8-2019

Administering intramuscular injections: Summary

Children's Mercy Kansas City

Office of Evidence Based Practice (EBP) – Critically Appraised Topic: Aspirating for Blood When Administering Intramuscular (IM) Injections

Specific Care Question:

When administering intramuscular injections (vaccines, dexamethasone, leuprolide, etc.) should the nurse aspirate for blood before administering the medication?

Recommendations from the IM Injection Team

1. *A strong recommendation is made that when giving a vaccine IM, aspiration is not required (Cattaneo, Engert, Gray, & Vineyard, 2016; ACIP, 2019). The certainty in the evidence is high based on AAP and CDC guidelines (Cattaneo, Engert, Gray, & Vineyard, 2016; ACIP, 2019). Usual sites of vaccine administration are the deltoid, vastus lateralis, and rectus femoris muscles (See Figure X). See Summary of Outcome for substantiation of recommendation.*
2. *CM administers a large number of medications IM. The top three non-vaccine medications administered IM at CM are listed below, and aspiration is not required.*
    - *Ceftriaxone (Rocephin) – LexiComp® (2019a) states to administer deep into a large muscle mass*
    - *Medroxyprogesterone (Depo-Provera®) - LexiComp® (2019d) states to administer deep into the gluteal or deltoid muscle*
    - *Vitamin A – LexiComp® (2019g) states the syringe/needle requirements for IM dosing but no additional information*

    Other medications not requiring aspiration include:
    - *Penicillin G Benzathine (Bicillin) - LexiComp® (2019e) states to administer to deep muscle not near an artery (i.e. not dorsogluteal)*
    - *Testosterone - LexiComp® (2019f) states to administer deep into the gluteal muscle*
    - *Dexamethasone - LexiComp® (2019b) states the concentrations to be administered IM, but no additional information*
    - *Leuprolide – (LexiComp®, 2019c) states to administer into the gluteal area, anterior thigh, or deltoid*
3. *For other medications that are administered IM, following the guidance in resources such as LexiComp® is advised.*

Literature Summary

Background. To aspirate when giving an IM injection, is to apply negative pressure in the syringe after the needle is inserted and before medication is administered. To achieve negative pressure, the nurse pulls back on the syringe plunger for up to 10 seconds to see if blood is returned which is a sign of improper location of the tip of the needle (Sisson, 2015). Historically in adults, procedures for giving IM injections included aspirating for blood because the usual injection site was the dorsogluteal muscle, which is close to the gluteal artery (Greenway, 2014). Injection sites for vaccines have moved away from the dorsogluteal muscle to sites of with fewer large blood vessels. The preferred vaccine injection site for infants is the vastus lateralis (thigh), followed by the ventrogluteal (hip) muscle (WHO, 2015). The Centers for Disease Control and Prevention (CDC) states the preferred site for older children is the deltoid or anterolateral area of the thigh (CDC, 2019).

Recommendations on whether to aspirate or not when administering an IM injection are inconsistent. To reduce pain, fear, and distress caused by injections, the World Health Organization (WHO) trains healthcare workers to not aspirate when giving vaccines IM (WHO, 2019). For vaccine administration, the American Academy of Pediatrics (AAP), the American Academy of Family Physicians (AAFP), and Advisory Committee on Immunization Practices (ACIP) have stated aspiration is not necessary for vaccine administration (Crawford & Johnson, 2012).

However, the practice of aspirating prior to giving vaccines has not changed universally. *Harriet Lane Handbook* and *Clinical Key for Nursing* continue to recommend aspirating prior to an IM injection (Miller & Moake, 2018; Wilson & Hockenberry, 2012). Neither source differentiates between vaccines and other medications. Greenway (2014) posits aspirating when giving an IM injection is a nursing ritual, not based in evidence, and steps to decrease its performance both in nursing education and post degree mentorships should be embraced. This review will summarize identified literature on the topic.

Study characteristics. The search for suitable studies was completed on February 14, 2019, 18 articles were identified. Ten additional records were identified by Wendy Mosiman, DNP, RN, PPCNP-BC, APRN-PNP, APRN-PCNS, RN-BC, bringing the total to 28. Ms. Mosiman reviewed the 28 titles and/or abstracts found in the search and identified 14 articles believed to answer the question. After an in-depth review three articles answered the question. Taddio et al. (2015) is a systematic review, and included trails completed by Girish and Ravi (2014), Ipp, Taddio, Sam, Gladbach, and Parkin (2007), and Petousis-Harris et al. (2013). Also included in this synthesis are Moores and Allan (2012), a report of a continuing education program, and Thomas et al. (2016) a survey of nursing practice.

The literature search yielded information on the IM vaccination procedure. Literature on the IM injection procedure when administering other medications was not found. Literature specifically reporting differences in outcomes when aspirating versus not aspirating was not found.

Summary by Outcome

Blood Aspiration. One study (*N* = 164) surveyed nurses on the occurrence of aspirating for blood return during an IM injection (Thomas et al., 2016). The reported frequency of aspiration was 48% (79/164) aspirated every time, while 26% (42/164) aspirated about 90% of the time. The remainder selected less than 70% of the time, including 10% (16/164) who rarely or never aspirated. From the total sample, 60% never aspirated blood. Of the 40% who had aspirated blood, 15% were injecting into the dorsal gluteal muscle, 12% were injecting into the deltoid, 6% into the ventral gluteal, and 4% into the vastus lateralis, and 31% did not remember.

The evidence was of very low certainty based on study design. As a cohort study, it used a convenience sample, and it is only one study. Furthermore, it is difficult to determine the denominator for the percentages reported from the survey. It is difficult to generalize the findings of the survey.

Pain. One study reported on pain during IM injection (Taddio et al., 2015). It is a systematic review (SR) that included Girish and Ravi (2014), Ipp et al. (2007), and Petousis-Harris et al. (2013) for this outcome (*n* = 698). Further, the SR authors separated the outcome into the following domains: (a) pain, *n* = 114 (Petousis-Harris et al., 2013); (b) distress acute, *n* = 313, (Girish & Ravi, 2014; Ipp et al., 2007); and (c) distress acute plus recovery, *n* = 200, (Girish & Ravi, 2014).

Pain was measured by the subject with a validated visual analog scale. Petousis-Harris et al. (2013) reported on the pain outcome (*n* = 113). There was no difference in pain when administering an IM injection with aspiration versus without aspiration, *SMD* = 0.28, 95% CI [-0.12, 0.68]. Subjects in this study were older children receiving the HPV vaccine.

Distress was measured by an observer for subjects who could not report pain, for example infants and subjects less than 7 years of age, as reporting from these age groups was considered unreliable. Distress was defined as a behavior during receipt of an IM injection and quantified in the latter two domains above. For the outcome, distress, acute, there was significantly less distress in subjects receiving IM injections without aspiration, *SMD* = -0.82, $p < .001$, 95% CI [-1.18, -0.46] (Girish & Ravi, 2014; Ipp et al., 2007). For the outcome, distress plus recovery, (Recovery was defined as returning to calm behavior within 1 to 5 minutes after the injection), there was no difference if aspiration occurred or did not occur, *SMD* = -0.27, 95% CI [-0.55, 0.01] (Girish & Ravi, 2014; Ipp et al., 2007).

The evidence was of very low certainty based on the inability to blind personnel and indirectness because all studies evaluated IM injections for giving vaccines, other medications were not included.

Identification of Studies

Search Strategy and Results (see Figure 1)

PubMed

("Injections, Intramuscular"[Mesh] OR "Intramuscular Injections") AND (aspiration[tiab] OR aspirating[tiab]) 0 results

("Injections, Intramuscular/methods"[Mesh] OR "Injections, Intramuscular/nursing"[MeSH]) AND (aspiration[tiab] OR aspirating[tiab]) AND ("last 10 years"[PDat]) 6 results

CINAHL

#	Query	Limiters/Expanders	Last Run Via	Results
S3	S1 AND S2	Search modes - Boolean/Phrase	Interface - EBSCOhost Research Databases Search Screen - Advanced Search Database - CINAHL	12
S2	(MH "Aspiration") OR "aspiration"	Limiters - Age Groups: Infant, Newborn: birth-1-month, Infant: 1-23 months, Child, Preschool: 2-5 years, Child: 6-12 years, Adolescent: 13-18 years, All Infant, All Child Search modes - Boolean/Phrase	Interface - EBSCOhost Research Databases Search Screen - Advanced Search Database - CINAHL	2,446
S1	(MH "Injections, Intramuscular+") OR "Intramuscular Injections"	Limiters - Age Groups: Infant, Newborn: birth-1-month, Infant: 1-23 months, Child, Preschool: 2-5 years, Child: 6-12 years, Adolescent: 13-18 years, All Infant, All Child Search modes - Boolean/Phrase	Interface - EBSCOhost Research Databases Search Screen - Advanced Search Database - CINAHL	970

Records identified through database searching *n* = 18

Additional records identified through other sources *n* = 10

Studies Included in this Review

Citation	Study Type
Moores and Allan (2012)	Cohort study
Taddio et al. (2015)	Systematic review, meta-analysis
*Girish and Ravi (2014)	RCT

*Ipp et al. (2007)	RCT
*Petousis-Harris et al. (2013)	RCT
Thomas et al. (2016)	Cohort study - survey

Studies Not Included in this Review with Exclusion Rationale

Citation	Reason for exclusion
Chen, Lew, Tsai, Hung, and Hsu (2011)	Narrative review
Leyva-Moral (2012)	Article in Spanish
McMurtry et al. (2015)	Does not answer the question
Meyerhoff, Weniger, and Jacobs (2001)	Does not answer the question
Pillai Riddell et al. (2015)	Does not answer the question
Sisson (2015)	Systematic review, Taddio et al. (2015) is more current
Taddio et al. (2012)	Does not answer the question, (Time study)
Taddio, Ilersich, Ilersich, and Wells (2014)	Quality study on pain, not aspiration

Methods Used for Appraisal and Synthesis

[a]Rayyan is a web-based software used for the initial screening of titles and / or abstracts for this analysis (Ouzzani, Hammady, Fedorowicz & Elmagarmid, 2017).

[b]Review Manager (Higgins & Green, 2011) is a Cochrane Collaborative computer program used to assess the study characteristics as well as the risk of bias and create the forest plots found in this analysis.

[c]The Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) flow diagram depicts the process in which literature is searched, screened, and eligibility criteria is applied (Moher, Liberati, Tetzlaff, & Altman, 2009).

[d]The GRADEpro Guideline Development Tool (GDT) is the tool used to create the Summary of Findings table(s) and the Evidence to Decision Framework for this analysis

[a]Ouzzani, M., Hammady, H., Fedorowicz, Z., & Elmagarmid, A. (2016). Rayyan-a web and mobile app for systematic reviews. *Systematic Reviews, 5*(1), 210. doi:10.1186/s13643-016-0384-4

[b]Higgins, J. P. T., & Green, S. e. (2011). *Cochrane Handbook for Systematic Reviews of Interventions [updated March 2011]* (Version 5.1.0 ed.): The Cochrane Collaboration, 2011.

[c]Moher D, Liberati A, Tetzlaff J, Altman DG, The PRISMA Group (2009). *P*referred *R*eporting *I*tems for *S*ystematic Reviews and *M*eta-*A*nalyses: The PRISMA Statement. PLoS Med 6(7): e1000097. doi:10.1371/journal.pmed1000097 For more information, visit www.prisma-statement.org.

[d]GRADEpro GDT: GRADEpro Guideline Development Tool (2015). McMaster University, (developed by Evidence Prime, Inc.). [Software]. Available from gradepro.org.

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Acronyms Used in this Document

Acronym	Explanation
CDC	Centers for Disease Control
CIHR	Canadian Institutes of Health Research
EBP	Evidence Based Practice
IM	Intramuscular
MD	Mean Difference
PRISMA	Preferred Reporting Items for Systematic Reviews and Meta-Analyses
SMD	Standard Mean Difference
WHO	World Health Organization

Date Developed/Updated April 2019

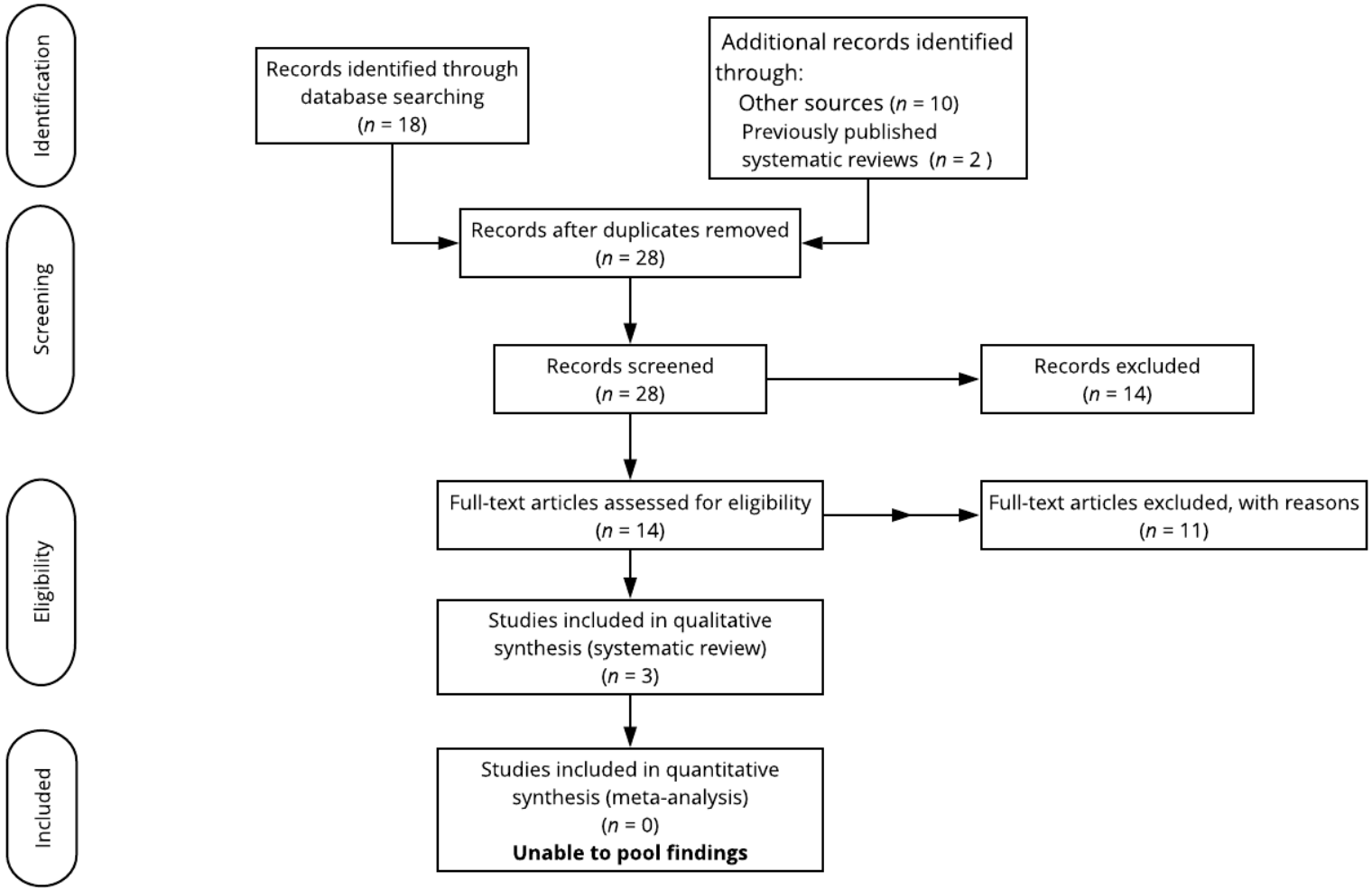

Figure 1. Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRIMSA)[c]

Characteristics of Studies

Moores 2012

Methods	Cohort study to evaluate the knowledge and practice of nurses who administer IM vaccines
Participants	**Participants:** 132 respondents were community health nurses and eight were acute care and occupational health nurses. **Setting:** A provincial immunization conference for nurses in Newfoundland and Labrador. **Number enrolled:** *N* = 140 **Number completed:** *N* = 140 **Gender, males:** Not disclosed **Age:** Not disclosed. **Inclusion criteria:** • Nurses who attended an educational session titled *"Immunization Techniques: Decreasing Pain During Immunization."* **Exclusion criteria:** • Conference attendees who did not attend the educational session.
Interventions	Nurses who attended the educational session and completed a pre-educational and post-educational questionnaire.

Outcomes	**Pre-educational questionnaire:**
	• Participants aspirate before IM injections, (39.6%)
	• Effect of injection speed on the pain response:
	  ○ does not affect pain response, (11.8%)
	  ○ injecting rapidly causes the most pain, (28.7%)
	  ○ injecting slowly causes the most pain, (32.4 %)
	  ○ don't know, (27.2%)
	• Aspiration is safer for clients Strongly agree and agree 32%; Undecided 22.4%; Disagree and strongly disagree 45.5%
	• Aspiration takes longer to give the injection. Strongly agree and agree 74.8%; Undecided 3%; Disagree and strongly disagree 22.2%
	• Aspiration is more painful for clients Strongly agree and agree 32.4%; Undecided 30.9%; Disagree and strongly disagree 36.8&
	Post-educational questionnaire:
	• Participants who need to aspirate before IM injections, (6.5%)
	• Effects of speed of injection on the pain response:
	  ○ Does not affect the pain response, (5.1%)
	  ○ Injecting rapidly causes the most pain, (0%)
	  ○ Injecting slowly causes the post pain, (94.2%)
	  ○ Don't know, (0.7%)
	• Aspiration is safer for clients:
	  ○ Strongly agree and agree, (9.4%)
	  ○ Undecided, (17.3%)

	○ Disagree and strongly disagree, (73.4%) • Aspiration takes longer to give the injection: ○ Strongly agree and agree, (88.6%) ○ Undecided, (4.3%) ○ Disagree and strongly disagree, (7.2%) • Aspiration is more painful for clients: ○ Strongly agree and agree, (83.5%) ○ Undecided, (10.1%) ○ Disagree and strongly disagree, (6.5%) **What influenced the decision to aspirate?** Pre-education • 41.7% to avoid injecting into a blood vessel. • 40.8% this is what they were taught in nursing school. • 10.7% because this is what they observed colleagues do. • 6.8% because this is what colleagues instructed them to do. Post-education statements regarding the need to continue to aspirate before IM injection. • "I think the safety of aspiration and not injecting into vessels far outweighs the level of pain. Injecting nonvascular compatible components into vessels, I think, is a far greater risk." • Policies and procedures for IM injections in acute care need to be updated."
Notes	In the *Limitation* section, it is noted that not all the participants were frontline nurses. Managers and regional/provincial consultants were included. A total of 19.3% of the participants reported that they were not currently in a position to administer injections.

Taddio 2015

Design	Quantitative Synthesis (meta-analysis)
Objective	Systematic review to evaluate the effectiveness of physical and procedural interventions for reducing pain and related to outcomes during vaccination.
Methods	**Protocol and registration.** **Eligibility Criteria.** • All ages undergoing vaccination in any setting **Information sources.** EMBASE, Medline, PsycINFO, CINAHL, and ProQuest Dissertations and Theses Global **Study Selection.** Published as a full or short report, and academic theses **Data collection process.** • Outcomes were identified *a* priori. ○ Critical outcomes ▪ Pain- in those who were able to self-report, the report of pain during a vaccination ▪ Distress- in those unable to self-report (infants), observer rated behavior during a vaccination ▪ Fainting ○ Other outcomes ▪ Procedure outcome ▪ Compliance ▪ Satisfaction ▪ Preference ▪ Safety ▪ Fear • Means and standard deviations were calculated from medians, ranges and standard errors, or estimated from graphs • For the outcome pain, it was assessed ○ Pre-procedural (before the injection) ○ Acute procedure (within the first minute of injection) ○ Post-procedure, or recovery (one to five minutes after the injection) **Risk of bias (RoB) across studies.** • Review Manager 5.2 software was used to assess the risk of bias. **Summary measures.** • Used standardized mean difference or relative risk, as appropriate. • A random effects model was used. I^2 and Chi Square tests were used to assess heterogeneity. **Synthesis of results.** • Grade Summary of Findings tables
Results	**Study Selection.** **Number of articles identified:** *N* = 114,389 **Duplicates:** 32,155 **Title and abstract reviewed:** 82,234 **Full-text articles assessed for eligibility:** *n* = 37

	○ **Studies included in qualitative synthesis:** *n* = 31 **Synthesis of results.** 1. For the question: Should no aspiration during IM injections be used for reducing vaccine injection pain in people of all ages a. Pain- measured with valid visual analog tool, lower is better, SMD = *0.28*, 95% CI [0.12, 0.68]. b. Distress, Acute, used validated tools, lower is better, *SMD* = 0.82, 95% CI [1.18, 0.46] c. Distress Acute (yes/no) assessed with validated tool (cry yes/no) by researcher, *RR* = 0.52, 95% CI [0.38, 0.72] d. Distress Acute plus Recovery, validated tool (cry duration) lower is better, *MD* = 0.27, 95% CI [0.55, 0.01] **Risk of bias across studies.** • Certainty in the evidence is very low. Main source of bias was blinding of participants, personnel, and those who performed outcome assessment. Furthermore, only one of the three studies for this comparison concealed allocation of subjects.
Discussion	**Summary of evidence.** • The outcome pain was assessed in subjects who were able to report pain. There was no difference in reported pain in those whose had aspiration versus those who did not. The outcome distress as ascertained by the researcher was reported in those who could not self-report pain. Distress appeared to be less in those injection was not aspirated. It is not clear if the decrease in Distress is clinically significant. **Limitations.** • Addresses the outcome pain, does not address safety, i.e. injecting to the blood stream. If data is the original trial was reported in graph only form, the mean and standard deviation was estimated. Injection speed was not considered in the analyses.
Funding	The project was funded by the Canadian Institutes of Health Research (CIHR) and funding to publish open access was provided by the Mayday Fund (US). Conflicts of interest of all authors are published, as are those authors without conflict of interest.

Thomas 2016

Methods	Cohort- Descriptive study - survey
Participants	**Participants:** Registered nurses **Setting:** One community hospital and one state university hospital, USA **Number enrolled into study:** *N* = 165 **Number completed:** *N* = 164, one survey was incomplete **Gender, males:** Not reported **Age, years, mean (SD):** 44.5 (11.5) **Inclusion criteria:** • Practicing registered nurse **Exclusion criteria:** • Not reported **Covariates identified:** Age, years of RN practice, RN specialty, highest level of education **Power analysis was performed:** 122 participants were needed.
Interventions	• A pilot study (*n* = 12) was performed to strengthen questions. Three questions were changed, and results from pilot testing was not included in the final analysis. Psychometrics were not performed. • The final survey contained eight questions of various types, specifically. fill in the blank, select the best option, and a 7-point Likert-like scale (never to every time).
Outcomes	**Primary outcome(s):** Technique registered nurses use for IM injections **Secondary outcome(s):** Incidence of blood aspiration·

Notes	**Results:**
	• Frequency of aspiration during an IM injection
	  ○ Every time - 48%
	  ○ About 90% of the time - 26%
	  ○ Between 30% and 70% of the time - 15%
	  ○ Rarely or never - 10%
	• Reasons for not aspirating during IM injections (*n* = 45, 28%)
	  ○ I see no purpose/benefit 22%
	  ○ I was taught not to aspirate 16%
	  ○ The equipment/syringe provided did not allow aspiration 9%
	  ○ Other reasons
	  ▪ the injection was needed in an emergency - 29%
	  ▪ a change in practice has been recommended - 13%
	  ▪ it takes too long to aspirate 9%
	  ▪ forget to aspirate 2%
	• Of those who did report aspirating, time of aspiration
	  ○ 2 seconds or less - 67%
	  ○ 3 to 4 seconds - 26%
	  ○ 5 seconds - 3%
	  ○ Greater than 5 seconds - 0

	• Have you ever aspirated blood?
	  ○ No - 60%
	  ○ Once 20%
	  ○ Twice 11%
	  ○ 3 times- 4%
	  ○ Greater than 13 times- 4%

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References marked with an asterisk indicate studies included in the meta-analysis.

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