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## 3 sites for im injection

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These include:oral (swallowed into the stomach)intravenous (injected into the vein)subcutaneous (injected into the fatty tissue just under the layer of skin)Intramuscular injections may be used instead of intravenous injections because some drugs are irritating to veins, or because a suitable vein can't be located. It may be used instead of oral delivery because some drugs are destroyed by the digestive system when a drug is swallowed.Intramuscular injections are absorbed faster than subcutaneous injections. This is because muscle tissue has a greater blood supply than the tissue just under the skin. Muscle tissue can also hold a larger volume of medication than subcutaneous tissue.Intramuscular injections are often given in the following areas:Deltoid muscle of the armThe deltoid muscle is the site most typically used for vaccines. However, this site is not common for self-injection, because its small muscle mass limits the volume of medication that can be injected — typically no more than 1 milliliter.It's also difficult to use this site for self-injection. A caregiver, friend, or family member can assist with injections into this muscle.To locate this site, feel for the bone (acromion process) that's located at the top of the upper arm. The correct area to give the injection is two finger widths below the acromion process. At the bottom of the two fingers, will be an upside-down triangle. Give the injection in the center of the triangle.Vastus lateralis muscle of the thighThe thigh may be used when the other sites aren't available or if you need to administer the medication on your own.Divide the upper thigh into three equal parts. Locate the middle of these three sections. The injection should go into the outer top portion of this section.Ventrogluteal muscle of the hipThe ventrogluteal muscle is the safest site for adults and children older than 7 months. It's deep and not close to any major blood vessels and nerves. This site is difficult for self-injection, and may require the help of a friend, family member, or caregiver.Place the heel of your hand on the hip of the person receiving the injection, with the fingers pointing towards their head. Position the fingers so the thumb points toward the groin and you feel the pelvis under your pinky finger. Spread your index and middle fingers in a slight V shape, and inject the needle into the middle of that V.Dorsogluteal muscles of the buttocksThe dorsogluteal muscle of the buttocks was the site most commonly selected by healthcare providers for many years. However, due to the potential for injury to the sciatic nerve, the ventrogluteal is most often used now. This site is difficult to use this site for self-injection and not recommended. You shouldn't use an injection site that has evidence of infection or injury. If you'll be giving the injection more than once, make sure to rotate injection sites to avoid injury or discomfort to the muscles.Any person who administers intramuscular injections should receive training and education on proper injection technique.The needle size and injection site will depend on many factors. These include the age and size of the person receiving the medication, and the volume and type of medication. Your doctor or pharmacist will give you specific guidelines about which needle and syringe are appropriate to administer your medication. The needle should be long enough to reach the muscle without penetrating the nerves and blood vessels underneath. Generally, needles should be 1 inch to 1.5 inches for an adult, and will be smaller for a child. They'll be 22-gauge to 25-gauge thick, noted as 22g on the packaging.Follow these steps for a safe intramuscular injection:1) Wash your handsWash your hands with soap and warm water to prevent potential infection. Be sure to thoroughly scrub between fingers, on the backs of hands, and under fingernails.The Centers for Disease Control and Prevention (CDC) recommends lathering for 20 seconds — the time it takes to sing the "Happy Birthday" song twice.2) Gather all the needed suppliesAssemble the following supplies:needle and syringe with medicationalcohol padsgauzepuncture-resistant container to discard the used needles and syringe — typically a red, plastic sharps containerbandages3) Locate injection siteTo isolate the muscle and target where you'll place the injection, spread the skin at the injection site between two fingers. The person receiving the injection should get into a position that's comfortable, provides easy access to the location, and keeps the muscles relaxed.4) Clean injection siteClean the site selected for injection with an alcohol swab and allow the skin to air dry.5) Prepare syringe with medicationRemove the cap. If the vial or pen is multi-dose, take a note about when the vial was first opened. The rubber stopper should be cleaned with an alcohol swab.Draw air into the syringe. Draw back the plunger to fill the syringe with air up to the dose that you'll be injecting. This is done because the vial is a vacuum and you need to add an equal amount of air to regulate the pressure. This also makes it easier to draw the medication into the syringe. Don't worry — if you forget this step, you can still get the medication out of the vial.Insert air into the vial. Remove the cap from the needle and push the needle through the rubber stopper at the top of the vial. Inject all of the air into the vial. Be careful to not touch the needle to keep it clean.Withdraw the medication. Turn the vial and syringe upside down so the needle points upward and pull back on the plunger to withdraw the correct amount of medication.Remove air bubbles. Tap the syringe to push any bubbles to the top and gently depress the plunger to push the air bubbles out.6) Self-injection with a syringeInsert the needle. Hold the needle like a dart and insert it into the muscle at a 90-degree angle. You should insert the needle in a quick, but controlled manner. Do not push the plunger in.Check for blood. Using the hand that's holding the skin at the injection site, pick up your index finger and thumb to stabilize the needle. Use your dominant hand — the one that did the injection — to pull back on the plunger slightly, looking for blood in the syringe. Ask your doctor if this is needed for the type of medicine you will be injecting, as it's not required for all injections. If you see blood going into the syringe, it means the tip of the needle is in a blood vessel. If this happens, withdraw the needle and begin again with a new needle, syringe with medication, and injection site. It's rare to have this happen.If you don't see blood going into the syringe, the needle is in the correct place and you can inject the medicine.7) Inject the medicationPush the plunger slowly to tip the medication into the muscle.8) Remove the needleWithdraw the needle quickly and discard it into a puncture-resistant sharps container. Don't recap the needle.A sharps container is a red container that you can purchase at any pharmacy. It's used to collect medical waste, like needles and syringes. You shouldn't put any of these materials into the regular garbage, as needles can be hazardous to anyone who handles the trash.9) Apply pressure to the injection siteUse a piece of gauze to apply light pressure to the injection site. You can even massage the area to help the medicine be absorbed into the muscle. It's normal to see slight bleeding. Use a bandage if necessary.To minimize possible discomfort before your injection:Apply ice or an over-the-counter topical numbing cream to the injection site before cleaning it with the alcohol pad.Allow the alcohol to dry completely before the injection. Otherwise, it might cause stinging.Warm the oil of medication by rubbing it between your hands prior to drawing the medication into the syringe.Have someone you trust give you the injection. Some people find it difficult to inject themselves.It's normal to experience some discomfort after an intramuscular injection. But certain symptoms may be a sign of a more serious complication. Call your doctor or healthcare provider right away if you experience:It's also normal to have some anxiety about performing or receiving an injection, especially an intramuscular injection due to the long needle. Read through the steps several times until you feel comfortable with the procedure, and take your time.Don't hesitate to ask your provider or pharmacist to go through the procedure with you beforehand. They're more than willing to help you understand how to perform a safe, proper injection. Kamlesh R. Lala Mrudula K. Lala\* Intramuscular injections (IM) are a common yet complex technique used to deliver medication deep into the large muscles of the body(1). However it is not a benign procedure and unsafe injection practices are estimated to have significant impact on patient morbidity and mortality. Unsafe injection practice results in millions of dollars in direct medical costs on an annual basis(2). Although there is significant research spanning over eight decades, on the procedure and techniques of administering medications by the IM route, instruction materials and clinician practice do not always reflect research-based practice. According to WHO, intramuscular injection is an administration of medications parenterally through a skin puncture by a syringe and a needle deep into a large muscle of the body for prophylactic or curative purposes(3). Injections are among the most frequently used medical procedures, with an estimated 12 billion administered throughout the world on an annual basis. Of these 5% or less are for immunization and rest are given for curative purposes, many of which have been judged to be unnecessary(4). In India, a survey found that 96% of all injections given by private doctors were of antibiotics, vitamins and analgesics(5). A conservative estimate of the average number of injection ranged from 0.9 to 8.5 per person per year, with a median of 1.5 injections per person per year(2). Giving an IM injection is not a benign procedure: the complications reported are muscle fibrosis and contracture, abscess at the injection site, gangrene and nerve injury. Unsafe injection practice may result in number of infections, particularly hepatitis B and C and HIV(6-8). Ironically, even though IM injections are known to have iatrogenic complications, healthcare providers are not imparted proper education(9). It has been found that techniques used by nurses in giving IM injections were "little more than a ritualistic practice, one based on tradition, which passes from one nurse to another and from one generation to the next". This happens inspite of the fact that there is a vast body of research extending back to 1920s regarding injection sites, blood flow and absorption in various muscle groups, discomfort, positioning, administration techniques and complications. Even today this is the area of study that continues to be of interest to nursing researchers(1). Until the introduction of antibiotics-penicillin in the late 1940s, the administration by IM route was a skill that was almost exclusively practiced by physicians. By the late 1960s, IM injections were routinely administered by nurses(10). This was the period when glass syringes were being replaced with disposable plastic syringes and needles in USA. The Goal Administering an IM injection is a complex psychomotor task that requires skill and knowledge on the part of the clinician who is performing the procedure. Our goal is to maximize the therapeutic effect of the medication, eliminate or minimize the complications and discomfort from IM injection. In addition to being able to physically perform the skill, the clinician needs knowledge of pharmacology, anatomy, physiology, physics and microbiology along with legal and ethical issues. The first decision that must be made before any IM injection is whether it is necessary and justified. According to WHO, "An injection should only be given if it is necessary and each injection that is given must be safe"(11). Once the decision has been made that based on medication and patient characteristics an IM injection is justified, the second decision is to determine the site for injection(12,13). The site selection is critically important because (i) the medication effect can be enhanced or diminished depending on the site of injection (ii) complications like muscle contracture and nerve injury are site dependent, (iii) site varies depending upon the age of the patient, and (iv) vaccines are never administered in gluteal area even in children, as gluteal fat retards absorption and affects the antibody titers. Site Selection Anterolateral thigh: The anterolateral thigh is the preferred site of injection for infants less than 12 months and sometimes in children above 2 years also. Here the target muscle is vastus lateralis (VL), which is part of the quadriceps femoris. This muscle is well developed at birth(13). The site is antero-laterally in the middle third of the portion between greater trochanter and lateral femoral condyle (Fig. 1). Damage to femoral nerve or artery can be prevented by assiduously selecting the site and using needle with proper length. Rectus femoris muscle which is anterior on the thigh should not be used. Fig. 1. Injection site for anterolateral thigh(14). Deltoid: Though the deltoid muscle is small, this site is adequate for low volume injection. For toddlers and older children deltoid may be used only if muscle mass is adequate. It is a triangular muscle that originates from the lateral one third of the clavicle, the acromion and the scapular spine and converges into the deltoid tuberosity near middle of the humerus. The site should be selected 3-5 cm below the bony landmark of acromion process or midway between acromion process and deltoid insertion(13,15) (Fig. 2). In younger children the layer of subcutaneous (SC) tissue over the deltoid muscle is fairly consistent i.e., approximately 4.9 mm regardless of weight(17). This site has potential for injury to (i) axillary nerve beneath the deltoid at surgical head of humerus, (ii) axillary nerve and posterior circumflex humeral vessels near deltoid tuberosity of humerus near insertion of deltoid and (iii) radial nerve under scapular portion of deltoid muscle if the injection is placed posteriorly and inferiorly. Fig. 2. Injection site for deltoid(16). The radial, brachial and ulnar nerves and profunda brachii artery are under the triceps muscle. So this muscle is not used for injection(13). Gluteal: It may be dorsogluteal (DG) or ventrogluteal (VG) (Fig. 3). This is a preferred site for injection volume 2-5 mL oily, painful and irritating injections and depot medications. The target muscle for DG injection is gluteus maximus. This muscle does not develop in size until child has been walking for a period of time. So this is not a preferred site(13). The target muscle for VG injection is gluteus medius. This muscle has a large mass, is well developed in young children and adults and is relatively free from major nerves and vessels. Subcutaneous layer over the muscle is uniform in thickness irrespective of patient's weight(6). Fig. 3. Injection sites for gluteal region. Also shows relation of nerves and vessels with potentiality of injury(14). There are various methods suggested to identify the site(1,18). (i) The area is bounded by the iliac crest, and by intersecting lines drawn from the upper end of the greater cleft to the anterior superior iliac spine and from ischial tuberosity to the uppermost part of the iliac crest respectively (Fig. 4). Only the upper outer quadrant area of this imaginary cross is used for injection site. If going high, then there is potential to hit the bone. If the site is chosen too close to the center, then there is potential of injuring greater or lesser sciatic nerves. Also this imaginary cross leaves too much margin of error as it may change with the position of the patient. The injection would be most of the time into gluteus maximus. Fig. 4. Methods for identification of injection site at gluteal region(19). (ii) The simplest method to identify the injection site is: spread the palm of the opposite hand flat against the greater trochanter. Index finger is placed on the anterior superior iliac spine and middle finger extended along the iliac crest towards the iliac tubercle, the gluteus medius muscle "pops" up between the fingers (Fig. 4). (iii) Draw an imaginary line between the posterior iliac spine and the greater trochanter of the femur. Injections are given in an area lateral and superior to this imaginary line and most of the time the injection would be into either the upper outer mass of the gluteus maximus or into the gluteus medius. Preparation of Injection Though some of the vaccines and medications are available in prefilled syringes, some are not. So here apart from site selection, size of the syringe, length and gauge of needle are to be selected. Ensure 'Universal Precautions' as laid down by WHO before any injection(20). Alcohol based hand rubs are more convenient and effective than soap and water if there is no dirt and mess. Equipment: Use only new disposable syringe and needle every time. WHO recommends that auto disable syringe is the preferred type of disposable equipment for administering vaccines and the equipment of choice for conducting mass immunization campaign(21). Withdrawing medication: Safest practice is to withdraw medication by using filter needle and change it before injection. It is believed to prevent particulate matter such as glass or rubber particles from being withdrawn into the syringe. If same needle is used then there is a fear that needle may be bent or dulled. But both the above points are theoretical and there are no research evidences to support either positive or negative claims(22,23). It is not recommended for immunization because of cost and use of higher gauge needle(24). Air Bubble: Though it is a topic of heated debate, it has been proved to be outdated and non-scientifically recommended procedure and should be eliminated from IM injection procedure(15,18,25). There were two thoughts: (a) It ensures correct dose taking into consideration of dead space. But disposable syringes are calibrated taking into account of medication within syringe hub and needle. Some syringes are available with projection on the plunger, which enters the hub after finishing of pushing the medication. (b) Air bubble seals the medication in the muscle after injection and prevents backflow of medication through needle track. This latter problem can be eliminated by using Z track technique(26,27). Skin is pulled downwards and laterally before injection. This displaces the skin and SC tissue leaving the muscle there only and uses the valve action to prevent leakage of medication into the SC tissue (Fig. 5). Fig. 5. Z-track technique for IM injection(19). Wiping the needle: Excess medication is expelled through the needle. Medication dripped on the needle should be wiped off as it can cause pain if tracked through SC tissue. Do not use alcohol swab to wipe the needle, as it is irritant. Cotton swab also should not be used as some cotton fibres may be left over on the needle. So use only dry gauze pad(28,29). Needle length and gauge: The selection of length of the needle depends upon the age of the child, the size of the muscle and SC mass over the muscle. For VL needles of 16 mm, 22 mm or 25 mm, for deltoid 16 to 32 mm and for VG 25 to 38 mm length are used. It has been found that longer needle with the same gauge was associated with significant reduction in redness and swelling following routine immunisation(30). It is because medication is sure in the muscle. For general biologicals and medications in aqueous solution, 23 g to 27 g and for viscous and oil based medication, 18 g to 23 g needle is used. Using higher gauge (thinner) needle may cause more trauma because they have a narrow bore producing a jet under higher pressure. So for immunisation 23 g needle is preferred over 25 g(30). Procedure 1. Positioning Proper positioning allows clinician to identify the site correctly and ensures patient comfort by relaxing the muscles. Expose the part completely. (i) For deltoid: The patient may sit or stand. Child may be held in an adult's lap. Placing the hand on the hip will relax the deltoid muscle(1). (ii) For VL: To position the child for left VL, the adult's left arm should be around the child, supporting the head and holding the outside arm. The child's inside arm should be tucked around the adult's body. The adult's right hand should firmly hold the child's legs(11). (iii) For VG: The patient may be sitting, standing or lying in supine or lateral. But having patient lay down is the safest position. Internal rotation of femur relaxes the gluteal muscle. In a lateral position, the upper leg can be flexed at 20° to ensure internal rotation. Flexing one or both knees will relax the muscle in a supine position(28). 2. Cleansing Once the patient has been positioned, the muscles relaxed and, the site properly identified by using bony landmarks, the site is cleaned properly avoiding the site where skin is obviously infected. There are several thoughts and hypotheses regarding cleansing of the site. In a study it was found that the rate of infection was so low as to be non-existent and so routine disinfection of the skin is not necessary, provided patient is physically clean and proper hygiene and asepsis are observed during the procedure(31,32). Since our goal is cleansing and not disinfection, if the intended vaccination site is visibly dirty, obvious dirt can be removed using clean water, water for injection or saline and a clean tissue, cloth, cotton wool, gauze or other such non-impregnated material. Wipes that are impregnated with medicated chemical must not be used. Such chemicals may interfere with the vaccines, especially live ones(33). There is a thought against this also. Most of the clinical trials in US evaluating the efficacy of vaccines are done wiping the injection site without evidence of inactivity(34). Hence we should not generalize the either recommendation on cleansing. In our setting it is better to clean the area with single use alcohol wipes in a circular fashion in an area approx. 5-8 cm and is allowed to dry. Pre-wetted cotton swabs are avoided for fear of contamination(34). 3. Technique One method of insertion of the needle is known as US method and is promulgated by ACIP(12,13,33). The clinician uses his non-dominant hand to bunch the muscle and direct the needle inferiorly along the long axis of leg at an angle appropriate to reach the muscle, usually 45°. This method stabilizes the leg and increases the muscle mass. In the second method, recommended by WHO(11), the skin is stretched flat between the index finger and thumb and the needle is pushed down at 90°. Both these methods are worthy of further discussion and investigation(31). 4. Methods for alleviating discomfort Comfort measures and distraction techniques (e.g., playing music or blowing toys) might help children cope with injection discomfort. Pretreatment with 5% topical lignocaine before 30-60 min. of injection can decrease pain and it has been shown not to interfere with immune response(24). Administering sweet tasting fluid (2 mL of 20% w/w sucrose solution or mother's milk -EBM) immediately before injection can result in a calming or analgesic effect(24,35,36). Applying pressure to the site for about 10 sec prior to injection would reduce injection pain. An interesting piece of anecdotal evidence suggests an alternate method(37). Place the needle point on the skin and if there is no pain at the initial point of contact, push the needle. If there is pain, the needle is moved over 2-3 mm at a time until a painless point on the skin is found, at which point the needle is then inserted. This is based on the anatomy of cutaneous innervations providing distinct points without pain receptors and hence no pain sensation. This technique is used by neurologists for EMG studies. But these methods to reduce discomfort seem to warrant further research. 5. Insertion of the Needle Ensure smooth and steady insertion of the needle with a dart technique. Though routine recommendations over the years has been to insert the needle at 90°, with angles ranging 72°-90°, the injection is in the muscles as opposed to SC tissue. 6. Aspiration (before pushing medication) Aspirate by pulling back the plunger for 5-10 sec to ensure that the needle is not in low flowing blood vessel. If blood is aspirated in the syringe, withdraw the needle and discard the syringe with medication. There are thoughts against this: (i) This is not possible while using AD syringe. (ii) Large blood vessels are not located around the recom-mended injection sites. (iii) Understanding the anatomy of injection sites and using appropriate landmarks prevent injury to vessels. (iv) All of the complications in the literature of intra-arterial injection involved penicillin and similar medications and not vaccines. It is safe to assume that immunization as a class of IM injection poses less risk to the patient than other medications particularly antibiotics(1,31,33). The disadvantages of the aspiration procedure are: it prolongs the time the needle is inserted into the patient, may result in loss of control of the syringe if both hands are used and may cause trauma at the site of injection. But because of lack of sufficient evidences against aspiration also, WHO is neither able to support nor offering alternative action and recommends to make locally appropriate choices keeping in mind the risk associated with a "blind injection"(33). After introduction of AD syringes in immunization, we at least do have substantial field experience that injection with EPI vaccines into standard sites has no reports of adverse events(34). According to ACIP, no data exist to document the necessity of aspiration during immunization(24). So we can conclude that aspiration is not necessary during immunization and care is to be taken with injections other than vaccines. 7. Pushing the medication Inject the medication at the rate of 1 mL per ten sec. This slow pushing allows muscle fibres to stretch and accommodate the injected volume while lessening the chances of leakage back through needle track. Once the syringe has been emptied of medication, wait for 10 sec before withdrawing the needle. Withdraw the needle with a smooth and steady movement and apply gentle pressure with a dry gauze. Use of alcohol or spirit swab may cause burning sensation(1). 8. Multiple Injections If more than one injection is to be administered simultaneously, it is preferable to administer each at a different anatomical site. If it is not possible then the thigh is usually a preferred site and two injections are sufficiently (1"-2") separated(24). 9. Post Injection Post injection syncopy is a known side effect especially in adults and adolescents and so it is better to observe the patient for 10-15 min after injection(38). Instruction is given for proper self-management with paracetamol like drugs for local pain and fever. All equipments used for injection are to be disposed of safely. Conclusion Based on this review, a research based guideline for practice has been developed (Table I). Use of these guidelines along with clinical judgment can assist the clinician to ensure that the practice of IM injection is evidence based. Contributors: KRL provided the framework and concept of the article and reviewed the literature. KRL and MKL drafted the paper. MKL was responsible for critical appraisal. She will act as the guarantor of the paper. Funding: None. Competing interest: None stated. Table I Clinical Practice Guidelines: Intramuscular Injection Guidelines for Evidence Based Technique Infants, toddlers, children and adults receiving medication by IM route for curative or prophylactic purpose. Objective: Administration of medication to maximize the therapeutic effect for the patient and minimize or eliminate patient injury and discomfort associated with procedure. Key points: An injection should be given if it is necessary and each one is safe as per WHO justification for IM injection. Consider: • Medication characteristics including formulation, onset and intensity of effect, duration of effect\* • Patient characteristics including compliance, uncooperativeness, reluctance, inability to take by another route\* Site Selection: It is single most consistent factor associated with complications and injury. Always use bony landmarks to properly identify the site.\* Consider: Age of patient: • Infants: Vastus lateralis is the preferred site\* • Toddlers and children: Vastus lateralis or deltoid\* • Adults: VG or deltoid\* Medication type: • Biologicals including immune globulins, vaccines and toxoids: VL in infants and young children or deltoid in older children and adults\* • Irritating, viscous or oily solution and depot formulations: VG\* Medication volume: • Volumes 2 mL or less in deltoid\* and larger volumes of 2-5 mL in VG\* Preparation of injection: Consider: Equipment (a) Needle Length corresponds to the site, age of patient and muscle mass. Use longer possible needle \*§ • VL ® 16mm to 25 mm\* • Deltoid for children ® 16 mm to 25 mm and for adults – 25 mm to 38 mm\* • VG (Adults) ® 38 mm\* (b) Needle gauge often dependent on needle length. In general for most biologicals and aqueous solutions 23-27 g and for oil based medication 18-23 g @ • Use 23 g needle for immunization \*§ • Always use a new sterile syringe and needle for every injection\* • Use the markings on the syringe barrel to 'determine the correct dose'\* • Do not include air bubble in the syringe\* Patient preparation and positioning: Consider site of injection • Deltoid, patient may sit or stand. A child may be held in adult's lap\* • VG: patient may stand, sit or lay laterally or supine\* • VL: Infants and young children may lay supine or be held in adult's lap\* • Remove clothing at the site for adequate visualization and palpation of bony landmarks® • Position patient to relax the muscle\* Injection Procedure: • Cleanse the site with alcohol wipes and allow it to dry. If cleanliness and asepsis are, observed, routine skin disinfection is not necessary @ \*§ • Insert the needle into the muscle using a smooth and steady motion @ • Though US technique is preferable, both US and WHO methods are worthy of further discussion and investigation ¶ • Research on two alternate techniques to reduce pain at the moment of injection is inconclusive at this time, but warrants further study \*§ • No need for aspiration in immunization, otherwise understand the anatomy of injection site and take care to minimize injury with blind injection® § • Inject slowly at the rate of 1 mL/10 sec @ • After injection, wait for 10 sec before withdrawing the needle @ • Withdraw the needle slowly, apply gentle pressure with a dry gauze @ Post injection: • Observe the patient for 10-15 minutes\* • Assess site for complication, both immediately and 2-4 hours later, if possible • Instruct patient regarding assessment, self-management of minor reactions and when to report more serious problems\* • Properly and promptly dispose of all equipments

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