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Abstract

Many long-held practices surrounding newborn injections lack evidence and have unintended consequences. The choice of needles, injection techniques, and pain control methods are all factors for decreasing pain and improving the safety of intramuscular injections. Using practices founded on the available best evidence, nurses can reduce pain, improve the quality and safety of care, and set the stage for long-term compliance with vaccination schedules.

Key words: Evidence-based Nursing; Infant, Newborn; Injection, intramuscular; Vaccination.

BEST PRACTICES *in* NEWBORN INJECTIONS

Recommended newborn care includes the administration of two intramuscular (I.M.) injections: vitamin K and the hepatitis B vaccine (Warren & Phillipi, 2012). While these procedures are common, they carry risk of pain and injury. Procedural pain in newborns can lead to *hyperalgesia*, or increased sensitivity to subsequent painful events (Kennedy, Luhmann, & Zempsky, 2008; Taddio, Shah, Atenafu, & Katz, 2009). Long-term consequences may also arise when parents witness unmanaged newborn pain. One study found that children in families who had a negative immunization experience, including witnessing strong negative reactions to injections, were twice as likely to be underimmunized compared to those without negative experiences (Stockwell, Irigoyen, Martinez, & Findley, 2010).

Some of the techniques that have been taught to improve injection safety or reduce pain were flawed and may inadvertently have increased distress.

All nurses should be competent in initiating effective treatments to relieve pain as well as in minimizing risks to patients and providers (Cronenwett et al., 2007). A safe injection does not cause harm to the patient, does not expose the nurse to injury, and does not expose the community to dangerous waste (World Health Organization [WHO], 2010). New evidence now suggests that some techniques taught to improve injection safety or reduce pain were flawed and may inadvertently have increased distress (Figure 1) (Ipp, Taddio, Sam, Goldbach, & Parkin, 2007; Kroger, Sumaya, Pickering, & Atkinson, 2011; Taddio, Ilersich et al., 2009). The purpose of this paper is to discuss best practices surrounding I.M. injections in newborns in light of the current evidence.

Choice of Needles

Adverse reactions with I.M. injections are reduced when the needle is long enough to deposit the medication into the muscle. The recommended needle length for I.M. injections is 5/8th inch for a term neonate (Kroger et al., 2011). Both 23- and 25-gauge needles have been used for infant injections with similar local reactions (Diggle, Deeks, & Pollard, 2006). However, one study found that 25-gauge needles were associated with less febrile reactions with vaccinations in infants, but the use of 23-gauge needles resulted in less crying (Bharti, Grewal, Kalia, & Pathak, 2010).

In conversations with colleagues, we frequently hear that they were taught in nursing school that it was important to change a needle after drawing a medication from a vial because penetrating the stopper affected the needle's sharpness. Using this dulled needle was thought to cause more injection pain. However, the classic study by Salomon, Halperin, and Yee (1987) found no difference in bruising or systemic reactions when using the one- or two-needle technique to administer the DPT vaccine to children. More recently, one large study of adults found no significant difference in pain or bruising associated with the use of retractable fixed needles versus the use of the two-needle technique (Lamblet, Meira, Torres, Ferreira, & Martucchi, 2011).

Although changing filter needles used to draw medications from a glass ampule, such as vitamin K, is still important, the Advisory Committee on Immunization Practices of the Centers for Disease Control and Prevention (CDC) states that needles used to draw up vaccines from vials, such as the hepatitis B vaccine, need only to be changed if they have been contaminated or damaged (Kroger et al., 2011). Changing needles unnecessarily may be considered a waste of resources, but even more importantly increases the risk of needlestick injuries (Immunization Action Coalition, 2010).

The Needlestick Safety and Prevention Act requires that safety-engineered injection devices, such as needle-shielding syringes, retractable fixed needles, or needle-free injectors, be used for injectables in all clinical settings (Table 1) (Occupational Safety and Health Administration [OSHA], 2001). Between 2001 and 2007, OSHA issued 144 citations and almost $400,000 in fines to institutions for failing to comply with the requirement to use safety needles (Jagger, Perry, Gomaa, & Phillips, 2008). Although self-shielding needles can be used, nurses need to understand that the two-needle technique limits the use of safety devices built into syringes such as retractable needles.

Injection Technique

Close attention to selecting the correct I.M. injection site is important to prevent injury (WHO, 2010). For new-

Figure 1.

* Administering Intramuscular Injections to Infants Lying on Their Backs in Cribs Does Not Reflect Best Practice.

borns and infants up to the age of 18 months, the recommended site is the thickest part of the vastus lateralis in the anterolateral thigh (Kroger et al., 2011). Some nurses were taught to bunch up the thigh muscle at the injection site and to inject at a 45° angle, but this practice may result in a subcutaneous versus I.M. injection when using a 5/8-inch needle (Immunization Action Coalition, 2009). Cook and Murtagh (2005) found that inserting the needle at 90° to the long axis of the femur with the skin stretched flat between the thumb and index resulted in fewer systemic and local reactions with vaccinations. Pressure at the injection site has been found to reduce injection pain (Schechter et al., 2007). Thus, it is possible that the stretching of the skin not only assures correct needle placement but also serve as pain management strategy.

For many years, aspiration, or the practice of pulling the plunger back prior to I.M. injections, was proposed as a safety measure to prevent accidental cannulation of blood vessels. This practice may have had some value when the dorsal gluteal was used as an injection site because of the proximity to the iliac artery, but this technique was never scientifically validated (Malkin, 2008; Taddio et al., 2010). According to the Advisory Committee on Immunization Practices of the CDC, aspirating for blood return before I.M. injections neither confirms or refutes correct needle placement (Atkinson et al., 2002), and the practice is unnecessary because there are no large vessels in the current recommended injection sites (Kroger et al., 2011). Although the CDC first stated that aspiration prior to I.M. vaccination was unnecessary over 10 years ago, many nurses still lack awareness of this practice change (Hensel & Springmyer, 2011; Ipp, Sam, & Parkin, 2006).

Experts now believe given the size of the vessels in the vastus lateralis, the size of the needle, and the 90° angle recommended for injections, accidental cannulation of a vessel resulting in the delivery of a medication intravenously is unlikely (Immunization Action Coalition, 2010). If a nurse does aspirate and obtains blood return, it is most like due to a ruptured blood vessel. Should this occur, this medication would still need to be wasted. The Immunization Action Coalition posits not aspirating decreases the risk of having to discard a medication unnecessarily.

In the past, slow injection was thought to minimize pain caused by sudden tissue distention, but there is very little literature surrounding the ideal rate to injection medications. Rapid injection of vaccines, at a total of 1 second for 0.5 mL, has been found to cause less pain (Ipp et al., 2007). Rapid injection combined with not aspirating for blood return results in a more rapid process and less time that the needle remains in the muscle. It is thought that pain is reduced by this technique because there is less needle "wiggle" (Taddio et al., 2010). However, there is limited literature on the ideal rate of injection for I.M. medications given to newborns other than vaccines. At least one manufacturer of vitamin K still recommends slow injection to minimize adverse reactions (International Medical Systems Limited, 2009).

Table 1. Recommendations for Safer Needles

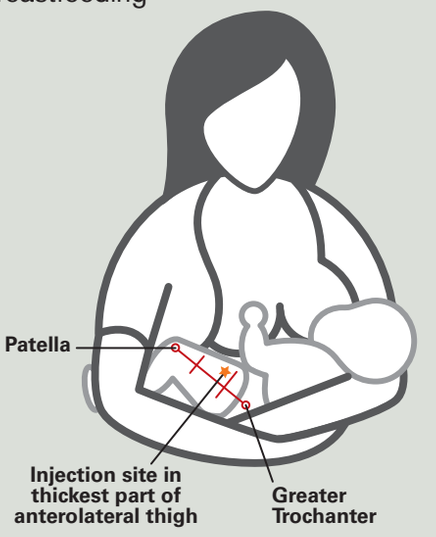
FDA recommends safer needle devices with a fixed safety feature that:

- Provide a barrier between the hands and the needle after use; the safety feature should allow or require the worker's hands to remain behind the needle at all times
- Is an integral part of the device and not an accessory
- Is in effect before disassembly and remains in effect after disposal to protect users and trash handlers, and for environmental safety
- Is as simple as possible, and requires little or no training to use effectively

Examples of safety needles devices include:

- Self-Sheathing Safety Feature: Sliding needle shields attached to disposable syringes
- Retractable Technology: Needles or sharps that retract into a syringe
- Hinged Safety Feature: Hinged or sliding shields attached to needles
- From http://www.osha.gov/SLTC/etools/hospital/hazards/sharps/sharps.html

Figure 2. IM Injection Site Exposure During Breastfeeding*



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Combining Interventions to Control Pain

There is good evidence from randomized controlled trials that breastfeeding and sucking on sucrose solution during injections are effective methods to reduce injection pain in newborns (Taddio et al., 2010). Other effective anal-

Using the best evidence, nurses can increase patient comfort, safety, and the quality of care associated with newborn injections.

Table 2. Suggested Clinical Implications

• Select a 5/8th-inch 23- or 25-gauge needle for term newborn I.M. injections.
• Always use the safest needle for the procedure.
• Inject the thickest part anterolateral thigh at 90° with the skin stretched. Aspiration for blood return is unnecessary.
• Use rapid injection for immunizations. Follow manufacturer's recommendations for other medications.
• Use combination interventions to reduce injection pain such as breastfeeding (preferred) or skin-to-skin holding combined with sucking on a sucrose solution.

gesic interventions applicable to newborns include skin to skin care, pressure, and lidocaine–prilocaine topical agents (Dilli et al., 2009; Kashaninia, Sajedi, Rahgozar, & Noghabi, 2008; Schechter et al., 2007; Taddio, Ilersich et al., 2009). Meta-analysis data suggest that combining two or more analgesic interventions gives superior pain relief as compared to the use of a single method (Shah, Taddio, Rieder, & HELPinKIDS Team, 2009).

Breastfeeding is considered a combined pain management intervention because it involves holding the baby, skin-to-skin contact, sweet-tasting milk, and the act of sucking (Taddio et al., 2010). These strategies work synergistically to create a superior response than one method alone. At least two evidence-based protocols recommend breastfeeding during injections as the first choice of analgesia because it is a combined pain management intervention, it is the preferred infant feeding method, and it does not incur additional costs or training for parents (Figure 2) (Bunik et al., 2010; Taddio et al., 2010). If coordination with a breastfeeding session is not possible, Bunik et al. (2010) recommend holding the baby skin to skin and administering sucrose solution as an alternative combined analgesia strategy.

Building strong parent–nurse collaborations is important for decreasing children's stress during routine immunizations (Plumridge, Goodyear-Smith, & Ross, 2009). Having a mother breastfeed or hold her newborn engages the parent in the process of consoling the infant, helps increase maternal confidence, and sets the foundation for future successful immunization sessions. Systematic review of the literature shows that the position during vaccination affects the pain response (Taddio et al., 2010). Being upright or being held was much less distressing than lying in the supine position. To reduce pain at the time of injection, nurses should not place babies on their back in their crib. If a parent does not feel capable or declines assisting with the process, the nurse should arrange for someone else to hold the newborn.

Clinical Implications

Nurses who care for infants and children have been taught the importance of both atraumatic care and patient safety. As new evidence unfolds, nurses must continually reappraise long-held practices to determine whether they still serve their intended purposes. Best practices in newborn I.M. injections include discarding practices not effective, such as injecting all medications slowly and aspirating for blood return, in favor of effective methods of pain control that require stronger parent–nurse collaborations (Table 2). Using the best evidence, nurses can increase patient comfort, safety, and the quality of care associated with newborn injections. Using the best evidence may create conditions that support future strong family–healthcare relationships and immunization compliance. ✣

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The authors declare no conflict of interest.

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References

Atkinson, W. L., Pickering, L. K., Schwartz, B., Weniger, B. G., Iskander, J. K., Watson, J. C., ..., Immunization Services Division, National Center for Infectious Diseases, Centers for Disease Control and Prevention. (2002). General recommendations on immunization: Recommendations of the Advisory Committee on Immunization Practices (ACIP) and the American Academy of Family Physicians (AAFP). *Morbidity and Mortality Weekly Report, 51*(RR-2), 1-35.

Bharti, B., Grewal, A., Kalia, R., & Pathak, P. (2010). Vaccine related reactogenicity for primary immunization: A randomized controlled trial of 23(wider) vs. 25(narrower) gauge needles with same lengths. *Indian Journal of Pediatrics, 77*(11), 1241-1246. doi: 10.1007/s12098-010-0173-3

Bunik, M., Chantry, C. J., Howard, C. R., Lawrence, R. A., Marinelli, K. A., Noble, L., . . ., Acad Breastfeeding Med Protocol, C. (2010). ABM clinical protocol #23: Non-pharmacologic management of procedure-related pain in the breastfeeding infant the Academy of Breastfeeding Medicine Protocol Committee. *Breastfeeding Medicine, 5*(6), 315-319. doi: 10.1089/bfm.2010.9978

Cook, I. F., & Murtagh, J. (2005). Optimal technique for intramuscular injection of infants and toddlers: A randomised trial. *Medical Journal of Australia, 183*(2), 60-63.

Cronenwett, L., Sherwood, G., Barnsteiner, J., Disch, J., Johnson, J., Mitchell, P., . . . , Warren, J. (2007). Quality and safety education for nurses. *Nursing Outlook, 55*(3), 122-131. doi: 10.1016/j.outlook.2007.02.006

Diggle, L., Deeks, J. J., & Pollard, A. J. (2006). Effect of needle size on immunogenicity and reactogenicity of vaccines in infants: Randomised controlled trial. *British Medical Journal, 333*(7568), 571-574A. doi: 10.1136/bmj.38906.704549.7C

Dilli, D., Kuecuek, I. G., & Dallar, Y. (2009). Interventions to reduce pain during vaccination in infancy. *Journal of Pediatrics, 154*(3), 385-390. doi: 10.1016/j.jpeds.2008.08.037

Hensel, D., & Springmyer, J. (2011). Do perinatal nurses still check for blood return when administering the hepatitis B vaccine? *Jognn-Journal of Obstetric Gynecologic and Neonatal Nursing, 40*(5), 589-594. doi: 10.1111/j.1552-6909.2011.01277.x

Ipp, M., Sam, J., & Parkin, P. C. (2006). Needle aspiration and intramuscular vaccination. *Archives of Pediatric and Adolescent Medicine, 160*(4), 451.

Ipp, M., Taddio, A., Sam, J., Goldbach, M., & Parkin, P. C. (2007). Vaccine-related pain: randomised controlled trial of two injection techniques. *Archives of Disease in Childhood, 92*(12), 1105-1108. doi: 10.1136/adc.2007.118695

Immunization Action Coalition. (2009). *Administering vaccines: Dose, route, site, and needle size*. Retrieved from http://www.immunize.org/catg.d/p3085.pdf

Immunization Action Coalition. (2010). *Ask the experts. General vaccine questions*. Retrieved from http://www.immunize.org/askexperts/experts_general.asp

International Medical Systems Limited. (2009). *Phytonadione injectable emulsion* [product insert]. South Monte, CA: Author.

Jagger, J., Perry, J., Gomaa, A., & Phillips, E. K. (2008). The impact of U.S. policies to protect healthcare workers from bloodborne pathogens: The critical role of safety-engineered devices. *Journal of infection and public health, 1*(2), 62-71. doi: 10.1016/j.jiph.2008.10.002

Kashaninia, Z., Sajedi, F., Rahgozar, M. and Noghabi, F. A. (2008). The effect of kangaroo care on behavioral responses to pain of an intramuscular injection in neonates. *Journal for Specialists in Pediatric Nursing, 13*(4), 275-280. doi: 10.1111/j.1744-6155.2008.00165.x

Kennedy, R. M., Luhmann, J., & Zempsky, W. T. (2008). Clinical implications of unmanaged needle-insertion pain and distress in children. *Pediatrics, 122* (Suppl. 3), S130-S133. doi: 10.1542/peds.2008-1055e

Kroger, A. T., Sumaya, C. V., Pickering, L. K., & Atkinson, W. L. (2011). General recommendations on immunization: Recommendations of the Advisory Committee on Immunization Practices (ACIP). *Morbidity and Mortality Weekly Report, 60*(RR2), 1-64.

Lamblet, L. C. R., Meira, E. S. A., Torres, S., Ferreira, B. C., & Martucchi, S. D. (2011). Randomized clinical trial to assess pain and bruising in medicines administered by means of subcutaneous and intramuscular needle injection: Is it necessary to have needles changed? *Revista Latino-Americana De Enfermagem, 19*(5), 1063-1071.

Malkin, B. (2008) Are techniques used for intramuscular injection based on research evidence? *Nursing Times, 104*(50/51), 48-51.

Occupational Safety and Health Administration. (2001). Occupational exposure to bloodborne pathogens; Needlesticks and other sharps injuries; Final rule (29 CFR Part 1910). Federal Register January 18, 2001;66:5318—25. Available at http://www.osha.gov/FedReg_osha_pdf/FED20010118A.pdf

Plumridge, E., Goodyear-Smith, F., & Ross, J. (2009). Nurse and parent partnership during children's vaccinations: A conversation analysis. *Journal of Advanced Nursing, 65*(6), 1187-1194. doi: 10.1111/j.1365/2648.2009.04999.x

Salomon, M. E., Halperin, R., & Yee, J. (1987). Evaluation of the two-needle strategy for reducing reactions to DPT vaccination. *Archives of Pediatrics & Adolescent Medicine, 141* (7), 796-798.

Schechter, N. L., Zempsky, W. T., Cohen, L. L., McGrath P. J., McMurtry, C. M., & Bright, N. S. (2007) Pain reduction during pediatric immunizations: Evidence-based review and recommendations. *Pediatrics 119*(5), 1184-1198.

Shah, V., Taddio, A., Rieder, M. J, & HELPinKIDS Team. (2009). Effectiveness and tolerability of pharmacologic and combined interventions for reducing injection pain during routine childhood immunizations: systematic review and meta-analyses. *Clinical Therapeutics, 31*(Suppl. 2), S104-S151. doi: 10.1016/j.clinthera.2009.08.001

Stockwell, M. S., Irigoyen, M., Martinez, R. A., & Findley, S. (2010). How parents' negative experiences at immunization visits affect child immunization status in a community in New York City. *Public Health Report, 126*(Suppl. 2), 24-32.

Taddio, A., Appleton, M., Bortolussi, R., Chambers, C., Dubey, V., Halperin, S., . . ., Shah, V. (2010). Reducing the pain of childhood vaccination: An evidence-based clinical practice guideline. *Canadian Medical Association Journal, 182*(18), E843-E855. doi: 10.1503/cmaj.101720

Taddio, A., Ilersich, A. L., Ipp, M., Kikuta, A., Shah, V., & HELPinKIDS Team. (2009). Physical Interventions and injection techniques for reducing injection pain during routine childhood immunizations: Systematic review of randomized controlled trials and quasi-randomized controlled trials. *Clinical Therapeutics, 31*(Suppl. 2), S48-S76. doi: 10.1016/j.clinthera.2009.07.024

Taddio, A., Shah, V., Atenafu, E., & Katz, J. (2009). Influence of repeated painful procedures and sucrose analgesia on the development of hyperalgesia in newborn infants. *Pain, 144*(1-2), 43-48. doi: 10.1016/j.pain.2009.02.012

Warren, J. B., & Phillipi, C. A. (2012). Care of the Well Newborn. *Pediatrics in Review, 33*(1), 4-18. doi: 10.1542/pir.33-1-4

World Health Organization. (2010). *WHO best practices for injections and related procedures toolkit*. Retrieved from http://whqlibdoc.who.int/ publications/2010/9789241599252_eng.pdf.

Administering Vaccines: Dose, Route, Site, and Needle Size.
www.immunize.org/catg.d/p3085.pdf

WHO best practices for injections and related procedures toolkit.
http://whqlibdoc.who.int/publications/2010/9789241599252_eng.pdf

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