To aspire or not: An integrative review of the evidence

By Cecelia L. Crawford, MSN, RN, and Joyce A. Johnson, PhD, RN-BC

It all started with this question from an ambulatory care nurse educator: “Do we still have to teach aspiration of blood when giving an I.M. or subcutaneous injection?” This question led to an informal query about the practice of aspirating for blood before injection to confirm that the needle hasn’t inadvertently entered a blood vessel.

We verbally polled about 40 nurses at departmental and one-on-one meetings, and found that about 50% of respondents supported the practice of aspirating for blood before injection. The final tally of responses found no correlation to their age, education, or other demographics. However, the responses did seem to illustrate that how nurses were taught to give injections during basic nursing education strongly influenced their views: those who’d been taught to aspirate supported the practice while those who weren’t taught to do so continued to omit this step.

This impromptu survey mirrored a brief literature search about this long-standing injection technique. We developed this targeted clinical question: “What’s the evidence for aspirating for blood before administering I.M. or subcutaneous immunizations in the ambulatory care setting?” We decided to formally explore this clinical topic and selected the integrative review process as our method of investigation. This article describes how we conducted an integrative review to answer this deceptively simple clinical question and discusses the impact of the integrative review results on nursing practice. First, we’ll explain the method we chose.

What’s an integrative review? Our examination of the evidence included literature, systematic, and integrative reviews.1 (See Sorting out types of evidence reviews.) Although a systematic review is the most rigorous method for minimizing bias, it’s also likely to provide more information than necessary to answer a simple clinical question.1,2 An integrative review suited our area of clinical inquiry best because it lets the researcher draw conclusions about the current state of knowledge among diverse studies.2,3 By combining diverse methodologies, integrative reviews create a more well-rounded evidence review.1,6

Evidence search and review methodology
We conducted a review of research studies and other types of evidence from 2000 to 2008 with electronic databases (CINAHL, MEDLine, PubMed, Cochrane Library, Kaiser National Evidence-Based Guidelines, and OVID), using the key search

<table>
<thead>
<tr>
<th>Sorting out types of evidence reviews</th>
<th>Literature</th>
<th>Integrative</th>
<th>Systematic</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Description</strong></td>
<td>Narrative account of published materials on a topic of interest</td>
<td>Literature compilation and synthesis of diverse studies via narrative analysis</td>
<td>Literature compilation and synthesis of like studies (such as randomized controlled trials) via narrative or statistical analysis</td>
</tr>
<tr>
<td><strong>Purpose</strong></td>
<td>Conveys current state of knowledge and ideas on a specific topic; doesn’t answer a clinical question</td>
<td>Answers a targeted clinical question using a systematic search strategy and rigorous appraisal methods</td>
<td>Addresses a targeted clinical question using a detailed, comprehensive search strategy and rigorous appraisal methods</td>
</tr>
<tr>
<td><strong>Intent</strong></td>
<td>Presents a “snapshot” and sets a research problem into context</td>
<td>Presents varied perspectives of diverse methodologies without an overemphasis on empirically based research</td>
<td>Summarizes, appraises, and communicates contradictory results and/or unmanageable amounts of research</td>
</tr>
<tr>
<td></td>
<td>Doesn’t employ summary statistics; sample sizes can’t be pooled due to heterogeneity</td>
<td></td>
<td>Sample sizes are pooled and summary statistics are used to present results</td>
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For decades, aspiration has been added to and eliminated from nursing practice based on anecdote, assumption, and arbitrary choice.

Injection of immunizations. This article references a primary source contained within the original integrative review. Limitations of the integrative review included the relatively narrow focus of administered medications, immunizations, insulin, heparin, and PCN.

Finally, we asked a doctorally prepared immunization nurse specialist often cited in the literature to critique the evidence findings and our recommendations about aspiration, which received her support. The Institute of Medicine has recommended third-party peer review of evidence summaries as a demonstration of rigor and transparency.

Integrative review results: The history of aspiration

Search results revealed the interesting history behind this clinical question. The practice of aspirating for blood before an injection has been discussed in medical journals since the early 1900s and is a tradition taught in nursing for the past 40 years. This precautionary technique ensures that an artery or vein hasn't been penetrated inadvertently. For decades, aspiration has been added and eliminated based on anecdote, assumption, and arbitrary choice.

Literature and integrative reviews have indicated that the practice of aspirating before injection has no basis in the scientific evidence. Critics of the practice argue that depositing immunizations in a vein when inserting the needle at a 45- or 90-degree angle at appropriate injection sites is almost impossible.

Currently, the American Academy of Pediatrics, The American Academy of Family Physicians (AAPF), the Advisory Committee on Immunizations Practices (ACIP), the United Kingdom's Department of Health, and the World Health Organization (WHO) have stated that aspiration isn't necessary and serves only to prolong the injection procedure. Even so, the aspiration technique has been widely practiced over several decades.

Integrative review results: Aspiration for blood and the 10-second rule

Aspiration for blood before injection is defined as pulling the syringe plunger back for 5 to 10 seconds to create negative pressure in the tissue and looking for blood return. If blood is present, indicating that the needle has entered a blood vessel, the nurse withdraws the needle, discards the medication, needle, and syringe, and repeats the procedure with sterile medication and equipment. If no blood is present, the nurse injects the medication at a rate of 1 mL per 5 to 10 seconds. Although it's not formally stated in the literature, the evidence suggests a specific procedure for the administration of any immunization or medication. We call this procedure the 10-second rule.

- slow aspiration (5 to 10 seconds)
- slow injection (5 to 10 seconds)
- slow withdrawal, no rubbing

Information about injection pain with I.M. versus subcutaneous injection is contradictory. Although muscle fibers have fewer pain receptors than subcutaneous tissue, patients often report that I.M. injections are very painful.
### Summarizing the Evidence About Aspiration

<table>
<thead>
<tr>
<th>Author(s)</th>
<th>Study Purpose/Methods</th>
<th>Conclusions/Critical Appraisal</th>
<th>Evidence Level</th>
</tr>
</thead>
</table>
| Atkinson et al., 2002<sup>27</sup> | Update of 1994 MMWR recommendations                                                   | • No data supports the aspiration procedure  
• Injection discussion doesn't mention aspiration technique                     | 1              |
| Chiodini, 2001<sup>13</sup>    | Best practice guidelines developed based on a survey of 500 nurses to assess their knowledge of best practices in vaccine administration | • Wide variation in training, injection techniques, and sources of referral information  
• May or may not aspirate during an IM injection; aspiration during subcutaneous injection isn't necessary | 1              |
| Diggle, 2007<sup>26</sup>     | Theory behind injection techniques to determine best practices in immunization        | • Aspiration before injection isn't necessary                                                | 1              |
| Gammel, 1927<sup>9</sup>      | Case report of complications arising from IM injections of potassium bisulfate tartrate in a 48-year-old man with syphilis | • Hematoma from arterial embolism caused by bisulfate crystals  
• Blood not obtained upon aspiration isn't an absolute safeguard; recommends careful injection technique | 2              |
| Ipp et al., 2007<sup>9</sup>  | Randomized controlled trial comparing the pain responses of two IM injection techniques involving 4- to 6-month-old healthy infants (N = 113) receiving IM, DPTaP-Hib immunizations | • No adverse events for any infant in any group  
• Most nurses who aspirate don't follow slow aspiration guidelines and they perform procedure too quickly  
• Pragmatic rapid injection technique is less painful than slow standard of care technique | 8              |
| Li et al., 2003<sup>22</sup>  | Physician practice guideline for various aspects of allergy immunotherapy            | • Aspiration used as a precaution against IV. administration of allergy medication            | 1              |
| Livermore, 2003<sup>23</sup>  | Description of parent educational teaching package on administration of methotrexate to children with rheumatic disease | • Aspiration before subcutaneous injection isn't necessary                                   | 1              |
| Middleton et al., 2003<sup>28</sup> | Review of 2003 Recommended Childhood Immunization Schedule and 2002-2003 Recommended Adult Immunization Schedule | • No data to support the concept that aspiration is required before injection  
• Aspiration before injection isn't necessary                                   | 1              |
| Nicoli and Hesby, 2002<sup>2</sup> | Integrative review and practice guidelines to:                                         | • Recommends aspiration technique to ensure needle isn't in a low-flow blood vessel         | 1              |
| Ozel et al., 1995<sup>14</sup> | Case report of 7-month-old infant who developed limb necrosis after IM injection of procaine PCN into the thigh | • Arterial injury suggested by extensive vascular changes to the right lower extremity  
• Large crystals of IM benzathine or procaine PCN may occlude small arterioles  
• Case report doesn't state whether aspiration had or hadn't been followed or whether aspiration would have prevented this injury | 2              |

(Continued...)
**Summarizing the evidence about aspiration (Continued...)**

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| Peragallo-Ditto, 1995 | Quasi-experimental cross-sectional study of adults with and without diabetes to investigate rationale for blood aspiration of the insulin syringe | • 102 subjects with 304 injections aspirated yielded no blood return  
• Aspiration isn't a reliable indicator of correct needle placement  
• Individualize insulin injection technique to decrease the risk of incorrect needle placement | 7              |
| Roger and King, 2000 | Literature review to establish current knowledge, procedures, and guidelines for I.M. injections | Literature is consistent in recommending:  
• aspirate for blood  
• draw back plunger for 5-10 seconds  
• if blood is present, discard and repeat | 1              |
| Talbert et al, 1967  | Case report of a 3-month-old infant who developed gangrene of the foot after I.M. injection of procaine PCN in left midlateral thigh | • Needle traversed thigh and PCN deposited in adductor canal with femoral artery thrombosis  
• Absence of aspirated blood failed to suggest artery proximity  
• Aspiration wouldn't have prevented this injury | 2              |
| Workman, 1999       | Informational update on the routine procedures for safe techniques for intradermal, subcutaneous, and I.M. injections | • Nonaspiration seems safe before subcutaneous injections  
• For I.M. injection, aspirate for several seconds to allow blood to appear, particularly with small-bore needle  
• If no blood, inject medication at 1 ml/10 seconds | 1              |
| World Health Organization, 2004 | 29-page resource guide with several immunization modules used by health-care agencies worldwide | Module 6, Section 3.5: How to give an injection using autodisposable syringes, Instruction item 4: “It’s not necessary to aspirate first” | 1              |

Using a pragmatic rapid injection technique without aspiration is less painful than the 10-second rule technique. The rapid injection technique without aspiration has been recommended for routine I.M. immunization because its implementation is easier and more cost-effective than other pain-reducing modifications. Ascertain the relative contribution of injection speed versus aspiration on observed overall pain reduction is difficult. Nevertheless, a recent study says that reduced pain in children from rapid medication injection without aspiration contributes to better parental acceptance of their children's immunizations.

Reduced injection time, decreased injection pain, and increased immunization acceptance are particularly important in nursing care of children, who receive the most vaccines and immunizations.

**The jet gun conundrum**

Jet injection involves the use of needle-free "guns" that drive liquid medication through a nozzle orifice, creating a narrow stream under high pressure that penetrates skin to deliver the drug into intradermal, subcutaneous, or I.M. tissue. Since the 1950s, mass injections of immunizations and vaccines have been given to large groups via jet gun.

The article discussing jet guns doesn’t mention aspiration, which isn’t possible with jet injection equipment. No references described complications resulting from non-aspiration during jet gun administration of medications, or complications arising from inadvertent I.M. medication administration of intended subcutaneous jet injections.

**Case reports misinterpreted**

Those who support aspiration often cite three older case reports to illustrate...
As nurses, we must continuously question what we do in our nursing care and not be caught up in past practices and unfounded fears. Injection of vaccines and immunizations isn’t necessary. No evidence has been reported to indicate that aspiration with or without blood return confirms correct needle placement or eliminates the possibility of injection of an I.M. medication into a blood vessel. Fears of adverse reactions following non-aspiration of I.M. injections mainly center on intraarterial injection of medications such as PCN. Based on the reviewed evidence, we offer the following recommendations for consideration:

- Aspiration isn’t indicated for subcutaneous injections of immunizations, heparin, and insulin.
- Aspiration isn’t indicated for I.M. injections of vaccines and immunizations.
- Aspiration may be indicated for I.M. injections of medications such as PCN.

Integrative review limitations

Although no currently available data document the necessity for aspiration, we must acknowledge that as-yet unreported publications or data might provide evidence that aspiration is effective. The primary reliance on conflicting best practice guidelines reflects the need for more research to examine this deceptively routine patient-care procedure. However, it’s highly unlikely an RCT will answer this question, due to patient safety issues, the rarity of adverse events, and the extremely large sample size required to detect aspiration for blood during medication administration.
Conclusions: The art and science of nursing practice

The practice of aspiration is a fearful one, as voiced by the concern nurses express when asked why they continue to aspirate for blood before medication injections. The most common complications of injections arise not from lack of aspiration, but from incorrect technique and inappropriate injection sites, needle size, and needle gauge.6,14,15,24

The art of nursing practice must be based on science. Using this science, we can answer the deceptively simple question, “Do we still need to teach aspiration for blood when giving an I.M. or subcutaneous injection?” Based on the reviewed evidence, expert opinion, and scientific judgment, the answer is clearly “no” for the injection of vaccines, immunizations, hepatic, and insulin.

What’s important is that nurses are asking this question. As nurses, we must continuously question why we do what we do in our nursing care and not be caught up in past practices and unfounded fears. ■

REFERENCES