The practice of blood aspiration during injections is a tradition taught in nursing for the past 40 years (9). This precautionary technique is performed to ensure that a low flow blood vessel/artery has not been penetrated (2,9,10,11,12). Aspiration has been added and eliminated based on anecdote, assumption, and arbitrary choice for decades (11). However, past literature and integrative reviews have indicated that the need to aspirate blood prior to injection is not based on scientific evidence (1,3,8). This integrative review will examine the aspiration technique for subcutaneous (SC) and intramuscular (IM) injections, primarily involving the administration of vaccines and immunizations, in the ambulatory care setting.

A review of the research evidence from 2000-2008 was conducted via electronic databases (CINAHL, Medline, PubMed, Cochrane Library, Kaiser National Evidence-Based Guidelines and OVID) using the search terms of “aspiration”, “subcutaneous”, “intramuscular”, and “injections”. A total of 306 hits yielded 14 articles. Reference links and a Google web-based search resulted in 7 additional articles. 21 total articles were reviewed and 15 selected as relevant. The strength of the research evidence ranged from insufficient to fair, with a final grade of insufficient. In addition, an immunization nurse specialist was asked to critique the research findings and recommendations (3). Much of her clinical judgment and expert opinion is validated by the evidence captured in this review. Result limitations include the relatively narrow focus of administered medications, mainly vaccines, immunizations, insulin, and penicillin. The primary reliance on conflicting best practice guidelines reflects the need for more research in this deceptively routine patient care procedure. However, it is highly unlikely a randomized control trial will answer this question, due to patient safety issues and the extremely large sample size required to detect this rare major adverse event (5).

Current injection practices vary throughout healthcare organizations and practice settings (2,3,6,7,9). There is a wide variation in the training that nurses receive, injection techniques used, and sources of resource information (2). There are no studies confirming or rejecting current aspiration techniques that can contribute to a standardized procedure, regardless of healthcare setting (11). Although no data currently exists to document the necessity for aspiration, it must be acknowledged that a lack of reported publications might provide evidence that aspiration is effective (1,5,8). The use of jet injection for delivery of vaccines and immunizations does not involve the aspiration technique, yet no discussion of non-aspiration risks related to this device was found in the literature (1). Elimination of the aspiration technique has the potential to reduce injection duration time and decrease injection pain, thereby increasing medication injection compliance (2,5,14). These three aspects are particularly important in the pediatric population, which receives the majority of vaccines and immunizations.

Key Summary of the Evidence

- Aspiration may not be a reliable indicator of correct needle placement (11).
- Aspiration during SC injection is not necessary (2,7,8,11,14).
- There is no reported evidence that aspiration with or without blood return confirms needle placement or eliminates the possibility of an IM injection into a non-SC blood vessel (8,11).
- Fears of adverse reactions following non-aspiration of IM injections mainly center on intrarterial injection of penicillin and other large molecule medications (4,6,9,10,13).
- Most nurses do not follow slow aspiration guidelines and perform the procedure too quickly for it to be effective (5).

Based on the reviewed evidence, the following recommendation is offered for consideration:

- Until a standard can be determined, injection techniques must be individualized to the patient, the equipment, and the medication being administered in order to decrease the risk of incorrect needle placement (3,11,13,14,15).
- Aspiration is not indicated for SC injections of vaccines, immunizations and insulin.
- Aspiration is not indicated for IM injections of vaccines and immunizations.
- Aspiration may be indicated for IM injections of large molecule medications, such as penicillin.
Aspiration Technique for SC/IM Injections – An Integrative Review

A Topic Summary of the Evidence

➢ Historical Background [3, 11, 14]
    ➢ 1885 - First published account of SC injection with syringe & needle (11)
  ○ 20th Century [3, 4, 11]
    ➢ Aspiration immediately before injection is an outdated procedure going back decades (3).
      • Conflicting technique instructions in 1923 & 1925 (11).
      • 1927 Case report of the arterial embolism complications arising from an intramuscular injection of potassium bismuth tartrate in a 48 year old man with syphilis (4).
      • 1930s article in a medical journal suggested one could mistakenly enter a vein when administering large doses of penicillin (3).
    ➢ Practice of aspiration added and eliminated based on anecdote, assumption, and arbitrary choice (11)
    ➢ Although critics argued that depositing vaccine in a vein when injecting at 45 or 90 degree angle was almost impossible, aspiration procedure became widely accepted (3).
  ○ 21st Century [3]
    ➢ World Health Organization (WHO), American Academy of Pediatrics (AAP), and England’s Department of Health (DoH) have stated aspiration only serves to prolong the injection procedure and is not necessary (3).

➢ Injection Techniques
  ○ Aspiration [1, 6, 9, 12, 14, 15]
    ➢ Definition: Syringe plunger pulled back for 5-10 seconds to create negative pressure in tissue before injection (1, 12).
      • If blood present, withdraw, discard and repeat procedure (1, 6, 12, 14).
      • If no blood, inject at rate of 1ml/ten seconds (14).
    ➢ No data exit to document the necessity for the aspiration procedure (1).
      • However, lack of reported publications might provide evidence that aspiration is effective (5).
    ➢ Aspiration is cited as being necessary in order to maximize therapeutic effects of administered medications while minimizing or eliminating patient injury and discomfort associated with IM injections (9).
    ➢ Majority who aspirate do not follow slow aspiration guidelines and perform procedure too quickly for it to be effective (visualize blood flash back) (5).
  ○ Subcutaneous [2, 8, 11]
    ➢ No study has documented that blood on aspiration following SC injection is definite evidence that needle penetrated muscular microcirculation or non-SC circulation (8, 11).
      • Aspiration is unnecessary for SC injections (2, 8, 11).
    ➢ Aspiration of syringe cited as causing histopathologic skin & SC tissue changes, with resulting delayed absorption at site (11).
    ➢ Until a reliable method to decrease risk of incorrect IM needle placement is available, literature supports lifting a skin fold for all SC insulin injections (11).
    ➢ Demographic question of usual injections methods yielded no patient reporting blood on aspiration (35% taught to aspirate) (11).
Intramuscular [2, 9, 10, 11, 12, 13, 14]
- Used to deliver medications into a well perfused muscle (14)
  - Rapid systematic action & absorption of large doses (1-5ml) in adults (14).
  - Z track method recommended for use with full range of IM meds to reduce pain and leakage of irritating meds (14).
  - Needle angle should be 90 degrees (14).
  - Air bubble method under review (14).
  - Site massage after injection discouraged re: leakage and irritation (14).
- Aspiration performed to ensure a low flow blood vessel has not been penetrated (2, 9, 10, 11, 12).
  - Literature reports complications resulting from intra-arterial or IV injection of medication (9).
  - No studies published to confirm that aspiration identified correct needle placement (11).
  - Maximum attention must be paid for the appearance of blood both at the distal end of the injector and just below the piston (10).
  - Localized bleeding beyond the usual after injection should arouse suspicion of intra-arterial injection (10).
    - If needle inserted horizontally to right, may reach femoral artery; occlusion of femoral artery or branches causes ischemic changes to foot or leg (10).
    - Absence of blood on aspiration does not suggest artery proximity and cannot prevent thrombus formation caused by medication injected into a closed space surrounding a blood vessel (13).

Jet Injection (1)
- Definition: Needle-free devices that drive liquid medication through a nozzle orifice, creating a narrow stream under high pressure that penetrates skin to deliver a drug or vaccine into ID, SC, or IM tissue. (1)
  - Jet injection discussion does not mention aspiration technique, which is not technically possible with Jet injection equipment (1).

Miscellaneous [11]
- Unable to confirm actual placement of needles in SC or IM sites (11).

Medications
- Subcutaneous [2, 6, 7, 8, 11, 14]
  - Vaccines should be given IM or deep SC, depending on the medication (2).
  - No data to support the concept that aspiration on the plunger is required before immunizations/vaccines injections in adults & children (8).
  - Insulin (11)
    - Insulin injection technique should be individualized to decrease the risk of incorrect needle placement (11).
    - Inadvertent IV insulin injection has not been documented, although its occurrence has been cited in the literature (11).
    - No RCT of SC/IM insulin injection used aspiration as needle detection method (11).
Aspiration Technique for SC/IM Injections – An Integrative Review

A Topic Summary of the Evidence

- Insulin syringe manufacturers’ patient education literature does not include aspiration technique (11).
  - Change based on anecdotal preference of diabetes educators, not scientific evidence (11).

- Allergens (6)
  - Aspiration is used as a precaution against IV administration of allergen medication, which can lead to systemic reactions (6)

- Heparin (14)
  - Heparin injection with aspiration increases risk of hematoma formation (14).

- Methotrexate (7)
  - Aspiration not recommended for home SC injection (7).

  - Intramuscular [4, 5, 8, 10, 13, 14]
    - Immunizations/Vaccines
      - No data to support the concept that aspiration on the plunger is required before immunizations/vaccines injections in adults & children (8).
      - No report of complications following inadvertent IV injection in anterolateral thigh or deltoid muscle during immunization (5).

- Penicillin (PCN) (10, 13)
  - Intra-arterial PCN injection can trigger distal and proximal tissue injury, with tissue injury following distribution of the lower aorta (10)
    - Crystals of benzathine, bismuth, or procaine PCN are bigger than erythrocytes and may occlude small arterioles (4, 10).
    - Non-aspiration of blood is not an absolute safeguard (4).
  - PCN injection into closed space surrounding blood vessel has been linked to tissue injury and thrombus formation (13).
    - Aspiration does not prevent this injury (13).

- Needles [3, 11, 13, 14, 15]
  - Individualization of Needle Injection Gauge, Length, & Angle, Gauge
    - Dependent upon
      - Age
      - Body size
      - Subcutaneous/muscle development
      - Medication
      - Injection site

- Pain Perception [2, 5, 14]
  - Intramuscular [2, 5, 14]
    - Contradictory information regarding IM vs. SC injection pain (2, 14)
      - Muscle fibers have fewer pain receptors than SC tissue (2) versus IM often reported as a very painful injection (14)
    - Immunization using a pragmatic rapid injection technique is less painful than slow standard of care technique and should be recommended for routine IM immunizations (5).
      - Easy to implement (5)
      - Cost effective compared to other pain reducing modifications (5)
Better parental vaccine compliance re: reduced pain of child (5)
- Difficult to ascertain relative contribution of injection speed vs. aspiration on observed overall pain reduction (5)

Guidelines, Protocols, & Strategies [11, 15]
- There are no studies confirming or rejecting the current technique that could contribute to the determination of a standard (11).
- World Health Organization modular guidelines are used by healthcare agencies worldwide (15)
  - Correct immunization preparation and administration techniques for women and infants are discussed in depth (15).
  - Under section 3.5 How to give an injection using AD syringes, instruction item #4 states: “It is not necessary to aspirate first.” (15)

Education & Training [2,14]
- Wide variation in training that nurses received, the injection techniques used, and sources of referral information (2).
- Patient education literature from insulin device makers do not advocate aspiration (14)
## Key Web Search Terms

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Contextual/Reference Links Relevant Articles: 7  
Web Search (Google) Relevant Articles: 1

## SCORE LEVELS OF STUDIES

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**Total Articles** 15
Appendix B – 2008 Bibliography

Purpose/intended Audience

Because we want everyone in our communities to have the healthiest lives possible, we are making our evidence reviews available to the communities we serve to help Californians and others lead healthier lives.

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