

## REVIEW

**Aspirating during the intramuscular injection procedure: a systematic literature review**

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**Aims and objectives.** To review the available evidence on aspirating when administering intramuscular injections and suggest recommendations for practice.

**Background.** The process of aspiration has been ingrained in the intramuscular injection procedure, and whilst many policies no longer recommend this practice, it often continues to be taught and practiced. The result is a variation in this procedure not always consistent with an evidence-based approach.

**Design.** A systematic literature review.

**Methods.** A systematic approach to searching the literature was undertaken using identified academic databases from inception to May 2014. Citation searching identified additional data sources. Six studies met the search criteria.

**Results.** The majority of health professionals do not aspirate for the recommended 5–10 seconds. Administering an injection faster without aspiration is less painful than injecting slowly and aspirating. The main influences on the decision of whether or not to aspirate are based on what health professionals are taught and fear of injecting into a blood vessel.

**Conclusions.** In the paediatric vaccination setting, the practice of aspirating during the administration of an intramuscular injection is unnecessary and there is no clinical reason to suggest that these principles may not be applied when using the deltoid, ventrogluteal and vastus lateralis sites in other settings. Owing to its proximity to the gluteal artery, aspiration when using the dorsogluteal site is recommended. Nurses must be supported in all settings, by clear guidance which rejects traditional practice and facilitates evidence-based practice.

**Relevance to clinical practice.** Educators need to ensure that their knowledge is up to date so that what they teach is based on evidence. This may be facilitated via regular educational updates. Further research and subsequent guidance are needed to support evidence-based practice in intramuscular injection techniques in all nursing settings.

**Key words:** aspiration, evidence-based practice, intramuscular injections

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**What does this paper contribute to the wider global clinical community?**

- This review's findings suggest that with the exception of the dorsogluteal site, the evidence does not support aspirating during the administration of an intramuscular injection.
- The findings of this review raise awareness for practitioners who administer intramuscular injections to maximise development opportunities so that their own practice is evidence based.

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## Introduction

The administration of an intramuscular (IM) injection is considered a basic nursing activity (Beyea & Nicoll 1995), yet there is considerable debate in practice regarding this fundamental nursing skill. Aspiration is commonly taught during the administration of an IM injection, a practice which is substantiated by current nursing procedure text books (Perry *et al.* 2014). Aspiration is the application of negative pressure prior to injection and described by Perry *et al.* (2014) as pulling back on the plunger for 5–10 seconds, the purpose of which is to ensure that the drug is not inadvertently given intravenously (Dougherty & Lister 2011). However, the need to aspirate when giving an IM injection is under scrutiny, and this has led to discrepancies in the guidance on IM injection technique which is reflected in practice (Crawford & Johnson 2009). Given that this is a vital and common nursing skill, this review seeks to assess the evidence concerning this practice.

## Background

The World Health Organization (WHO) estimates that approximately 16 billion injections are given every year and that these may be given for either preventive (vaccination) or curative reasons. The vast majority of these are given for curative purposes with 20 therapeutic injections being administered for every vaccination given (WHO 2006). Injections are commonly administered intravenously (IV), intradermally (ID), subcutaneously (SC) or intramuscularly, and the decision to use these routes depends on several factors. The IV injection route is used to promote fast action of a drug, whereas injections given either intradermally, subcutaneously or intramuscularly produce a slower yet more variable rate of absorption (Rang *et al.* 2012). Injections given by the IM route are absorbed at a faster rate than the ID and SC routes, and this site may be selected if the drug is likely to irritate the subcutaneous tissue or if the volume to be injected is large; however, it is noted that particularly for the IM injection route, this method of administration can pose the risk of tissue damage and be painful (Barber & Robertson 2009), indicating that those administering IM injections must do so using best practice guidelines. The practice of aspirating to avoid injecting medication into a blood vessel most likely stems from reports of IM injections inadvertently given intravenously. Some of the earliest recorded accounts of such errors focus on complications where penicillin was given intra-arterially (Atkinson 1969). However, these reports mainly focus on

injecting into the gluteal muscle, a practice which is no longer routinely recommended due to the risk of sciatic nerve damage (Chernecky *et al.* 2002). One report did involve an infant receiving a penicillin injection into the thigh (Talbert *et al.* 1967) although it was reported that the injection was given too low and an excessive needle length was used. Current sites recommended for IM injections include the deltoid, vastus lateralis and ventrogluteal muscles, and these sites are advocated because they avoid major blood vessels and nerves (Chernecky *et al.* 2002, Perry *et al.* 2014). Furthermore, recommendations of which of these sites to use vary according to the context. For example, the vastus lateralis is the site of choice for infants because it is the largest muscle mass into which vaccines can be safely injected (Department of Health 2013).

Official guidance concerning vaccination is mainly unanimous in its recommendations on aspiration in IM injection administration. The Department of Health (2013), Centers for Disease Control and Prevention (CDC 2014) and the Public Health Agency of Canada (2013) all state that aspiration is not necessary. In 2008, the WHO published immunisation guidance which focussed on the use of auto-disposable syringes (WHO 2008). These syringes are designed for single use only meaning that once a drug has been drawn up into it, aspiration is impossible. However, because all of these guidelines centre on vaccination practices, it is difficult to ascertain whether these standards extend beyond immunisation techniques. Additional sources of published guidance, frequently based on expert opinion, are divided in their recommendations. Previously, aspiration has been advocated by Rodger and King (2000) and Hunter (2008) but not recommended by Diggle (2007). Systematic reviews have also reached different conclusions with some authors agreeing that aspiration should be a fundamental element of the IM injection procedure (Beyea & Nicoll 1995, Nicoll & Hesby 2002 & Wynaden *et al.* 2005, 2006) and others negating aspiration entirely (Taddio *et al.* 2009). Perhaps unsurprisingly then, experience of nursing in a variety of settings suggests that the practice of aspirating when administering IM injections differs. Similarly, colleagues in nurse education are also divided in their teaching of this clinical skill, validating the need for clarity.

## Aim

The purpose of this paper was to review the available research around IM injections, focussing on the practice of aspiration so that recommendations for evidence-based IM injection procedure can be determined.

## Methods

The databases CINAHL, Medline, Academic Search Premier, Web of Science, SCOPUS and the Cochrane library were searched, and the reference lists of the articles identified from this search were checked for additional resources. Although not a systematic review, the search adopted a systematic approach to ensure the retrieval of papers relevant to the discussion. To ensure quality and completeness in reporting this process, PRISMA (Moher *et al.* 2009) was adhered to as shown in Fig. 1. The key words used were the following: [injection OR vaccination] AND [methods AND aspiration]. The number of papers retrieved is illustrated in Fig. 1. The abstracts were reviewed to assess suitability and subjected to inclusion and exclusion criteria. The majority of papers were excluded at this stage as they focussed on aspiration outside the practice of giving IM injections and were not primary sources. Inclusion criteria were that the studies had to include aspirating within the context of giving an IM injection in any setting. No date limits were applied, and papers from countries outside of the UK were included. The selected studies were critically appraised using a tool developed by Coughlan *et al.* (2007) so that their quality could be established prior to inclusion in the review.

## Results

The academic database search identified six studies deemed relevant to the topic which were published between 2000–2014 and originated from Canada, the USA and India. These are summarised in Table 1. Two of the studies were randomised controlled trials comparing two IM injection techniques, whilst the remainder were surveys which aimed to explore the practice of aspiration among health professionals.

To provide structure and clarity to the remainder of the review, the findings are critically appraised and summarised by a process comparable with thematic analysis. Three themes are identified: aspiration technique and management, pain and influences on aspiration practice.

### Aspiration technique and management

Two studies questioned health professionals about their IM injection technique. Ipp *et al.* (2006) found that of the respondents who did aspirate (74%), only 3% did so for the recommended 5–10 seconds. Similarly, the study by Engstrom *et al.* (2000) surveying fertility nurses found that 96% of nurses aspirated as they had been advised to, but it

is not stated whether or not the recommended aspiration time of 5–10 seconds had been adhered to. Furthermore, the study revealed that the appearance of a blood-stained aspirate was managed differently among the nurses as some discarded all equipment and medication and started again where others used a procedure which involved injecting the blood-stained medication. This study surveyed fertility nurses who were regularly injecting adults and the vast majority of them injected into the dorsogluteal site, whereas Ipp *et al.* (2006) surveyed community staff about their vaccination practices in children where the deltoid and vastus lateralis muscles are the advocated injection sites.

For both of these studies, at the time they were published, aspiration was recommended practice which would account for the high proportion of respondents reporting that they did aspirate. Although not stated by Engstrom *et al.* (2000), it is reported by Ipp *et al.* (2006), of those surveyed, that aspiration was only undertaken for the advised 5–10 seconds by 3%, indicating that even though a high proportion of respondents were aspirating, it was not being performed as recommended.

### Pain

Ipp *et al.* (2006) also reported on respondents who did not aspirate and found that 43% chose not to because they thought it increased pain (Ipp *et al.* 2006). These findings are supported by Girish and Ravi (2014) and Ipp *et al.* (2007) who conducted similar RCTs where two injection methods were studied; a slow 'standard' technique with aspiration lasting for 5–10 seconds was compared with a faster 'pragmatic' technique without aspiration, with the entire procedure lasting only one to two seconds. Findings from both of these studies report that the slower 'standard' process of administration is more painful than the faster 'pragmatic' method. A limitation of the study by Ipp *et al.* (2007) is the small sample size; however, given that these findings are supported by the more recent study by Girish and Ravi (2014), these findings are considered to be significant. Both of these studies are in the paediatric vaccination setting where the recommended injection sites are the deltoid and vastus lateralis.

### Influences on aspiration practice

Moore and Allan (2012) conducted a pre- and posteducational session survey of nurses who practice vaccination. Within the context of this study, aspiration is not recommended, yet despite this guidance, almost 40% of respondents still chose to do so. Whilst their findings indicate

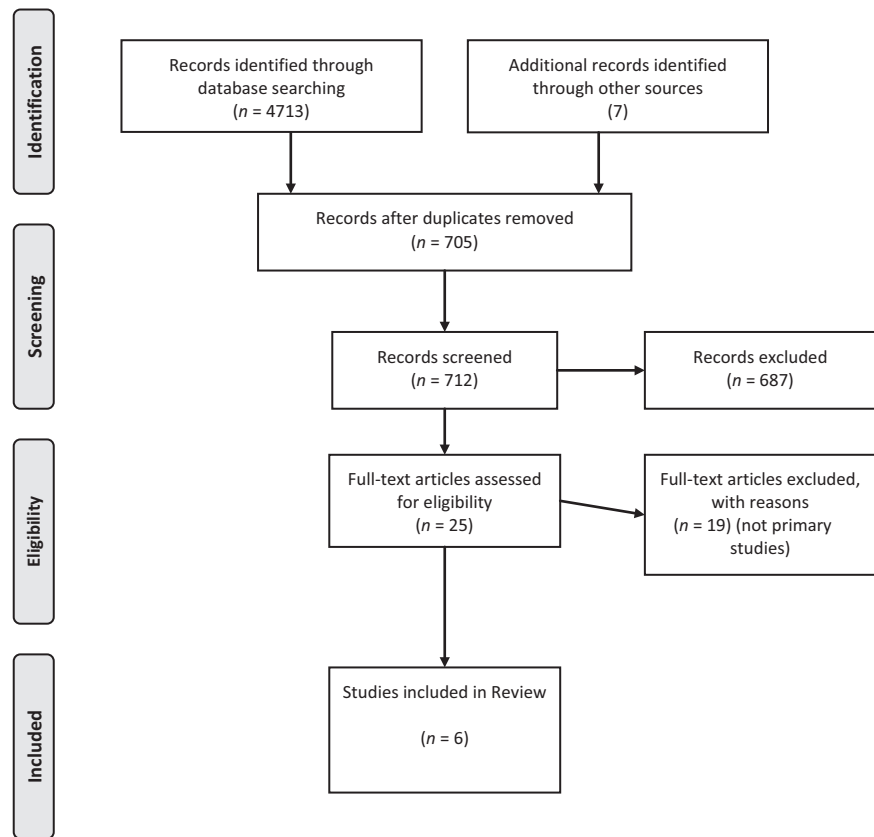


Figure 1 PRISMA flow diagram.

that the educational session was successful in influencing knowledge and intended practice among nurses as the number of participants favouring aspiration decreased in the postsurvey questionnaire, they also explored with participants reasons for aspiration. Responses included because it was what they had been taught (40.8%), what they observed colleagues doing (10.7%), what colleagues instructed them to do (6.8%) and to avoid injecting into a blood vessel (41.7%). The decision not to aspirate was mainly based on evidence-informed best practice, continuing education and information from a reliable source. Similarly in their survey (respondents  $n = 72$ ), Hensel and Springmyer (2011) report that the decision of whether or not to aspirate was influenced by practice recommendations ( $n = 4$ ), what respondents had been taught ( $n = 38$ ) and to avoid injecting into a blood vessel ( $n = 13$ ). Both of these studies (Hensel & Springmyer 2011, Moores & Allan 2012) were undertaken in the paediatric vaccination setting and report similar findings; that what the respondents were taught had a strong impact on their practice. Fear of injecting into a blood vessel was also a significant influence on individuals' practice in the study by Moores and Allan (2012).

## Discussion

This review sought to examine primary research regarding the practice of aspiration whilst administering an IM injection, with a view to making practice recommendations. The literature search only yielded six studies which met the research objectives, and it may be that this lack of evidence to substantiate this procedure accounts for the variations seen in practice. Within the context of each study, regardless of the official guidance on aspirating during the IM injection procedure, some disparities were still apparent.

### Aspiration technique and management

Much of the published guidance which recommends aspiration states that applying negative pressure for 5–10 seconds is a vital element of this procedure to confirm that the drug will not be injected into a blood vessel (Beya & Nicoll 1995, Rodger & King 2000, Nicoll & Hesby 2002, Wynaden *et al.* 2005). However, Ipp *et al.* (2006) found that only 3% of those who aspirated adhered to this practice. This may be explained by the study's context of paediatric vaccination. Administering IM injections in children can be

Table 1 Summary of findings

Authors (year), country	Aims and study design	Sample/setting	Position on aspiration	Main findings	Limitations
1 Girish and Ravi (2014) India	RCT to compare two intramuscular (IM) injection techniques – standard slow injection with aspiration and pragmatic rapid injection without aspiration	200 infants aged 6 weeks–18 months attending for routine vaccinations	Not stated	Standard slow technique significantly more painful than rapid pragmatic technique	Focus on IM injections of vaccines only
2 Moores and Allan (2012) Canada	Pre- and posteducational session survey to establish whether the session would result in a change in aspiration practice	140 nurses attending an immunisation conference	Not necessary	Questionnaires revealed that nurses demonstrated an understanding of recommendations not to aspirate after receiving an educational session	Focus on IM injections of vaccines only Validation of data collection tool not established
3 Hensel and Springmyer (2011) USA	Survey to establish whether practice guidance of not to aspirate had diffused into nursing practice	72 perinatal nurses	Not necessary	Despite the recommendations, 90% of nurses continued to aspirate	Focus on IM injections of vaccines only Validation of data collection tool not established Small sample size may impact on external validity
4 Ipp <i>et al.</i> (2007) Canada	RCT to compare a standard, slower method with aspiration with a pragmatic, faster administration without aspiration	113 infants aged 4–6 months attending for routine immunisation	Recommended by official guidance but challenged by authors of study	Faster administration without aspiration less painful than the standard technique	Focus on vaccination only Validation of data collection tool not established
5 Ipp <i>et al.</i> (2006) Canada	Survey to determine whether doctors aspirate as per recommendations when giving IM vaccines	123 community paediatricians and nurses	Recommended by authors of study	74% aspirated as advised, but only 3% did so for the recommended 5–10 seconds	Practice of aspiration not sole focus of study
6 Engstrom <i>et al.</i> (2000) USA	Survey to establish IM injection preparation and administration practices of nurses	645 fertility nurses	Recommended	96% of nurses surveyed aspirated as recommended	

difficult with the additional process of aspirating for the recommended 5–10 seconds only adding to this challenge.

### Pain

Both within the context of paediatric vaccination, Ipp *et al.* (2007) and Girish and Ravi (2014) found that a slower injection technique with aspiration was more painful than a faster injection without aspiration. These findings support the previous study by Ipp *et al.* (2006), also in the paediatric vaccination setting, where 43% of respondents did not aspirate because they thought that it caused increased pain. These findings contrast with previously published integrative reviews which recommended that a more painless procedure was a slow technique with aspiration (Beyea & Nicoll 1995, Nicoll & Hesby 2002). What is significant here is that in the paediatric vaccination setting, parents have cited their child's pain during the procedure as a reason for not attending subsequent vaccinations (Mills *et al.* 2005). It is therefore vital that those administering vaccines do so using a technique which will not only be less painful for the child but will also promote the completion of the immunisation schedule.

### Influences on aspiration practice

This review revealed that the decision to aspirate was strongly influenced by what respondents had been taught (Hensel & Springmyer 2011, Moores & Allan 2012). This has resonance with what happens in practice today with some educators still teaching aspiration. Additionally, this is taught to ensure that the drug is not injected into a blood vessel, another reason for aspiration cited by Moores and Allan (2012) and Hensel and Springmyer (2011). The purpose of aspirating clearly has its origins in avoiding major vessels, but whilst considering the context within which the IM injection is administered, using the recommended injection sites significantly reduces the risk of erroneously injecting into a vessel. This places an emphasis on nurses' knowledge of anatomy and the ability to correctly locate the appropriate injection site. However, for many nurses, aspiration has become a custom in the IM injection process, and adopting an evidence-based approach to this may be challenging for some, perhaps due to the fear associated with accidentally injecting into a vessel. Clinical decision-making is influenced by many factors, and understanding these is necessary for changes in practice to be successful. Furthermore, current textbook procedures advocate aspiration, and this coupled with previous recommendations to aspirate contradicts current guidance; it is therefore perhaps unsurprising that variations exist both in the practice and in the teaching of this procedure.

All but one of the studies included in this review (Engstrom *et al.* 2000) focussed on the practice of aspiration in the paediatric vaccination setting meaning that the application of these findings to other areas of nursing practice is limited; but there are no reasons to suggest that these findings may not be applicable in other settings where commonly used injection sites include the deltoid and vastus lateralis. Additionally, the ventrogluteal site is also advocated because it avoids major vessels (Hemsworth 2000), meaning that aspiration when using this site may also be unnecessary. Intramuscular injections are also regularly administered in mental health nursing where the focus is on depot injections, and published recommendations in this setting promote aspiration (Wynaden *et al.* 2006, Cocoman & Murray 2008). However, these types of injections tend to be given in the dorsogluteal muscle (Cocoman & Murray 2008), and Malkin (2008) advises that aspiration is only necessary when performing an injection using this site owing to its proximity to the gluteal artery, a recommendation which is supported by guidance which focuses on IM injections in this setting (Feetham & White 2011). The recommendation to aspirate when giving an injection into the dorsogluteal site is consistent with the findings reported by Engstrom *et al.* (2000) that the majority of nurses included in this study aspirated and chose the dorsogluteal muscle as their preferred injection site. This site is not recommended for infants and children owing to the risk of sciatic nerve damage (Villarejo & Pascaul 1993). This indicates that additional policies are needed to address the administration of IM injections outside of the vaccination and mental health settings, so that this procedure is evidence based.

### Strengths and limitations of the review

Of the studies which were relevant to the aims of this review, with the exception of one study, the remainder concerned the practice of aspirating in the vaccination setting. Whilst the majority of them do not recommend it, they fail to suggest that their recommendations may be applied in other settings. This may be because vaccines tend to be given in the deltoid in older children and adults, and the vastus lateralis in infants and younger children, and these muscles are advocated owing to the absence of major vessels at these sites (DH 2013). Nevertheless, this review does indicate that aspiration is unnecessary when administering IM injections at the recommended site in infants and children. It also highlights the importance of aspirating when using the dorsogluteal muscle due to its proximity to the gluteal artery.



## Conclusion

Administering an IM injection is a common nursing procedure, yet debate over the necessity to aspirate during the procedure is evident in the literature and reflected in practice. More recently, evidence-based guidelines do not advocate aspiration, and whilst these guidelines refer to vaccination, it is recommended that with the exception of the dorsogluteal site, the principles should be applied when administering any IM injection regardless of the context. The lack of policy in other practice areas should be addressed to support this.

## Relevance to clinical practice

The following recommendations could contribute to the improvement of practice ensuring that it enhances the quality of care provided for those receiving IM injections whilst enabling nurses to make evidence-based decisions:

- Current guidance negating aspiration during vaccination should be disseminated through regular educational updates.
- Nurse educators must ensure that their knowledge is up to date so that the IM injection procedure that is taught is based on the latest evidence and guidance.

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- More research is needed to investigate aspiration practices in other areas of nursing. This could contribute to the development of policies where IM injections are administered, thereby supporting nurses in all practice settings.

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The author has confirmed that author meets the ICMJE criteria for authorship credit ([www.icmje.org/ethical\\_1author.html](http://www.icmje.org/ethical_1author.html)), as follows: (1) substantial contributions to conception and design, acquisition of data, or analysis and interpretation of data; (2) drafting the article or revising it critically for important intellectual content; and (3) final approval of the version to be published.

## Conflict of interests

No conflict of interest.

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