughout the world (World Health Organization, 2011). In developing countries alone, some sixteen thousand million injections are administered annually, over, 90%, are administered for therapeutic aims whereas 5 to 10% are administered for disease prevention, the foremost important side-effect associated with injections is that the related pain. Injection pain is associated with the penetration of the skin by the needle and to the mechanical and chemical effects of the drug during and after its injection [8, 9].

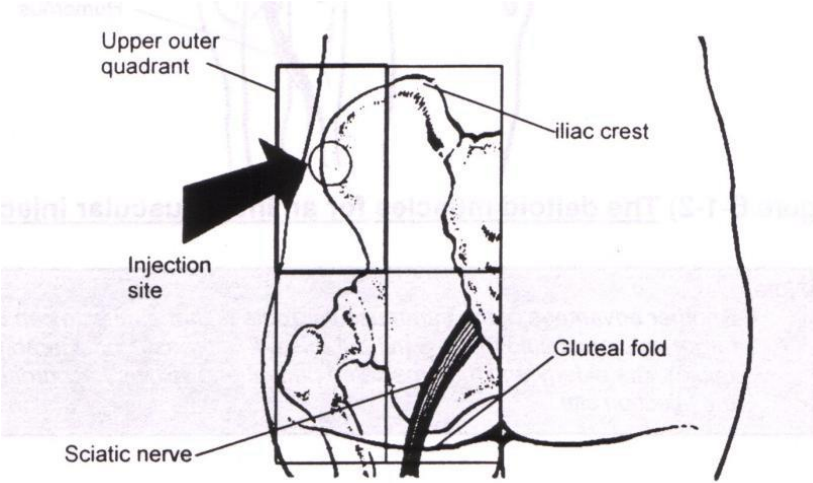
Intramuscular injection can be an unpleasant experience for patients, making an appropriate explanation and psychological support necessary [6]. Intramuscular (IM) injection is one of many routes for administering medications, including antibiotics, vaccines, hormonal therapies, and corticosteroids. IM injections may be preferred when a patient cannot tolerate oral medication; wherever medication delivers into the deep large muscles of the body with greater blood supply; so, provides more rapidly drug absorption than the subcutaneous route. Furthermore, some medications cannot administer by subcutaneous route because contain components that can irritate subcutaneous tissue but not muscle tissue, which also can tolerate larger fluid volumes with minimal discomfort. Intramuscular Injection [10].

### 1.1: IM Injection sites:

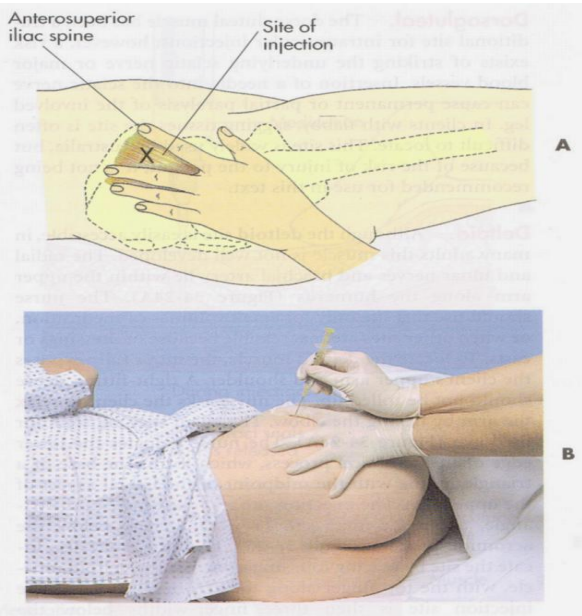
Intramuscular injections sites include the **deltoid site** (figure 1); although the deltoid site is easily accessible, palpate the lower edge of the acromion process, which forms the base of the inverted triangle in line with the midpoint of the lateral aspect of the upper arm. The injection site is in the centre of the triangle, about 2.5 to 5 cm below the acromion process. **Dorsogluteal** site (figure 2) has been a traditional site for intramuscular injections; however, a risk exists of striking the underlying sciatic nerve or major blood vessels. Insertion of a needle into the sciatic nerve can cause permanent or partial paralysis of the involved leg. **Ventrogluteal Site** (figure 3) is a safe site for all patients. It situated deep and away from major nerves and blood vessels. The ventrogluteal site is the preferred injection site for adults and anyone over seven months old. Locate the muscle by placing the heel of the hand over the greater trochanter of the patient's hip with the wrist perpendicular to the femur. **Vastus Lateralis (figure 4)** is another injection site used in the adult patient. The muscle is thick and well developed, is located on the anterior aspect of the thigh, and extends in an adult from a handbreadth above the knee to a handbreadth below the greater trochanter of the femur. The middle third of the muscle is the suggested site for injection. The width of the muscle usually extends between the midline of the thigh and the midline of the thigh's outer side [11, 12 and 13].



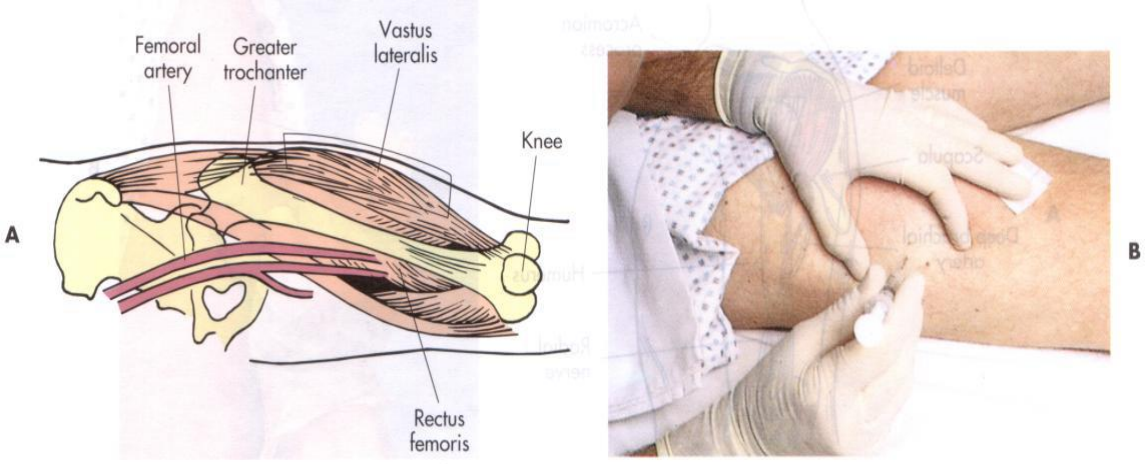
**Deltoid Site for Intramuscular Injection (figure1) [11]**



Dorsogluteal Site for Intramuscular Injection (figure 2) [12]



Ventrogluteal Site for Intramuscular Injection (figure 3) [13]



Vastus Lateralis Site for Intramuscular Injection (figure 4) [11]

Site selection may be based on familiarity and confidence rather than on “best practice”. However, there is sufficient evidence that the ventrogluteal IM site is the preferred site whenever possible, and is an acceptable site for oily and irritating medications. The ventrogluteal site is free from blood vessels and nerves, and has the greatest thickness of muscle when compared to other sites [14].

**1.2: Medications Routinely Administered by the IM Route with Site Recommendations [15]:**

Medication Class	Generic Name	Brand Names	Recommend Sites and Needle Size
<b>Antibiotics</b>	<ul style="list-style-type: none"> <li>Streptomycin sulfate</li> <li>Penicillin G benzathine</li> <li>Penicillin G procaine</li> </ul>	<ul style="list-style-type: none"> <li>Streptomycin sulfate Injection</li> <li>Bicillin, Wyclin, Pfizerpen</li> </ul>	<ul style="list-style-type: none"> <li>Adults: ventro-gluteal with 38 mm, 18 to 25-g needle</li> <li>Infants and young children: vastus lateralis with 16 to 25 mm, 22 to 25-g needle</li> </ul>
	<ul style="list-style-type: none"> <li>Diphtheria and tetanus toxoids adsorbed</li> <li>Diphtheria, tetanus, and a cellular pertussis</li> <li>Haemophilus influenzae type b Conjugate</li> <li>Haemophilus influenzae type b conjugate and hepatitis B (recombinant)</li> <li>Hepatitis A vaccine, inactivated</li> <li>Hepatitis B vaccine (recombinant)</li> <li>Hepatitis B Immune Globulin (human)</li> <li>Hepatitis A inactivated and hepatitis B (recombinant)</li> <li>Immune globulin for pre- and post-exposure prophylaxis for Hepatitis A infection</li> <li>Influenza Virus Vaccine</li> <li>Lyme disease vaccine</li> <li>Pneumococcal vaccine, Polyvalent</li> <li>Rabies vaccine adsorbed</li> <li>Rabies immune globulin (Human)</li> <li>Rh<sup>o</sup>(D) immune globulin (human)</li> <li>Tetanus immune globulin (human)</li> <li>Tetanus toxoid adsorbed</li> </ul>	<ul style="list-style-type: none"> <li>DT (pediatric), Td (adult)</li> <li>Acel-Immune, Infanrix, Tripedia, Certiva</li> <li>ActHIB</li> <li>Comvax</li> <li>Havrix, Vaqta</li> <li>Engerix-B, Recombivax HB</li> <li>BayHepB, Nabi-HB</li> <li>Twinrix</li> <li>Fluogen, FluShield, Fluvirin, Fluzone</li> <li>LYMErix</li> <li>Prevnar</li> <li>RabAvert</li> <li>BayRhoD, MICRhoGAM, RhoGAM, WinRho SDF</li> <li>BayTet</li> <li>Tetanus toxoid adsorbed purogenated</li> </ul>	<ul style="list-style-type: none"> <li>Adults: Deltoid with 25 to 38 mm, 22 to 25-g needle. Hepatitis B and rabies must be given in the deltoid site. Immune globulin may be given in the deltoid (volumes of 2 mL or less) or VG site (volumes of More than 2 mL).</li> <li>Toddlers and older children: deltoid, if the muscle mass is adequate, with 16 to 32 mm, 22- to 25-g needle</li> <li>Infants, young children and those with inadequate muscle mass at the deltoid site: vastus lateralis with 22 to 25 mm, 22- to 27-g needle</li> </ul>
<b>Hormonal Agents</b>	<ul style="list-style-type: none"> <li>Medroxyprogesterone acetate</li> <li>Chorionic gonadotropin</li> <li>Menotropin</li> <li>Testosterone enathanate</li> </ul>	<ul style="list-style-type: none"> <li>Depo-Provera</li> <li>Novarel, Pregnyl</li> <li>Humegon, Repronex</li> <li>Delatestry</li> </ul>	<ul style="list-style-type: none"> <li>Adults: ventro-gluteal with 38 mm, 18- to 25-g needle (these medications are typically not indicated for infants and young children)</li> </ul>

(Needle sizes are provided in metric lengths to conform to the international standard; for US readers, Corresponding needle sizes in inches are as follows: 16 mm \_ 5/8"; 22 mm \_ 7/8"; 25 mm \_ 1"; 32 mm \_ 1 1/4"; 38 mm \_ 1 1/2")



**1.3: IM Injection sites contraindications:**

Avoid the IMI if the site is: Inflamed, irritated, infected, painful, bruised or edematous, Contains moles, birthmarks, abrasions, scar tissue or other lesions. [16, 17].

**1.4: IM Injection Contraindications for patients;**

IMI may not be suitable for patients with: clotting abnormalities as thrombocytopenia, neutropaenia or patients receive anticoagulant / thrombolytic therapy. Moreover, IM injection may also be contraindicated in immunocompromised patients, and those with occlusive vascular disease, edema, shock, myocardial infarction, and/or moderate/severe acute illness as these conditions impair peripheral absorption [18].

**1.5: Complications of Intramuscular Injections:**

Neuropathy, peripheral nerve injuries and sciatic nerve damage (may result in paralysis, palsy, fibrosis, abscess, tissue necrosis, gangrene and contracture of the muscles; severe pain at the injection site; tingling or numbness; redness, swelling or warmth at the injection site; hematoma formation, persistent nodules, local irritation; pain; Infection prolonged bleeding; signs of an allergic reaction, such as difficulty breathing or facial swelling [19].

**1.6: Causes of Pain after IM Injection:**

Causes of pain after IM injection depend on the nurses' skill to carry out the technique; giving IM injections by traditional rather than evidence based as Z track technique; many nurses did not use correct procedures for IM injections to reduce pain and tissue trauma and presence of wide variation in the techniques used by nurses to prepare and administer medications; so most of patients complain of post IM injection pain. [2, 20].

Other factors can affect a patient's perception of IM injection pain are the drug chemical composition its concentration, injected volume, the used technique, patient anxiety, patient position, the speed of delivery of the drug, the injection site, and the size and length of the needle bore (needle gauge). Other factors are injury to nerve fibres from mechanical trauma caused by a needle puncture, by increasing pressure from an accumulation of fluid within the tissues, or by sudden distension of tissue from rapid introduction of fluid can lead to injection pain [21].

**1.7: Intramuscular injection pain complications:**

Needle phobia which leads to several varieties appeared in:

**1.7.1: Vaso-vagal:**

It affecting 50% of those afflicted is an inherited vaso-vagal reflex reaction. Approximately 80% of people with a fear of needles report that a relative within the first degree exhibits the same disorder. The primary symptom of vaso-vagal fear is vaso-vagal syncope, or fainting due to a decrease of blood pressure which lead to increase sweating nausea, pallor, tinnitus, panic attacks, and sometimes the vaso-vagal shock reflex may cause death. Others patients suffer initially high blood pressure and heart rate followed by a plunge in both at the moment of injection. The best treatment strategy for this type of needle phobia use of a technique known as "applied tension" for maintaining blood pressure [22].

**1.7.2: AssociativeL**

Associative fear of needles is the second most common type, affecting 30% of needle phobics. This type is the classic specific phobia; which causes symptoms that are primarily psychological in nature, such as extreme unexplained anxiety, insomnia, preoccupation with the coming procedure and panic attacks. Effective treatments include cognitive therapy, hypnosis, and/or the administration of anti-anxiety medication [23].

**1.7.3: ResistiveL**

Resistive fear of needles occurs when the underlying fear involves not simply needles or injections but also being controlled or restrained. Patients have forced physical or emotional restraint. It affects around 20% of those afflicted. Symptoms include combativeness, high heart rate coupled with extremely high blood pressure, violent resistance, avoidance and flight. The suggested treatment is psychotherapy, teaching the patient self-injection techniques or finding a trusted health care provider [24].

**1.7.4: Hyperalgesic or hypersensitivity to painL**

Hyperalgesic fear of needles is another form that does not have as much to do with fear of the actual needle. Patients with this form have an inherited hypersensitivity to pain, or hyperalgesia. To them, the pain of an injection is unbearably great and many cannot understand how anyone can tolerate such procedures. It affects around 10% of needle phobia. The symptoms include extreme explained anxiety, and elevated blood pressure and heart rate at the immediate point of needle penetration or seconds before. Its treatment includes some form of anesthesia, either topical or general [22, 23].

**1.7.5: Vicariousl**

Whilst witnessing procedures involving needles it is possible for the phobic present to suffer the symptoms of a needle phobic attack without actually being injected. Prompted by the sight of the injection the phobic may exhibit the normal symptoms of vaso-vagal syncope and fainting or collapse is common. While the cause of this is not known, it may be due to the phobic imagining the procedure being performed on them. Recent neuroscience research shows that feeling a pin prick sensation and watching someone else's hand get pricked by a pin activate the same part of the brain [22, 23 and 24].

**1.8: Nursing Management for Post IM Injection Pain:**

Nurses are ethically and legally responsible for managing pain and relieving suffering. Effective pain management not only reduces physical discomfort, but also improves quality of life. To prevent post-injection pain, nurses need to be knowledgeable of the assessment of pain, psychosocial and cultural factors affecting pain expression, genetic and ethnic determinants of pain threshold and pain tolerance, and, most importantly, current evidence-based practices regarding pain. However, although it is a common nursing practice, there is a paucity of research on IM injection [2, 25 and 26].

**1.9: Theoretical Explanation of Pain:**

The Gate Control Theory of pain offers a theoretical explanation of how physical

Interventions might reduce pain. The theory suggests that pain is transmitted from the peripheral nervous system to the central nervous system where it is modulated by a gating system in the dorsal horn of the spinal cord. Physical stimulation – such as rubbing, massage, and vibration – activates the fast, large diameter, myelinated nerve fibers (A-beta) and inhibits the transmission (closes the gate) of pain, which travels via the small diameter unmyelinated fibers (A-delta) [26].

**1.10: Nursing Innovations for Painless IM injection (Measures):**

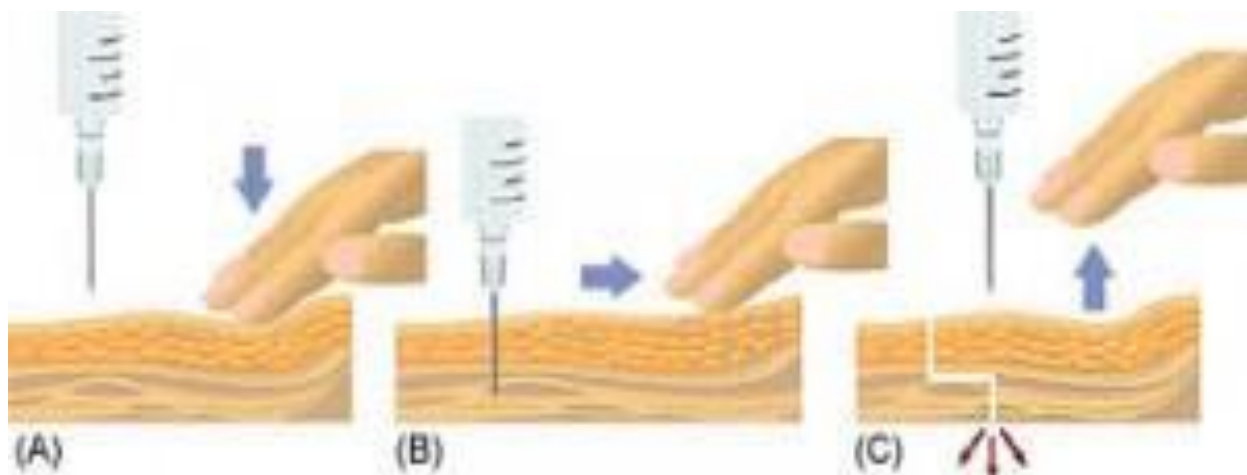
Innovation in nursing means use of a new method use in nursing practice and/ or practice device. Practice is regarded as a practicing; habit or custom, repeated action for gaining skill, the resulting condition of being skilled, knowledge put into action and the exercise of a profession. Innovation in nursing practice is imperative to improve patient safety and quality care [28].

Nursing Innovations in IMI use to lessen pain divided into pharmacological and non-pharmacological. Non-pharmacological measures also called complimentary or alternative nursing interventions; examples for non-pharmacological measures of pain management strategy are picking up the prominence; as cryotherapy or cold application; which is one of the non-pharmacological techniques utilized and acted through local skin allotments as indicated by gate – control theory. While utilizing the body's own nervous system, the GATE control theory mentions the idea that the last normal pathway for sharp pain to the brain can be hindered by the nerves that transmit cold and it has been appeared to reduce pain effectively in the IMI pain management. Techniques for cryotherapy or cold application incorporate cold packs, cold immersion, and ice massage, spray and stretch is an application of cryotherapy with a vapo-colant spray, which then is followed by stretching of the included muscles [28, 29].

Joanne in 2000, Malkin in 2008 and Omima Said M. H. Shehata in 2016; they used Helfer Skin Tapping technique to reduce pain in giving injection “ in which tapping of the skin over the injection site. It is an accepted fact that there is reduced pain in giving injection into a relaxed muscle because tapping over the skin is considered one of the various techniques to keep the muscles relaxed. As well as, Helfer skin tapping technique is one of the mechanical stimulation over the skin that can alter the balance between the small diameter fibers that carry pain to the brain, and the large diameter fibers that do not carry pain. The large diameter non-pain fibers block the slower small diameter pain carrying fibers. It provides a mechanical stimulation and distraction during IM injection and thus helps to decrease pain as

described in gate control theory. In Helfer skin tapping technique rhythmic tapping before injection over the skin at the site of injection keeps the muscle relaxed and stimulates large diameter fibers [9, 30].

Other measures have positive effect for painless IM injection; are applying simple pressure to the site for 10 seconds before an intramuscular injection would reduce injection pain, this an approach suggested by anecdotal observation and the gate control theory [31]. Pressure application, is effective practice, as it is a simple and cost effective method for pain reduction especially in intramuscular injection of benzathine Penicillin. IM injections should be administered to the patient in prone position with an internally rotated foot, and pointing the toes down and/or using of Z track technique is a method of IM injection that prevents the medication being tracked through the subcutaneous tissue, sealing the medication in the muscle, lead to prevent leakage back into the subcutaneous tissue and skin so minimizing irritation from the medication, decrease incidence; severity of discomfort and lesions at the injection site; was compared with the traditional injection technique. Using the Z-track technique, the skin is pulled laterally, away from the injection site, before the injection; then the medication is injected, the needle is withdrawn, and the skin is released as the figure [6, 9].



Z-track technique Figure (5) [33]

Base on pain is best conceptualized as a perceptual, rather than a sensory; use of divisional therapy for muscle relaxation with injection administration will reduce the perception of pain before administering an intramuscular injection [6, 21 and 33].

Apply some measures during IM injection; pain can reduce start by choosing a needle size depends on the weight of the patient, age, amount of adipose tissue, medication viscosity, and injection site; use two-needle process reduce consumer discomfort, one needle for preparation and another for administration; spread the skin taut between the thumb and forefinger in fatty patients or muscle can be bunched up with little muscle; inject medication slowly in 1-2 seconds; if possible, leave needle in injection site for 5-10 seconds after injecting medication; to allow surrounding tissue to expand and absorb the medication; after removing needle, use gentle pressure with sterile gauze. Do not rub injection site, to avoid discomfort and feeling of pain [34, 35 and 36].

**Note: Swift needle entry, slow injection of medication and swift needle withdrawal = less pain [37].**

## 2. CONCLUSION

Pain is referred as “the fifth vital sign” to stress its significance and to improve attention of health care professionals about the importance of effective pain management strategies, as well as continuous assessment. Intramuscular (IM) injections are a common and painful part of routine health care. Pain relieving measures are a most fundamental requisite of human right, thus it's the responsibility of the nurse to use best approach to pain management. There are many nursing innovations for IM injection painless as cryotherapy or cold application; Helfer skin tapping technique; Pressure application; administer IM for patient in prone position with an internally rotated foot, and pointing the toes down and/or Z track technique.

### REFERENCES

- [1] International Association for the Study of Pain. Retrieved 12 January 2015. Derived from the need of taxonomy. *Pain*. 1979; 6(3): 247–8. doi: 10.1016/0304-3959(79)90046-0. PMID 460931. Available at: <https://en.wikipedia.org/wiki/Pain>
- [2] Leyla Ozdemir; Emine Pinarci; Bengu Nisa Akay; and Aynur Akyol; "Effect of Methylprednisolone Injection Speed on the Perception of Intramuscular Injection Pain". *Pain Manag Nurs*. 2013; 14(1):3-10. © 2013 Elsevier Science, Inc. Available at: [http://www.medscape.com/viewarticle/780432\\_3](http://www.medscape.com/viewarticle/780432_3)
- [3] Ozdemir L, Pinarci E, Akay BN and Akyol A. "Effect of Methylprednisolone injection speed on the perception of intramuscular injection pain". *Pain Management Nursing* 2010; 12: 1–8.
- [4] Malkin B. "Are techniques used for intramuscular injection based on research evidence"? *Nursing Times* 2008; 12: 48–51.
- [5] Keller J. "Obesity and pain perception". *IDEA Fitness Journal* 2006; 3: 17.
- [6] Gitanjali Zore and Ragina Dias; "Effectiveness of Nursing Interventions on Pain Associated with Intramuscular Injection". *International Journal of Science and Research (IJSR) Volume 3 Issue 6, June 2014*. ISSN (Online): 2319-7064.
- [7] Shinde, M. B., and Durgawale, P. M. Nursing Audit of Health Workers Providing Health Services in Rural Area with Special Emphasis to Community Satisfaction in Satara District. *International Journal of Science and Research (IJSR)*, (2014). 3(2), 94-104.
- [8] World Health Organization, (2011). Injection safety. *Health Topics A to Z*. Available at: [https://en.wikipedia.org/wiki/Injection\\_medicine](https://en.wikipedia.org/wiki/Injection_medicine)
- [9] Omima Said M. H. Shehata. "Effects of Helfer Skin Tapping and Z – Track Techniques on Pain Intensity among Hospitalized Adult Patients Who Receiving Intramuscular Injection"
- [10] eNotes: Study Smarter Web site. <http://www.enotes.com/intramuscular-injection-reference/intramuscular-injection>. Accessed January 16, 2013
- [11] Perry, A., Potter, P., & Ostendorf, W. (2014). *Clinical skills and nursing techniques* (8th Ed.). St Louis, MO: Elsevier-Mosby.
- [12] Cook, IF and Mutagh, J. Optimal techniques for intramuscular injection of infants and toddlers: a randomized trial. *MJA* 2005; 183(2): 60-63
- [13] Kozier B & Erb G. (2009). *Fundamentals of Nursing*. Pearson education company, Australia, 949.
- [14] Ogston, Tuck; "Intramuscular injection technique: an evidence-based approach". *Nurs Stand*. 2014 Sep 30; 29(4):52-9. Doi: 10.7748/ns.29.4.52. e9183. Available at: <https://www.ncbi.nlm.nih.gov/pubmed/25249123>
- [15] Leslie H. Nicoll and Amy Hesby, *Intramuscular Injection: An Integrative Research Review and Guideline for Evidence-Based Practice*. Leslie@medesk.com Copyright 2002, Elsevier
- [16] Dougherty L, Lister S, editors. *The Royal Marsden Hospital manual of clinical nursing procedures*. 8th ed. West Sussex, UK: Wiley-Blackwell; 2011.
- [17] Zimmermann PG. Revisiting IM injections. *American Journal of Nursing*. 2010; 110(2):60-1
- [18] The Joanna Briggs Institute. "Acute care practice manual". JBI; 2013. Available from: <http://connect.jbiconnectplus.org.kelibresources.health.wa.gov.au/ViewPdf.aspx?0=3133&1=6>
- [19] Kiss D. "Evidence summary: Injection (intramuscular): Clinician information". 2013. In: *Acute care practice manual* [Internet]. The Joanna Briggs Institute; [422-6]1.2:



**International Journal of Novel Research in Healthcare and Nursing**

 Vol. 4, Issue 1, pp: (129-137), Month: January - April 2017, Available at: [www.noveltyjournals.com](http://www.noveltyjournals.com)

- [20] Carter-Templeton H. and McCoy, T. "A comparison of intramuscular injection explanations in nursing fundamental texts". *MEDSURG Nursing*. 2008; 17(4):237–240
- [21] Dilek Kara Yılmaz and Ülkü Yapucu Güneş; "The effect on pain of three different methods of intramuscular injection". *International Journal of Nursing Practice* (2014) 22: 152–159. Available at: <https://www.researchgate.net/publication/263858771>
- [22] Ditto, B.; et al. (2009). "Physiological correlates of applied tension may contribute to reduce fainting during medical procedures". *Annals of Behavioral Medicine*. 37 (3): 306–314. Doi: 10.1007/s12160-009-9114-7. PMID 19730965.
- [23] Jump up^ Ayala, E.S.; et al. "Treatments for blood-injury-injection phobia: a critical review of current evidence." *Journal of Psychiatric Research*. 43 (15): 1235–1242 REVIEW. Doi: 10.1016/j.jpsychires.2009.04.008. PMID 19464700
- [24] Hogan, M.E.; et al. (10 February 2010). "A systematic review of measures for reducing injection pain during adult immunization." *Vaccine*. (2009). 28 (6): 1514– 1521. Doi: 10.1016/j.vaccine.2009.11.065. PMID 20003927
- [25] Cocoman A, and Murray J. 'Intramuscular injections: "A review of best practice for mental health nurses". *Journal of Psychiatric and Mental Nursing*. 2008; 15:424–434.
- [26] Monsivais D, and McNeill J. "Multicultural influences on pain medication attitudes and beliefs in patients with nonmalignant chronic pain syndromes". *Pain Management Nursing*. 2007; 8(2):64–71
- [27] Cobb, J. E., and Cohen, L. L. "A randomized controlled trial of the Shot Blocker® for children's immunization distress". *The Clinical Journal of Pain*, 25(9), 790-796. (2009). DOI: 10.1097/AJP.0b013e3181af1324
- [28] Rob Mcsherry and Mary Douglas, "Innovation in nursing practice: a means to tackling the global challenges facing nurses, midwives and nurse leaders and managers in the future". *Journal of Nursing Management*, 2011, 19, 165–169
- [29] Rasha H. Ramadan, Yasmin A. El-Fouly, Wafaa E. Sharaf and Amany S. Ayoub. "Effect of Cryotherapy on Pain Intensity among Adult Patients Receiving Intramuscular Injections". *IOSR Journal of Nursing and Health Science (IOSR-JNHS)* e-ISSN: 2320–1959.p- ISSN: 2320–1940 Volume 5, Issue 2 Ver. VI (Mar. - Apr. 2016), PP 01-10 [www.iosrjournals.org](http://www.iosrjournals.org)
- [30] Joanne H. (2000). "Painless Injections": Helfer Skin Tap Technique. *Nurse Educator*. 25(6):272-3.
- [31] Macqueen S., Bruce E.A. and Gibson F. "The Great Ormond Street Hospital Manual of Children's Nursing Practices". (2012) Wiley-Blackwell, Oxford.
- [32] Jane, D. (2010). "Z-Track Method". Available at: <http://nursingcrib.com/nursing-notes-reviewer/fundamentals-of-nursing/z-track-method/>. Derived on: 15/6/2016.
- [33] Douglas Songer "Psychotherapeutic Approaches in the Treatment of Pain". *Psychiatry (Edgmont)*. 2005 May; 2(5): 19–24. Available at: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3000182/>
- [34] Agac E, Gunes UY. "Effect on pain of changing the needle prior to administering medicine intramuscularly": A randomized controlled trial. *Journal of Advanced Nursing* 2011; 67: 563–568.
- [35] National Immunization Advisory Council. "Immunization Guidelines for Ireland". (2013) [http://www.immunisation.ie/en/Downloads/NIACGuidelines/PDFFile\\_17401\\_en.pdf](http://www.immunisation.ie/en/Downloads/NIACGuidelines/PDFFile_17401_en.pdf), (last accessed 13/06/2014)
- [36] Ford L., Maddox C., Moore E. and Sales R. "The safe management of medicines for children. In *Practices in Children's Nursing: Guidelines for Community and Hospital*". (2010) 3rd edn, (Trigg E and Mohammed TA., Eds), Churchill Livingstone, Edinburgh, 417 -445.
- [37] Naomi Bartley; "Guidelines on the Administration of Intramuscular and Sub-Cutaneous Injections". August 2014, 4th Edn. (3rd edn. 2011, 2nd edn 2009, 1st edn. (2006).