VACCINE AND IMMUNIZATION TRAINING

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Topic Overview

Vaccines are one of the most effective life-saving inventions of all time. Vaccines have saved roughly 37 million lives between 2000 and 2019 and are projected to save 69 million deaths by 2030. This makes vaccines one of the top public health interventions in history. These statistics are even more impressive because much of the benefit has been in children under the age of five. An understanding of vaccine administration best practices and the contraindications and inclusion or exclusion criteria of vaccines for patients are essential to the safe and effective administration of vaccines.

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Target Audience: This educational activity is for pharmacists.

How to Earn Credit: From February 18, 2023, through February 18, 2026, participants must:

1) Read the "learning objectives" and "author and planning team disclosures;"
2) Study the section entitled "educational activity;" and
3) Complete the Course Test and Evaluation form. The Course Test will be graded automatically. Following successful completion of the Course Test with a score of 70% or higher, a statement of participation will be made available immediately. (No partial credit will be given.)
4) A participant's credit for this course will be uploaded to CPE Monitor.

Learning Objectives: Upon completion of this educational activity, participants should be able to:

1. **Identify** vaccine administration clinical activities and immunization resources for current vaccines.
2. **Describe** administration routes and sites for routinely recommended vaccines.
3. **Identify** strategies and best practices to prevent vaccine administration errors
4. **Identify** contraindications and inclusion or exclusion criteria for patients.

Disclosures

The following individuals were involved in the development of this activity: Steve Malen, PharmD, MBA, and Susan DePasquale, MSN, PMHNP-BC. There are no financial relationships relevant to this activity to report or disclose by any of the individuals involved in the development of this activity.

Introduction

Vaccines are one of the most effective, life-saving inventions of all time. The introduction of vaccines dates back over 2,200 years ago. In modern times, vaccines have saved millions of lives. This makes vaccines one of the top public health interventions in history. An understanding of vaccine administration best practices and the contraindications and inclusion or exclusion criteria of vaccines for patients are essential to the safe and effective administration of vaccines.

The History of Vaccines

The history of events relating to the discovery of vaccines begins far in the past, as set forth in the image below.[1] Prior to the development of vaccines, people understood that survivors of smallpox were immune to the disease.[2] This led to the practice of inoculation or variolation, which was used to expose a person to a virus.[2] The earliest example of variolation may have been in China in 200 BC, where the smallpox virus was derived from cowpox scabs, and people were exposed to smallpox with the goal of giving them immunity to the disease.[1]

In the late 1700s, the smallpox vaccine was introduced.[1,2] It was in 1796 that Edward Jenner met a young dairymaid named Sarah Nelms whose arms and hands had fresh cowpox lesions.[2] Jenner used a new procedure he called vaccination on an 8-year-old boy, James Phipps.[2] The boy experienced moderate symptoms but then became well. A couple of months later, Jenner vaccinated the boy again, and this time he showed no symptoms, leading Jenner to the conclusion that inoculation was successful and complete.[2] In 1798, Jenner published his findings. He chose to call this new procedure "vaccination" from the Latin word "vacca," which means cow, and the derivative word "vaccinia," meaning cowpox.[2] Other vaccines were to follow this momentous introduction of the cowpox vaccine.[3] For example, in 1884, Louis Pasteur created the rabies vaccine.[1,3]

Image 1: A History of Vaccines Timeline

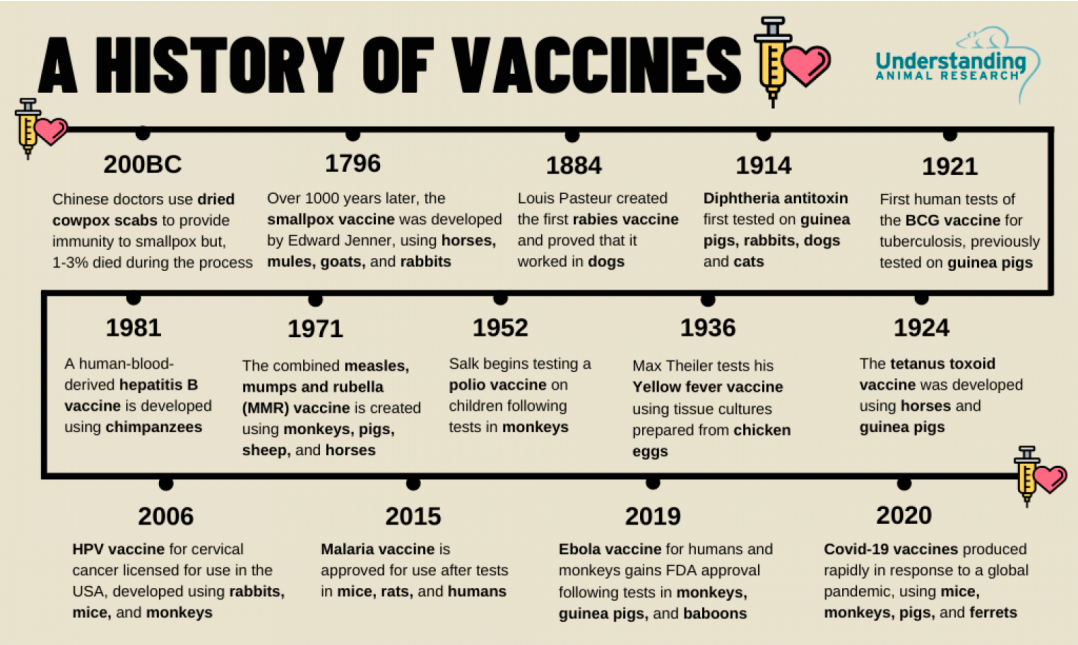

Image provided by Understanding Animal Research, London, UK

Most of the vaccines used today were created in the 1900s with the tuberculosis vaccine leading the way. Finally, during the COVID-19 pandemic, vaccine research advanced further with the use of mRNA technology.[1] Common vaccines are listed in Table 1 below.[5]

Table 1: Common Vaccines

Inactive Vaccines*	Live Vaccines
Influenza (IM) (A/B/H1N1)	Influenza (nasal)
Typhoid (IM)	Typhoid (oral)
Tetanus/Diptheria/Pertussis (Tdap)	Yellow fever
Pneumococcal (23/7valent)	Varicella [Varivax] [Zostavax#]
Human papilloma virus (HPV)	Measles, mumps, rubella (MMR)
Hepatitis B (HBV)	BCG (bacillus Calmette-Guerin)
Hepatitis A (HAV)	Polio (oral)
Hemophilus influenza B (HIB)	Smallpox (vaccinia)
Meningococcus	Anthrax
Rabies	Rotavirus
	Adenovirus type 4, 7 (oral)

#H. Zoster: Ok give if ≥60 yrs on MTX, AZA, pred, but avoid w/ biologics. Give before biologic or give 4wks after biologic stop, vaccinate, wait ≥2wks before biologic restart

Table 1 provided by ReumNow

Types of Vaccines

"Vaccine modalities include live, attenuated viruses, inactivated pathogens, protein subunit vaccines, polysaccharides, conjugate vaccines, DNA platforms, mRNA platforms, and viral vectors."[4] Each of these modalities has its advantages and disadvantages. There are other examples of the advantages and disadvantages or challenges of vaccine modalities. Verdecia, *et al.* (2021), discuss these at greater length. One example, inactivated vaccines, is discussed here. The advantages of inactivated vaccines are many. They have a long history and a better safety profile than other modalities and are generally useful in administration to immunosuppressed and pregnant patients.[4,6] Manufacturing of these drugs is cost-effective given their long history and the availability of continuous cell lines.

As depicted in Table 2 below, live vaccines require spacing between the vaccine stocks, whereas inactivated vaccines do not.[7] Regulatory agencies are also familiar with these vaccines and approval is more routine.[4] On the other hand, inactivated vaccines are often less immunogenic than their live, attenuated vaccine counterparts. They do not replicate, which limits their activation of dendritic cells. "Inactivated vaccines can only activate innate responses at the injection site, making the site and administration route critical."[4]

TABLE 2. Guidelines for spacing of live and inactivated antigens

Antigen combination	Recommended minimum interval between doses
≥2 inactivated	None; can be administered simultaneously or at any interval between doses
Inactivated and live	None; can be administered simultaneously or at any interval between doses
≥2 live parenteral*	4-week minimum interval, if not administered simultaneously

* Live oral vaccines (e.g., Ty21a typhoid vaccine, oral polio vaccine) can be administered simultaneously or at any interval before or after inactivated or live parenteral vaccines.

Table 2 provided by CDC

Effectiveness of Vaccines

Vaccines are one of the most effective life-saving inventions ever invented.[8] Roughly one billion lives have been saved which put them on par with blood transfusions, toilets, and synthetic fertilizers. Introduction Vaccines have saved roughly 37 million lives between the years 2000 and 2019 and are projected to save a total of 69 million deaths if you go to 2030.[8] This was based on research at the University of Cambridge evaluating epidemiological data in 98 countries and was published in The Lancet medical journal.[8] This makes vaccines one of the top public health interventions in history. What makes these statistics even more powerful is that most of the benefit has been in children under five years old.

Table 3: Global Child Deaths by Year

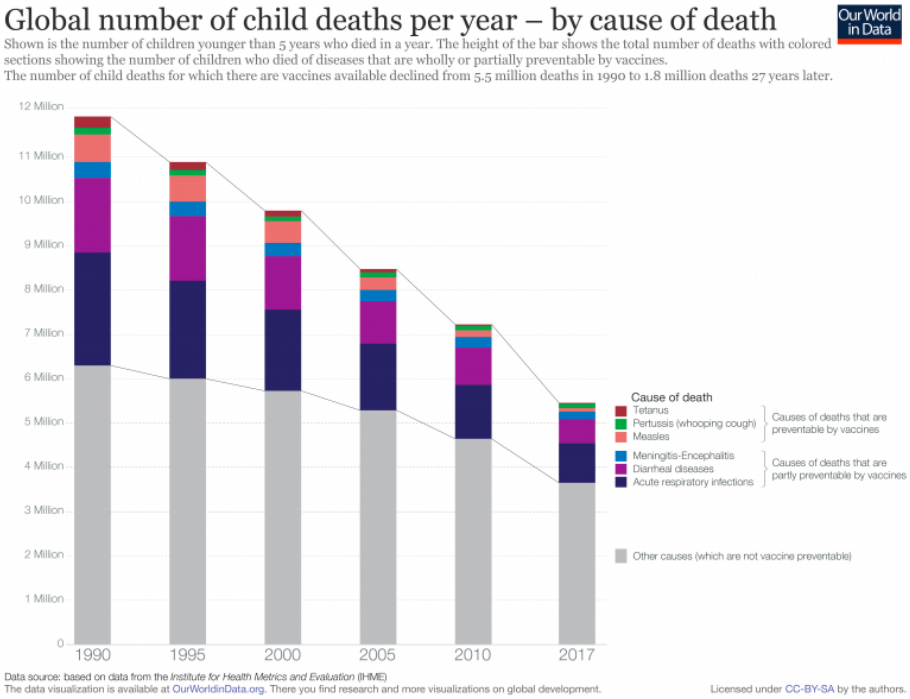

Table 3 provided by Our World in Data[9]

From 1990 to 2017, vaccine-preventable deaths in children went from 5.5 million to 1.8 million.[9] That is a reduction of over 80%.

Table 4: Vaccine-preventable deaths in the U.S.

Vaccine-preventable diseases in the US

Shown is the reduction of cases and deaths after the introduction of the vaccine

Our World in Data

	Cases (All post-vaccine cases refer to 2006)			Deaths (All post-vaccine deaths refer to 2004)		
Diphtheria	Pre-vaccine: 158 cases per million per year (1936-45)	100% Reduction	Post-vaccine: 0 cases per million per year	Pre-vaccine: 13.7 deaths per million per year (1936-45)	100% Reduction	Post-vaccine: 0 deaths per million per year
Measles	Pre-vaccine: 3044 cases per million per year (1953-62)	99.99% Reduction	Post-vaccine: 0.2 cases per million per year	Pre-vaccine: 2.5 deaths per million per year (1953-62)	100% Reduction	Post-vaccine: 0 deaths per million per year
Mumps	Pre-vaccine: 830 cases per million per year (1963-68)	97.4% Reduction	Post-vaccine: 22 cases per million per year	Pre-vaccine: 0.2 deaths per million per year (1963-68)	100% Reduction	Post-vaccine: 0 deaths per million per year
Pertussis	Pre-vaccine: 1534 cases per million per year (1934-43)	96.6% Reduction	Post-vaccine: 52 cases per million per year	Pre-vaccine: 30.8 deaths per million per year (1934-43)	99.7% Reduction	Post-vaccine: 0.09 deaths per million per year
Acute Poliomyeltis	Pre-vaccine: 141 cases per million per year (1941-50)	100% Reduction	Post-vaccine: 0 cases per million per year	Pre-vaccine: 10 deaths per million per year (1941-50)	100% Reduction	Post-vaccine: 0 deaths per million per year
Paralytic Poliomyeltis	Pre-vaccine: 103 cases per million per year (1951-54)	100% Reduction	Post-vaccine: 0 cases per million per year	Pre-vaccine: 11.8 deaths per million per year (1951-54)	100% Reduction	Post-vaccine: 0 deaths per million per year
Rubella	Pre-vaccine: 242 cases per million per year (1966-68)	99.98% Reduction	Post-vaccine: 0.04 cases per million per year	Pre-vaccine: 0.09 deaths per million per year (1966-68)	100% Reduction	Post-vaccine: 0 deaths per million per year
Congenital Rubella Syndrome	Pre-vaccine: 0.76 cases per million per year (1966-69)	99.6% Reduction	Post-vaccine: 0.003 cases per million per year	Pre-vaccine: no data (1966-69)	no data	Post-vaccine: 0 deaths per million per year
Smallpox	Pre-vaccine: 350 cases per million per year (1900-49)	100% Reduction	Post-vaccine: 0 cases per million per year	Pre-vaccine: 2.9 deaths per million per year (1900-49)	100% Reduction	Post-vaccine: 0 deaths per million per year
Tetanus	Pre-vaccine: 4 cases per million per year (1947-49)	96.6% Reduction	Post-vaccine: 0.14 cases per million per year	Pre-vaccine: 3.2 deaths per million per year (1947-49)	99.6% Reduction	Post-vaccine: 0.01 deaths per million per year
Hepatitis A	Pre-vaccine: 465 cases per million per year (1986-95)	89% Reduction	Post-vaccine: 51 cases per million per year	Pre-vaccine: 0.5 deaths per million per year (1986-95)	88.7% Reduction	Post-vaccine: 0.06 deaths per million per year
Acute Hepatitis B	Pre-vaccine: 273 cases per million per year (1982-91)	83.9% Reduction	Post-vaccine: 44 cases per million per year	Pre-vaccine: 1 death per million per year (1982-91)	83.6% Reduction	Post-vaccine: 0.16 deaths per million per year
Haemophilus Influenza type b	Pre-vaccine: 84 cases per million per year (1980s)	99.8% Reduction	Post-vaccine: 0.17 cases per million per year	Pre-vaccine: no data (1980s)	no data	Post-vaccine: 0.02 deaths per million per year
Pneumococca Disease	Pre-vaccine: 233 cases per million per year (1997-99)	40.5% Reduction	Post-vaccine: 139 cases per million per year	Pre-vaccine: 24 deaths per million per year (1997-99)	31.3% Reduction	Post-vaccine: 16.5 deaths per million per year
Varicella	Pre-vaccine: 16018 cases per million per year (1990-94)	87.2% Reduction	Post-vaccine: 2046 cases per million per year	Pre-vaccine: 0.41 deaths per million per year (1990-94)	84.3% Reduction	Post-vaccine: 0.06 deaths per million per year

Data source: Roush and Murphy (2007) - Historical comparisons of morbidity and mortality for vaccine-preventable diseases in the United States. In The Journal of the American Medical Association, 298, 18, 2155–2163. Licensed under CC-BY by the author Max Roser

OurWorldinData.org – Research and data to make progress against the world's largest problems.

Table 4 provided by Our World in Data[9]

The effectiveness of vaccines is often questioned because of flu vaccines; however, most vaccines have over 90% and in some cases over 99% effectiveness rates.[9]

There are important training programs that a pharmacist or pharmacy technician must be taken before administering vaccinations. Most pharmacy staff get their vaccine training through APhA, the American Pharmacists Association, which covers the basics of how to administer a vaccine. In addition, a person administering vaccines must be certified in basic life support, which includes CPR (cardiopulmonary resuscitation), and how to use an automated external defibrillator or AED. Also, a pharmacy technician may be required to take additional training by the applicable board of pharmacy, or employer.

Identify Vaccine Administration Clinical Activities

Pharmacies will either administer vaccines in a waiting area with other patients or they will have a dedicated room for vaccinations and other clinical services. A dedicated room is preferred as it offers privacy as sometimes patients have clothing that makes it impossible to immunize without them taking off clothing. Unfortunately, there have been cases in pharmacies that do not have dedicated rooms where patients received the vaccine improperly. This will be discussed later in the course in further detail.

Image 2

Image 2 provided by U.S. Department of Health and Human Services[10]

It is important to have all the necessary vaccine supplies specific to each vaccine available. Furthermore, as pictured above, it is also important to have the supplies laid out in a user-friendly layout to make the vaccination process as easy as possible. Once again, different vaccines require different supplies so the clinician must make sure all necessary supplies for vials, pre-filled syringes, and for vaccines that require dilution.

Preparing vaccines requires aseptic technique and a good working environment. In Image 3 below, there is an organized layout of supplies and the vaccine administrator is positioned in a comfortable seated position to make sure the preparation technique goes well.[11]

Image 3

Image 3 provided by Penn Medicine

Influenza vaccines may be manufactured in a vial and a prefilled syringe. Vials have the benefit of being lower cost and prefilled syringes have the benefit of ease of use and minimizing needlesticks. If possible, try to order prefilled syringes unless they are not available. The extra cost of the prefilled syringe is well worth it.

Regardless of the vial or prefilled syringe, a clinician must get rid of air bubbles in the syringe. With a flick of a finger, the bubbles move to the top of the syringe, and then by pushing the syringe slowly, the clinician can remove the bubbles only. When doing this, it is possible for a small amount of the vaccine liquid to be lost but this is normal as long as it does not happen too often.

Some vaccines come in two parts in which one is the diluent and one is the active ingredient. The diluent needs to be removed and added to the active ingredient. The important part about this activity is that a vacuum is created if it is not done properly. This vacuum makes preparation if not impossible at least difficult and unsafe. The rule of thumb is whenever you take out a certain volume of liquid you need to draw that same volume of air prior to inserting the needle. This added air will prevent a vacuum because when you draw out the liquid the pressure will be balanced. This makes not only diluting vaccines relatively difficult but even vial vs prefilled syringe vaccines more difficult. Before vaccinating a patient for a vaccine make sure you practice the exact technique with saline, which is the ingredient in most diluent vials.

Table 5: Vaccines With Diluents

Vaccine product name	Manufacturer	Lyophilized vaccine (powder)	Liquid diluent (may contain vaccine)	Time allowed between reconstitution and use, as stated in package insert*	Diluent storage environment
ActHIB (Hib)	Sanofi Pasteur	Hib	0.4% sodium chloride	24 hrs	Refrigerator
Hiberix (Hib)	GlaxoSmithKline	Hib	0.9% sodium chloride	24 hrs	Refrigerator or room temp
Imovax (RAB_{HDCV})	Sanofi Pasteur	Rabies virus	Sterile water	Immediately†	Refrigerator
M-M-R II (MMR)	Merck	MMR	Sterile water	8 hrs	Refrigerator or room temp
Menveo (MenACWY)	GlaxoSmithKline	MenA	MenCWY	8 hrs	Refrigerator
Pentacel (DTaP-IPV/Hib)	Sanofi Pasteur	Hib	DTaP-IPV	Immediately†	Refrigerator
ProQuad (MMRV)	Merck	MMRV	Sterile water	30 min	Refrigerator or room temp
RabAvert (RAB_{PCECV})	GlaxoSmithKline	Rabies virus	Sterile water	Immediately†	Refrigerator
Rotarix (RV1)‡	GlaxoSmithKline	RV1	Sterile water, calcium carbonate, and xanthan	24 hrs	Refrigerator or room temp
Shingrix (RZV)	GlaxoSmithKline	RZV	$AS01_B$§ adjuvant suspension	6 hrs	Refrigerator
Varivax (VAR)	Merck	VAR	Sterile water	30 min	Refrigerator or room temp
YF-VAX (YF)	Sanofi Pasteur	YF	0.9% sodium chloride	60 min	Refrigerator or room temp

Table 5 provided by Immunize.org

Table 5 above shows all the current vaccines that come with a diluent.[12] Notice that the diluent ingredients vary from vaccine to vaccine and are not interchangeable. The "time allowed between reconstitution and use" as it varies substantially.

Keeping track of temperatures in which vaccines are stored is a board of pharmacy requirement in every state and is the right thing to do to make sure injectable medications are safe. The original method was with handwritten logs; however, this method is tedious and does not track temperatures when a pharmacy is closed. That is why it is preferred to use an electronic thermometer with automatic logging and an alert system. Electronic systems alert clinicians if the temperature was too high or too low, and can alert them of a problem when they are not there.

Administration Routes and Sites for Routinely Recommended Vaccines

In the pharmacy, all the vaccines administered are either intramuscular or subcutaneous. A subcutaneous injection is administered at a 45-degree angle into the triceps area of the arm.[13] This injection is kind of awkward given the angle, location, and the fact that a clinician will need to pinch the skin. The added difficulty is that the margin of error is much lower than an intramuscular injection as you need to get it into the subcutaneous tissue rather than a muscle. An intramuscular does not require pinching of the skin, is administered at a 90-degree angle approach, and is injected into the deltoid muscle. It is important not to inject this too close to the shoulder as this could result in injury which requires many months of physical therapy.

Patients' skin and muscles also have different thicknesses so a clinician must be careful to make sure the depth is appropriate. If the patient is a man over 260 lbs. (118 kg) or a woman over 200 lbs. (90 kg) then make sure you use a 1.5-inch needle rather than the standard 1-inch needle. The same goes for children which may require a ⅝ inch needle rather than the standard 1-inch needle. Another point that is worth mentioning is trying to always have

25-gauge needles to decrease pain for the patient. Unfortunately, during the pandemic, there was a shortage of thin needles, so some vaccinations had to be done with thicker needles. However, now the shortages are mostly gone so try to always get the thinnest needle possible. Generally, geriatric patients need extra care when giving vaccines as their skin and muscles are very thin, so it is easy to hit the bone by accident. While this is not dangerous, it is not ideal and is something to keep in mind.

Image 4: Administration Best Practices

Image 4 provided by ECG

The picture above is an intramuscular injection. It is worth noting that the vaccine in this picture is being delivered slightly too high as it is too close to the shoulder. Also, it looks like the elbow is hanging which is not ideal as it is better to have the elbow resting on a surface to prevent muscle tone.

During the pandemic, there were many videos of COVID-19 vaccines being given and one thing that recurred was the pinching of the skin. All COVID-19 vaccines are intramuscular vaccines that do not require pinching. It is best not to pinch as this could unintentionally cause the injection to go into the subcutaneous tissue.

Image 5

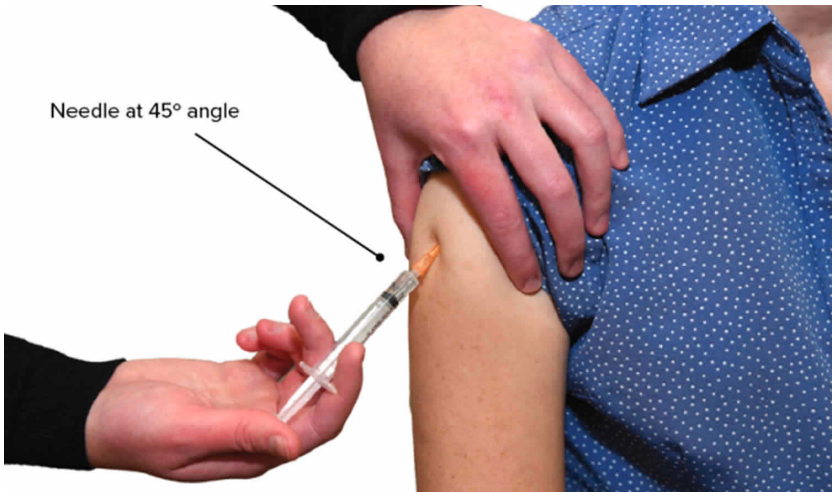

Image 5 provided by HealthJade

The picture above shows an attempt at a subcutaneous injection.[14] First thing that is wrong is that it is being injected into the deltoid area while it should be in the triceps area behind the arm. The second thing that is wrong is that the skin is not being pinched. The fingers on the left hand resting on the shoulder need to be closer to the needle and pinching the skin up. Regardless of the incorrect procedure in the picture, the subcutaneous injection is more awkward right from the beginning, as mentioned before, so definitely practice this beforehand with saline on an inanimate object such as a banana. Most people recommend an orange however the skin of the orange is too thick and hard to mimic human skin.

Strategies and Best Practices to Prevent Vaccine Administration Errors

Vaccine errors are among the most difficult for a pharmacy and its staff. The table below, Table 6, lists different categories of errors and how to avoid them.[15] The best practices to prevent errors are vital and it is important for the entire pharmacy staff to be aware of them. Allowing trained technicians to vaccinate has been a great advancement for the pharmacy profession; however, it also requires additional staff training. The main tip that is recommended is right before giving a vaccine to a patient, read the patient's

name and the vaccine name out loud to the patient. This is equivalent to the checklist surgeons do to make sure all the surgery supplies have been removed from a surgery site. The worst error is giving the wrong vaccine to a patient and this tip is the best system for preventing that. It is also a good time to ask the patient if they have any last questions about the vaccine, which should be said out loud to make sure it is the correct vaccine.

Table 6: Avoiding Vaccine Errors

ERROR: Wrong vaccine, administration site, or dosage

- Circle important information on vaccine packaging to highlight differences between vaccines
- Include brand names with vaccine abbreviations whenever possible
- Separate vaccines into containers based on type and formulation
- Store look-alike vaccines in different areas of the storage unit
- When possible, purchase products with look-alike packaging from different manufacturers
- Establish interruption-free areas or times when vaccines are being prepared or administered
- Prepare vaccines for 1 patient at a time
- Prepare the vaccines you will be administering. Do not administer vaccines prepared by someone else

ERROR: Scheduling errors

- Use standing orders if and when appropriate
- Create procedures to obtain a complete vaccination history via the immunization information system, patient medical records, and personal vaccination records
- Implement vaccine administration training into orientation process
- Post current immunization schedules for quick reference
- Counsel patients on the importance of maintaining their immunization records

ERROR: Documentation errors

- Avoid using error-prone abbreviations to document vaccine administration
- Use the Advisory Committee on Immunization Practices' vaccine abbreviations

ERROR: Administration of improperly stored and/or handled vaccines

- Implement training for vaccine storage and handling requirements based on manufacturer guidelines or requirements
- Rotate vaccines. Those with the earliest expiration dates should be at the front of the storage unit
- Remove expired vaccines and dilutants from storage units where viable vaccines are stored
- Isolate vaccines exposed to improper storage temperatures

ERROR: Wrong patient

- Verify patient identity via name and date of birth prior to vaccine administration
- Educate staff on eliminating unnecessary distractions and interruptions when administering vaccines

Source: Adapted from the CDC[1]

The picture below, Image 6, is of a retracting syringe. A retracting syringe automatically retracts all the way when it is pushed in.[16] An automatically retracting syringe is preferable as the needle retracts while it is inside the patient's body. This removes an additional step by the person administering the vaccine. A problem with this syringe is that making the syringe retract requires some strength, so some people are not able to do it.

Image 6

Image 6 provided by BD

Image 7 is another type of safety syringe that has a pink shield that can be put on the syringe safely.[16] Although safer than a regular syringe, it is not as safe as the auto-retracting syringe in Image 6, since the clinician must reach for the pink shield to close it.

Image 7

Image 7 provided by BD

It is important to not recap needles, which is a relatively common practice. As soon as a clinician takes the cap off a needle, the needle should be immediately discarded to prevent needlesticks and side effects to a patient who may be injured since the tip of a needle can be blunted during capping.

Current Immunization Resources

The ACIP advisory committee on immunization practices is a part of the CDC and dictates the immunization schedule.[17] The protocols that pharmacies have to vaccinate generally go hand in hand with these schedules, so it is

important to be familiar with them. The schedules not only tell you who is eligible for a certain vaccine by age but also by a medical condition.[17]

The right to vaccinate in a pharmacy varies from state to state. The first protocol is through authorization by a physician, which outlines exactly which vaccines can be given to specific populations.[18] The second and less ideal way is via a prescription. Most vaccinations are given by protocol and during the pandemic, this protocol was provided by many states. Generally, this protocol needs to be custom-made for each pharmacy. In large, national pharmacies, this protocol is automatically provided by the company. However, with a vaccination program at an independent pharmacy, the pharmacy must develop approved protocols, which can be done affordably via a PSAO or pharmacy services administrative organization.[18]

Whenever a patient has a side effect from a vaccine, it is important to report the event to VAERS via their website: www.vaers.hhs.gov. The patient, pharmacy, or physician can report it. Finally, if a patient suffers severe harm from a vaccine, they can apply for injury compensation through HRSA: www.hrsa.gov. This government fund is in place because vaccine manufacturers often have immunity and cannot be sued for injuries caused by their vaccine products.

Inclusion and Exclusion Criteria

Inclusion criteria vaccines are provided by the ACIP vaccine schedule and by vaccine protocols. This inclusion could be based on age and medical condition. Exclusion criteria can generally be found in the package insert of each vaccine above for the M-M-R vaccine which shows five contraindications. Inclusion and exclusion criteria Another useful tool for inclusion and exclusion criteria are the vaccination checklists in the pictures above. Since there are vaccines that are medical condition dependent you may find out a patient is eligible based on this form. Similarly, you may find out the patient is not eligible for a vaccine based on these forms; especially if they say they are pregnant. Pregnancy, as you saw with M-M-R, is a contraindication with many

vaccines so whenever any patient says yes on these forms this is a time to slow things down and double-check that it is appropriate to give the vaccine. Checking with the package insert is one of the best ways to double-check check the patient does not have a contraindication.

Age is an important inclusion criterion, especially with flu vaccines. Flu vaccines range from 6 months to specifically over 65 years. It is important to note that most vaccines that are appropriate for adults that are less than 65 are also appropriate for those over 65. The vaccines for patients over 65 often are either on backorder or are in short supply so there will be situations where seniors may be administered a regular adult vaccine, and this is authorized per the package insert. The difference in effectiveness is small despite a quadruple dose; however, it is still important to counsel geriatric patients that they are getting a regular flu vaccine.

COVID-19 and Other New Vaccine Information

COVID-19 vaccines are novel not only in their ingredients but their ever-changing and dynamic expiration dates. Most vaccines will have their expiration date on the vial like all medications however because of storage requirements and the Emergency Use Authorization by the FDA the expiration dates were not printed on the vaccines. Instead, for Moderna and Janssen the expiration date can be found on their respective websites.

The Pfizer-BioNTech COVID-19 vaccine products come in vials with different cap colors to assist pharmacists and technicians identify the appropriate Pfizer-BioNTech COVID-19 vaccine for each age group.[19] Table 6, below, provides that a maroon cap indicates the vaccine is appropriate for 6 months through 4 years of age, an orange cap indicates the vaccine is appropriate for 5 through 11 years of age, and a gray or purple cap indicates the vaccine is appropriate for 12 years of age and older.[19] Moreover, the CDC's Pfizer-BioNTech COVID-19 Vaccine Products At-A-Glance provides an excellent reference of other important information for pharmacists and technicians who are administering Pfizer-BioNTech COVID-19 vaccines.[19]

Table 6: COVID-19 Vaccines Vial Cap Colors

Vial cap color	Monovalent Maroon Cap	Monovalent Orange Cap	Bivalent Orange Cap	Monovalent Gray Cap	Bivalent Gray Cap
Ages	**6 months through 4 years**	**5 through 11 years**		**12 years and older**	
Supplied in multidose vial	10 doses per vial **Requires diluent**	10 doses per vial **Requires diluent**	10 doses per vial **Requires diluent**	6 doses per vial **No diluent**	6 doses per vial **No diluent**
Storage Temperature: Before Puncture **Do NOT store vaccine in a standard freezer**	**Between:** -90°C and -60°C (-130°F and -76°F) until the expiration date* 2°C and 8°C (36°F and 46°F) for up to 10 weeks **NOTE:** The beyond-use date (10 weeks) replaces the manufacturer's expiration date but NEVER extends it. Always use the earliest date. Do NOT use vaccine if the expiration date or beyond-use date has passed.				
Thawing Frozen Vaccine **Do NOT refreeze thawed vaccine**	**Between:** 2°C and 8°C (36°F and 46°F) OR Up to 25°C (77°F) Amount of time needed to thaw vaccine varies based on temperature and number of vials.				
Storage Temperature: After 1st Puncture **Do NOT use after 12 hours**	**Between:** 2°C and 25°C (36°F and 77°F) for up to 12 hours. Discard vial and any unused vaccine after 12 hours.				

*Vaccine expires 12 months after the manufacture date on the vial. Use Pfizer-BioNTech expiration date tool at lotexpiry.cvdvaccine.com

Table 6 provided by CDC[19]

The expiration date for Pfizer vaccines is much more complicated as it depends on the sequence of the vaccine being in transit, in the ultra-cold freezer, in the regular freezer, in thawing, and then finally in regular storage. For more details look at the package insert for the Pfizer COVID-19 vaccine being given.

Table 7: COVID-19 Vaccines

	Johnson & Johnson	Moderna	Pfizer-BioNTech
Vaccine Type	Viral Vector	mRNA	mRNA
Eligibility	18 and older	18 and older	12 and older
Doses Needed	One	Two, 28-day interval	Two, 21-day interval
Side Effects	Injection site pain, fatigue, headache, chills, body aches	Injection site pain, fatigue, headache, chills, body aches	Injection site pain, fatigue, headache, chills, body aches
Serious Side Effects	Rare	Rare	Rare
Storage Requirements	36-46° F	Ultracold/frozen	Ultracold/frozen
FDA Status	Emergency use authorization	Emergency use authorization	Emergency use authorization

Table 7 provided by Banner Health

The table above, Table 7, shows the differences between COVID-19 vaccines in terms of storage, diluent, doses per vial, and age requirements.[20] It is also important to keep in mind that the age requirements and other inclusion criteria are ever-changing with these vaccines. The schedule for COVID-19 vaccines is relatively complicated as they have multiple boosters.[21]

Billing and Documentation

Billing vaccines can be done via the prescription plan or medical plan. This varies based on vaccine and insurance and requires a relatively long learning curve. The processes can also be very different from pharmacy to pharmacy. Regarding documentation, it is important to have the filled-out questionnaire and the rest of the information will be documented in the computer system including lot #'s, expiration dates, *etc.* Vaccines can be done via clinics offsite so in these situations make sure to document on the questionnaire the lot#, expiration, and which arm was injected as all these are required.

Case Study

A 55-year-old diabetic male comes into the pharmacy in October to pick up prescriptions. What vaccines is he eligible for? He has only received a flu shot since childhood. The goal is to see which vaccines this patient is eligible to receive.[22] This information may be found on the Centers for Disease Control and Prevention website, under Immunization Schedules made available to healthcare providers.[22]

The Centers for Disease Control and Prevention provides guidance for patients with underlying medical conditions that may be associated with a higher risk for severe COVID-19.[23] Since it is October it is appropriate to offer the flu shot as it is needed once a year. The next vaccine which you can recommend is the Td or Tdap which requires a booster every 10 years. Generally, pharmacies will only have the Tdap in stock which is appropriate. The M-M-R vaccine is also recommended as the patient was born after 1957;

however, you need to double-check if they received it. There are state vaccine registries that are linked to pharmacies and doctors so you could offer to the patient to double-check the registry. The next vaccine that is eligible is the zoster or shingles vaccine since the patient is over 50. The PPSV23 is Pneumovax or one of the pneumonia vaccines and is recommended because of the patient's diabetes. Finally, the patient may be eligible for their COVID-19 booster based on the schedule.

Summary

Before the pandemic, vaccinations were difficult to prepare, administer, and bill. Since the pandemic, these difficulties have only increased. The goal of this course was to review a brief history of the discovery of vaccines, describe the common vaccines, and the best practices around vaccine administration. There are also contraindications, patient inclusion or exclusion criteria, that must be followed for the safe and effective administration of vaccines.

It is important to stay up to date on COVID-19 vaccinations since they are continually changing in terms of inclusion or exclusion criteria and boosters. The important thing to note is vaccinations are preventive and can improve the health outcomes of patients. It is also a way to build better relationships with patients.

Course Test

1. **Any two vaccines can be given**

    a. at the same time.
    b. one week apart.
    c. two weeks apart.
    d. three weeks apart.

2. **True or False: A waiting room is better than a dedicated vaccine room for administering a vaccine.**

    a. True
    b. False

3. **True or False: All vaccines require the same supplies.**

    a. True
    b. False

4. **_____ vaccines have the lowest risk of needle sticks.**

    a. Single-dose vial
    b. Prefilled syringe
    c. Reconstituted
    d. Multi-dose vial

5. **Intramuscular vaccines are given in the**

    a. triceps area.
    b. gluteal area.
    c. deltoid area.
    d. trapezoid area.

6. **Subcutaneous vaccines require pinching skin at a ___-degree angle.**

    a. 0
    b. 45
    c. 90
    d. 180

7. **True or False: Retracting syringes does not decrease needle sticks.**

    a. True
    b. False

8. **A subcutaneous administration of a vaccine is done**

    a. with the needle at a 90-degree angle.
    b. without pinching the skin.
    c. with the needle at a 45-degree angle into the triceps area of the arm.
    d. into the deltoid.

9. **Vaccines can be given**

    a. without a prescription or protocol.
    b. with a prescription.
    c. with a protocol.
    d. All the above

10. **Covid vaccines are**

    a. all the same.
    b. each different in regard to storage and dosage.
    c. each different in regard to storage.
    d. each different in regard to dosage.

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