

COVID-19 Vaccination:
An Overview and Education Tool for Nuclear Medical Technologists

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Background

Healthcare systems nationwide are struggling with the logistical challenges of administering COVID-19 vaccinations.⁽¹⁾ On January 5, 2021, less than 30% of the 15,418,500 COVID-19 vaccines distributed to states had been administered, with only 4,563,260 individuals receiving the first of two required vaccine injections. ⁽²⁾ One barrier to vaccine administration has been the shortage of available healthcare professionals trained to administer the vaccine.⁽¹⁾ One solution to the problem proposes the utilization of healthcare professionals from outside of nursing to provide injections. Several health systems have already implemented the Centers for Disease Control's (CDC) contingency strategy for mitigating staffing shortages by asking health care providers to support patient care in areas outside of their usual work setting.⁽³⁾

The Society of Nuclear Medicine and Molecular Imaging-Technologist Section (SNMMI-TS) COVID-19 Task Force recognizes some nuclear medicine technologists (NMTs) may be called upon to administer COVID-19 vaccines as it is a skill incorporated within the NMT scope of practice.⁽⁴⁾ Some of these same technologists may be uncomfortable giving intramuscular (IM) injections, and many, if not all NMTs, may have never administered a vaccine. For this reason, the CDC has created an online COVID-19 vaccination training program and reference materials to assist inexperienced healthcare professionals.⁽⁵⁾ This article

summarizes COVID-19 vaccination procedures and provides links to access additional information, training, and self-assessment.

COVID-19 Vaccination Training Resources

Healthcare providers proactively preparing to administer COVID-19 vaccines will benefit from a refresher on vaccine administration and medical information about the COVID-19 vaccine. The CDC launched a series of web-based, self-paced eLearning modules.⁽⁶⁾ Three modules with text and images, no audio or video, are currently available:

1. COVID-19 Vaccine Training: General Overview of Immunization Best Practices for Healthcare Workers⁽⁷⁾
 - <https://www2.cdc.gov/vaccines/ed/covid19/SHVA/index.asp>
2. Moderna COVID-19 Vaccine: What Healthcare Professionals Need to Know⁽⁸⁾
 - <https://www2.cdc.gov/vaccines/ed/covid19/moderna/index.asp>
3. Pfizer-BioNTech COVID-19 Vaccine: What Healthcare Professionals Need to Know⁽⁹⁾
 - <https://www2.cdc.gov/vaccines/ed/covid19/pfizer/index.asp>

NMTs planning to administer COVID-19 vaccines are encouraged to complete these modules in their entirety. Upon completion of the modules, technologists can print a continuing education certificate worth 1.25 hours. The Accreditation Council for Pharmacy Education (ACPE), one of

the organizations offering CE, is recognized by the Nuclear Medicine Technology Certification Board (NMTCB).⁽⁷⁻⁹⁾

About COVID-19 Vaccines

COVID-19 vaccination efforts began nationwide in December 2020 following the United States' Food and Drug Administration's Emergency Use Authorization (EUA) of the Pfizer-BioNTech and Moderna vaccines. Both vaccines are messenger ribonucleic acid (mRNA) vaccines.⁽⁷⁻⁹⁾ Although this type of vaccine's clinical use is relatively new, it is a product of research and development spanning decades.⁽¹⁰⁾

The two approved COVID-19 mRNA vaccines do not incorporate the live virus, severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2).⁽¹⁰⁾ Therefore, one cannot contract COVID-19 disease from the vaccine.^(8, 9) Instead, the vaccine instructs the body's cells to create a single harmless protein unique to the virus. The protein produced mimics the SARS-CoV-2 virus's spike-shaped surface protein. The immune system detects the protein spike, recognizing it does not belong there, which triggers the immune system to create "memory" T-lymphocyte and B-lymphocyte antibodies that will recognize and fight the Covid-19 virus and prevent future infection. Note, the vaccinated material does not enter the cell nuclei to interact with genetic material. Once the cell produces the spike protein, the immune system destroys the injected vaccine's instructions to make the protein.⁽¹⁰⁾

Due to severe health risks associated with COVID-19 and because re-infection with COVID-19 is possible, the CDC recommends that individuals with prior COVID-19 disease should be offered the vaccination and encouraged to accept it ⁽¹¹⁾. However, those with active COVID-19 infection should defer vaccination until after recovery.^(8,9) Additional vaccination

considerations include individuals with immunocompromising conditions, including HIV, those taking immunosuppressive medications, and pregnant and lactating women.

Pfizer-BioNTech. Each 2ml multidose vial contains 6 doses of the vaccine and requires dilution with 1.8ml of 0.9% sodium chloride (i.e., preservative-free normal saline) as a diluent.⁽⁹⁾ The recommended dose is 0.3ml administered IM on two separate occasions, 21 days apart. After both doses have been administered, the vaccine effectively prevents COVID-19 disease in 92% of recipients. Contraindications include severe allergic reaction (e.g., anaphylaxis) to any vaccine component or a previous dose of the COVID-19 vaccine (Pfizer). The Pfizer EUA lists the vaccine ingredients.⁽¹¹⁾ Precautions include severe allergic reaction to any other vaccine or injectable therapy (IM, intravenous, or subcutaneous) and individuals with moderate to severe acute illness.⁽⁹⁾

Moderna. Each 5ml multidose vial contains 10 doses of the vaccine in preservative-free sterile liquid.⁽⁸⁾ No diluent is required. The recommended dose is 0.5ml administered IM on two separate occasions, 28 days apart. After both doses have been administered, the vaccine effectively prevents COVID-19 disease in 94% of recipients. Contraindications include severe allergic reaction (e.g., anaphylaxis) to a previous dose or component of either mRNA COVID-19 vaccines. The Moderna EUA lists the vaccine ingredients.⁽¹²⁾ Precautions include history of an immediate allergic reaction to any other vaccine or injectable therapy (IM, intravenous, or subcutaneous vaccines or therapies not related to a component of mRNA COVID-19 vaccines) and individuals with moderate to severe acute illness.⁽⁸⁾

Anaphylaxis. Rare cases of anaphylaxis, an acute life-threatening allergic reaction, have been reported following COVID-19 vaccine administration.^(8, 9) Per the CDC, appropriate medical treatment for severe allergic reactions must be immediately available in the event that an

acute anaphylactic reaction occurs following administration of an mRNA COVID-19 vaccine.⁽¹³⁾ For this reason, the CDC recommends monitoring any individual with a history of anaphylaxis, regardless of the cause, for 30 minutes following COVID-19 vaccination. Everyone else should be monitored for 15 minutes following COVID-19 vaccination. A comprehensive discussion of the medical management of anaphylaxis is outside the scope of this article. The CDC recommends that all vaccination centers have a written protocol, equipment, and medications to manage medical emergencies following vaccination.⁽⁸⁾

Storage and Handling. Both the Pfizer-BioNTech and Moderna COVID-19 vaccines are shipped and stored at extremely low temperatures requiring temperature monitoring until administration.^(8, 9) The Pfizer-BioNTech vaccine arrives packaged in dry ice. The CDC provides a one-page Dry Ice Safety document for healthcare professionals. The Pfizer-BioNTech vaccine can be refrigerated between 2°C - 8°C (36°F - 46°F) for up to 5 days (120 hours) prior to administration.⁽⁹⁾ The Moderna vaccine can be refrigerated between 2°C - 8°C (36°F - 46°F) for up to 30 days prior to administration.⁽⁸⁾

Preparation. Following hand hygiene, the vaccine's (and diluents for the Pfizer-BioNTech vaccine) expiration dates must be checked before preparing the medication in a clean area using strict aseptic technique.^(8, 9) Each vial of the Pfizer-BioNTech vaccine must be diluted with 1.8ml of 0.9% sodium chloride.⁽⁹⁾ The CDC's *Pfizer-BioNTech COVID-19 Vaccine: What Healthcare Professionals Need to Know* module provides detailed instructions for mixing the vaccine and diluent.⁽⁹⁾ The Moderna vaccine does not require a diluent.⁽⁸⁾ Once prepared, both the Pfizer-BioNTech and Moderna vaccines should be kept at room temperature (i.e., 2°C - 25°C (35°F - 77°F)) and administered within 6 hours of preparation.⁽⁹⁾ Any mixed, or unused vaccine (Pfizer-BioNTech and Moderna) must be discarded after 6 hours.^(8, 9)

Administering COVID-19 Vaccines

As previously mentioned, IM injections are within the NMT's scope of practice.

However, they may not be part of a technologist's routine clinical practice. The CDC's

Intramuscular Injection (IM): Supplies (Adults 19 Years and Older) (link:

<https://youtu.be/odQTVg7s3HA>) provides a refresher on administering IM injections to adult patients.(15) Table 2 summarizes the information presented in the video. Figure 1 illustrates the deltoid muscle and preferred IM injection site.

Table 1: A Summary of Intramuscular Injection (IM): Supplies (Adults 19 Years and Older)

Video(16)

Step	Description
1	Perform proper hand hygiene
2	Use aseptic technique when handling, preparing, and administering the vaccine
3	Remove the vaccine from the storage unit
4	Verify that the correct vaccine has been selected
5	Check the vaccine's expiration date ^a
6	Gather supplies: syringe (1 or 3ml), needle (5/8, 1, or 1.5in ^b -- 22-25g), sterile alcohol wipes, bandaids, gauze, medication label
7	Identify administration site: deltoid muscle (preferred site) or vastus lateralis ^d muscle

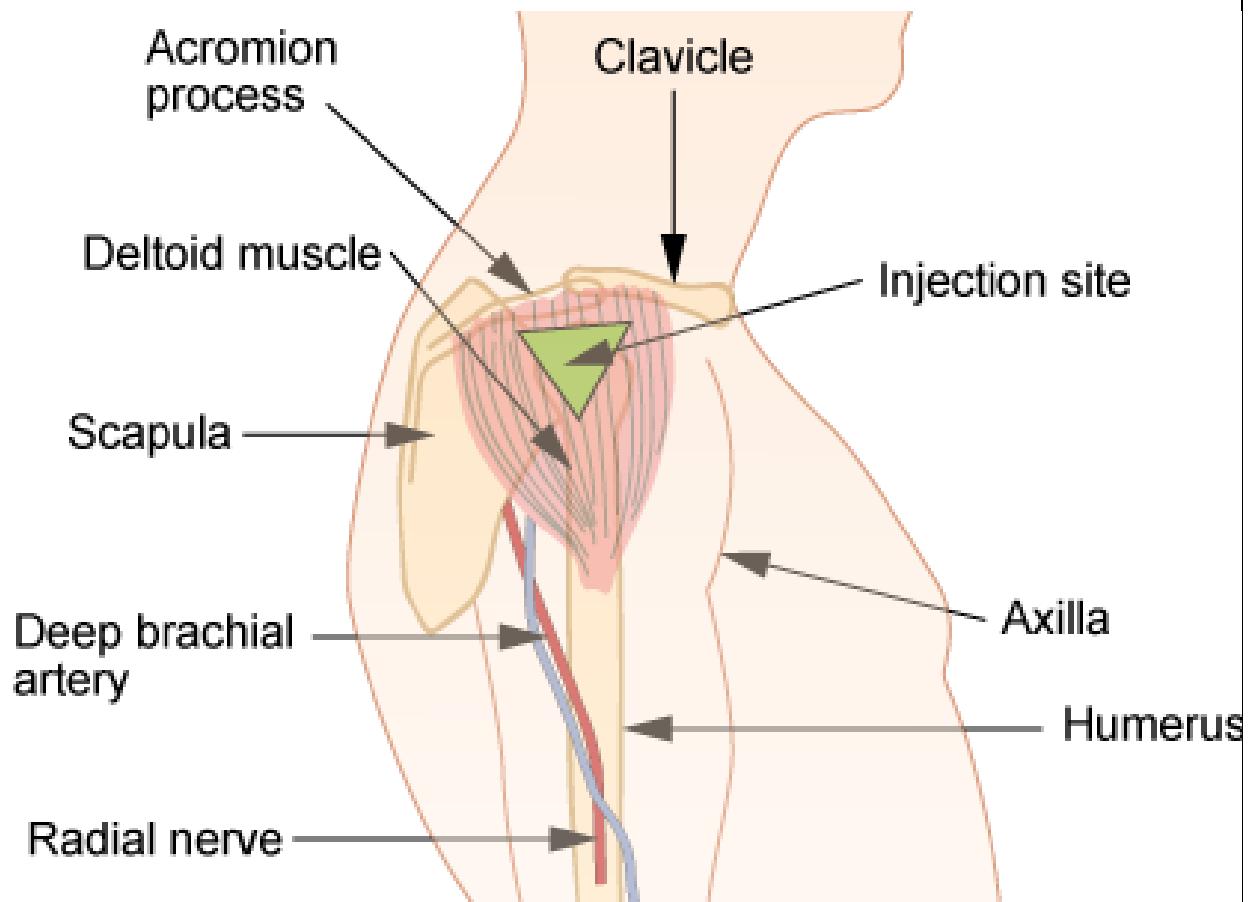
^aTo check the expiration date for the Moderna vaccine, scan the QR code on the vial.(8)

^bFor deltoid administration in adults, recommended needle length is based on patient weight:
<130lbs (5/8-1in); 130-152lbs (1in); women 152-200lbs & men 152-260lbs (1 or 1.5in);
women >200lbs & men >260lbs (1.5in)

^cThe deltoid muscle in the upper arm is the preferred site for adult patients

^dThe vastus lateralis muscle of the anterolateral thigh may also be used

Figure 1: Deltoid Muscle and Intramuscular Injection Site



This figure illustrates the deltoid muscle and related anatomical landmarks. The image is sourced from Wikipedia.(17)

The CDC recommends wearing personal protective equipment, including a face covering, when administering COVID-19 vaccines.(8, 9) The vaccination process includes gathering the necessary supplies for the vaccination then identifying and welcoming the patient and establishing a rapport.(18) The patient should be provided with specific information, including the vaccination process, which vaccine is to be administered, and the type of injection (e.g., deltoid IM). Prior to administering the vaccine, it is important to review the patient's COVID-19

vaccine history, screen for contraindications and precautions, and give the patient the vaccine's EAU Fact Sheet for Recipients and Caregivers (Pfizer-BioNTech⁽¹²⁾ or Moderna⁽¹³⁾).^(8,9) It is recommended that the patient sit for the injection.⁽¹²⁾

Administration of the dose requires hand hygiene and the donning of clean gloves prior to identifying the injection site.^(8,9) The center of the deltoid muscle is the recommended IM injection site for COVID-19 vaccines in adult patients. This site, located approximately 2 inches below the acromion process on the lateral side of the shoulder above the axillary fold (i.e., armpit), is the thickest part of the deltoid muscle (See Figure 1). The skin over the injection site is cleaned with a sterile alcohol wipe using a circular motion from the center to a 2" to 3" circle, and the alcohol is allowed to dry.⁽¹²⁾ While stabilizing the patient's arm with the non-dominant hand, the needle is quickly inserted into the injection site at a 90-degree angle, and the entire dose is injected. The needle is withdrawn at the same 90-degree angle as inserted.^(8, 9, 12) It is important to note that the syringe should not be aspirated prior to or following the injection.⁽¹⁹⁾ Following the needle's removal, apply gentle pressure over the injection site with a clean gauze for several seconds or apply a bandaid.⁽¹²⁾ An important tip is to incorporate strategies to reduce the patient's anxiety and the pain associated with the injection using the recommended strategies listed in Table 3.⁽¹⁹⁾ Finally, the recipient's vaccination must be documented to include the date, lot number, vaccine manufacturer, administration site, education materials provided to the patient, and the provider's name/initials.⁽¹²⁾

Table 2: Strategies to Reduce Anxiety and Pain Associated with Injections(19)

- Display a positive attitude through facial expressions, body language, and comments
- Use a soft and calm tone of voice
- Make eye contact
- Explain why the vaccine is needed (e.g., "this medicine will protect you from getting sick" or "this shot is a shield to protect your body against infection")
- Be honest and explaining what to expect (e.g., do not say that "the injection won't hurt")

CDC's Best Practices for Vaccine Administration include 1) follow the Rights of Medication Administration Adapted for Vaccines, 2) provide staff training and education, and 3) use a checklist to assess vaccine administration skills. (19) Table 4 lists the Rights of Medication Administration Adapted for Vaccines. A Skills Checklist for Vaccine Administration is available for healthcare professionals to self-assess vaccine administration competency in five domains: 1) patient education, 2) medical protocols, 3) vaccine preparation, 4) vaccine administration and 5) documentation procedures. (18) To access the checklist, visit
<https://www.immunize.org/catg.d/p7010.pdf>.

Table 3: Rights of Medication Administration Adapted for Vaccines(18)

- Correct patient
- Correct vaccine with right diluent (if needed, e.g., *Pfizer-BioNTech*)
- Correct time, including correct age, appropriate interval, and vaccine and/or diluent that has not expired
- Correct dose
- Correct route, needle length, and technique
- Correct site
- Correct documentation

Summary

As healthcare systems face logistical challenges of COVID-19, the strategy of employing all competent healthcare providers to support patient care in areas outside of their usual work setting seems likely. Specifically, to address the shortage of available healthcare providers trained to administer vaccines, NMTs may be asked to administer COVID-19 vaccinations.

Doing so may be the first clinical experience some NMTs have in administering a vaccine. This article offers NMTs a summary of the procedure and provides several resources to proactively prepare to administer COVID-19 vaccinations. NMTs who will be administering COVID-19 vaccines are encouraged to complete the recommended CDC modules in their entirety.

Important note: The spectrum of responsibilities for a nuclear medicine technologist varies widely across the United States. Information presented in this document provides a basis for establishing knowledge and understanding related to the intramuscular injection of COVID-19 vaccines that may be performed by a nuclear medicine technologist. The nuclear medicine

technologists must comply with all federal, state, and institutional guidelines, including proper documentation of competency in the practice of this activity.

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