PHARMACIST CE:

Vaccine Preventable Errors: Current Prevalence and Solutions to Minimize Future Errors

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CE FOR **PHARMACISTS & TECHNICIANS**

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Learning Objectives

- Increase knowledge regarding significant preventable vaccine errors
- Describe the role of pharmacists in preventing vaccine-related errors
- Provide recommendations to combat vaccine errors

Over the past three decades, pharmacy-based immunization services have become increasingly common.[1] Just under one-third of immunized adults received their seasonal influenza vaccine in a pharmacy in 2017, and those rates are predicted to rise each year thereafter.[2] Currently in the state of Wisconsin, pharmacists are able to immunize anybody over the age of six years old with any vaccine that is indicated within the Centers for Disease Control and Prevention (CDC) immunization schedule. Because this law allows pharmacists to offer vaccinations without a prescription or protocol with a physician, pharmacists have been progressively able to provide this vital service to their patients.[3] In 2019 Wisconsin pharmacists capabilities were expanded – pharmacists can now administer vaccines to children under the age of six years with a valid prescription written fewer than 30 days ago. With these changes, pharmacists can now participate in immunization efforts across the age span. As pharmacists are extremely accessible providers for immunizations and have continually broadened their vaccine services since the authority to immunize was granted, it is important to revisit the basics on how to properly administer, document, and store vaccines within the pharmacy to prevent vaccination-related errors.

The World Health Organization (WHO) defines adverse events following immunization (AEFIs) as "any untoward medical occurrence which follows immunization and which does not necessarily have a causal relationship with the usage of the vaccine", whereas a vaccine-related error can be more broadly defined as any action related to the administration of a vaccine that is incorrect.[4] According to a 2017 study by the Institute for Safe Medication Practices (ISMP), the location with the highest percentage of vaccine errors was the outpatient medical setting or public health clinics, making up 54% of total reported errors.[5] Only 2% of reported errors in the study occurred in pharmacies. The ISMP reports that none of the vaccine-related errors resulted in immediate harm to the patient, but errors could potentially involve consequences such as disease outbreaks, reduced herd immunity, and cost-related consequences such as over-vaccination or revaccination. A systematic review of vaccine errors conducted by Morse-Brady and Hart found 1.15 errors occurred per

TABLE 1. Types of Reported Vaccination Errors (n = 24,263)

Error type	Total Errors (passive surveillance)	Total Errors (active surveillance)	Percentage of Total Documented Errors	Medication Administration Right violated[a]
Wrong vaccine administered	540	19,297	82%	Right drug
Off-schedule administration	903	2,667	15%	Right time
Administration error (wrong dose, route, site)	290	0	1.2%	Right dose, right route
Expired vaccine	238	0	1%	Right drug
Over vaccination (extra vaccine doses)	52	0	0.2%	Right time
Vaccine spillage	7	0	0.03%	Right dose
Contraindication	4	0	0.02%	Right drug
Documentation error	3	0	0.01%	N/A
Other or unspecified	220	42	1.1%	N/A

aThe Five Rights of medication administration: the right patient, the right drug, the right dose, the right route, the right time.
Adapted from Morse-Brady and Hart.[6]

10,000 vaccines given; the review did not identify how many errors occurred in each setting.[6] Out of the few studies in the review that described the consequences of the errors, one death occurred, one person experienced anaphylaxis, 64 patients experienced non-serious harm, and the other 1,066 patients experienced no harm at all. Non-serious harm included reactions such as pain, fever, and local injection site reactions. Table 1 shows the types of vaccine errors that were found in the review in order of incidence. While this comprehensive review did not base its findings solely on vaccines administered by pharmacists as it evaluated data from both national vaccine databases and primary care clinics, the results can be instructive as pharmacies build safe immunization practices.

Although vaccine errors appear to be rare, immunization providers must retool their practices to minimize error potential when immunization services are expanded and as part of routine quality improvement. Reported vaccine error rates are likely much lower than the rates at which they actually occur due to under-reporting; under-reporting may also be due to the pharmacist not noticing an error was made.[7] Other reasons pharmacists may not report vaccine errors could be due to time constraints in the workplace or fear associated with reporting errors. To enhance quality improvement and design strategies to minimize errors, it is essential to report all errors that occur to get accurate measurements for needed improvements. All vaccine errors should be reported to the Institute for Safe Medication Practices National Vaccine Error Reporting Program (ISMP VERP), which is a simple process that requires completing an online form regarding the actual or potential error that occurred. This online database is then evaluated for trends in vaccine errors and suggestions are provided by the ISMP for how to resolve them and avoid future errors.

Properly administering, storing, and documenting vaccines are crucial in order to protect patients in the most effective ways possible. Not following the recommended guidelines regarding vaccine usage can potentially lead to increased adverse events or decreased effectiveness of the vaccine. By adhering to the recommended guidelines, pharmacists can ensure that vaccines given will minimize harm to the patient and protect the patient from the infection as much as possible. This article aims to briefly discuss vaccine-related errors and provide strategies to minimize these errors going forward.

Scheduling the Vaccine Administration

An important principle of immunization is that the vaccine must be administered before exposure to the pathogen.[8] Immunizers use the frequently updated CDC immunization schedules to assist with vaccine scheduling.[9] There are many errors that could occur from failing to appropriately schedule vaccine administration such as off-schedule administration – not adhering to the recommended timing for vaccination by the CDC – or over vaccination, meaning giving the patient too many doses of a vaccine. The Morse-Brady and Hart review found that off-schedule administration and over vaccination caused 15% and 0.2% of errors respectively.[6] Off-schedule immunization could lead to poorer health outcomes such as disease outbreak or reduced immunity.[5] Although not ideal to over-vaccinate, the majority of the time adverse events do not occur if there is an additional dose of a vaccine given; if anything, the consequences are not serious to the patient as the most common reports are of fever, injection site redness, and pain.[10] According to ISMP, many errors regarding incorrect timing of vaccine administration were due to failure to check

TABLE 2. Most Common Vaccines to Cause Errors Based on Similar Formulations

Vaccine Type	Percentage of Errors
Diphtheria, tetanus, and/or pertussis vaccines (Tdap, DTaP, DT, Td, and combination vaccines)	23%
Measles, mumps, rubella, and/or varicella vaccines (MMR [M-M-R® II], MMRV [Proquad®], and varicella [Varivax®])	16%
Hepatitis A (Havrix® and Vaqta®), hepatitis B (Engerix-B®, Recombivax HB®, and Heplisav-B®), and combination vaccines (Twinrix® and Pediarix®)	11%
Pneumococcal vaccines (Pneumovax® 23 and Prevnar 13®)	10%
Influenza virus vaccines (Fluzone® high-dose, Fluzone® quadrivalent, Fluarix® quadrivalent, and Flulaval® quadrivalent)	9%

Adapted from the Institute of Safe Medication Practices.[5]

the patient's chart prior to administration; therefore, ensuring that either the patient's electronic medical record (EMR) and the Wisconsin Immunization Registry (WIR) are checked is an appropriate strategy to avoid these errors.[5] Off-schedule administration could be related to the complexity and misinterpretation of the CDC immunization schedules, whether that be the standard immunization schedules or an individual's catch-up schedule. Carefully reading the appropriate schedule and asking questions to the patient or their other providers would serve to be useful to pharmacists who are questioning if they should administer a vaccine due to timing concerns.

Another potential error related to timing of administration is giving live vaccines too close in proximity to other live vaccines. According to the CDC, live and inactivated vaccines may be administered at the same visit or without regard to any specific interval between them.[11] If not administered on the same day, then live vaccines should be separated by at least four weeks from other live vaccines. For example, the live vaccines, measles, mumps, rubella (MMR) and varicella each require two doses for most individuals. Although most of the time these vaccines are given at 12 months of age and again at 4-6 years old, the minimum interval for administration is at least four weeks since the last dose in the event an individual requires quick vaccination.[9] Pharmacists should refer to the CDC immunization schedules with any questions regarding appropriate timing of vaccines.

The Morse-Brady and Hart review found four errors reported due to a contraindicated vaccine given to a patient.[6] There is a lengthy list of precautions to receiving vaccinations which can become difficult for pharmacists to keep track of, but must be kept in mind to avoid patient harm. Three situations where live vaccines specifically are contraindicated are HIV-positive patients with low CD4 counts, pregnant women, and patients with severe immunocompromising conditions.[9] Live vaccines that are contraindicated in these populations include the live attenuated influenza vaccine, MMR, varicella, and live zoster vaccine. Prior to administering a live vaccine, it is crucial to evaluate a patient's medical history by assessing the EMR, their prescription medication history, or by directly asking the patient to ensure the vaccine is appropriate for them. The screening questionnaire completed by patients prior to vaccination is a useful tool to identify potential contraindications. While there are many other patient populations that require precautions for administering vaccines, a complete review of this topic is beyond the scope of this article.

Preparing for Vaccine Administration

Before administering a vaccine, it is essential to verify the five rights of medication administration as many vaccine errors that occur are due to one of these five rights either not being checked or accidentally omitted from the pre-administration process. Based on the 2017 ISMP report of vaccine errors, all five of the rights of medication administration landed within the top eight most common types of errors.[5] Among the five rights, the report states that the most common error was the wrong vaccine given, comprising 23% of total errors. Following the wrong vaccine given is the wrong dose, time, route, and then patient. To prevent these errors from occurring, it is useful to review suggested strategies to better equip healthcare providers with the tools they need to properly administer vaccines.

Pharmacists should store vaccines to facilitate choosing the correct vaccine based on composition, target patient population, diluents, and expiration dates. According to the systematic review by Morse-Brady and Hart, the wrong vaccine administered accounted for 82% of vaccine preventable errors.[6] In the 2017 ISMP report, the wrong vaccine administered accounted for 23% of errors.[5] These data provide validity

TABLE 3. Intramuscular Vaccine Administration Process

Steps
Wash hands
Gather supplies (dose, alcohol swab, cotton ball or gauze, bandage, sharps container)
Prepare dose aseptically with appropriate needle and properly attach to the syringe (Table 4)
Fully expose area for delivery of injection, removing any barriers such as clothing
Locate the proper area of the deltoid muscle for administration
Clean the injection site with an alcohol swab; allow appropriate time for drying
Place non-dominant hand on the arm for control and to help locate injection site
Hold the syringe similar to a dart, and insert swiftly at a 90-degree angle
Push the plunger in quickly and smoothly
Remove the needle smoothly from the muscle at the same 90-degree angle
Immediately place the used needle and syringe into the sharps container
Cover the injection site with cotton and apply pressure as needed for bleeding, apply bandage
Wash hands
Document the immunization

Adapted from Gabler et al.[14]

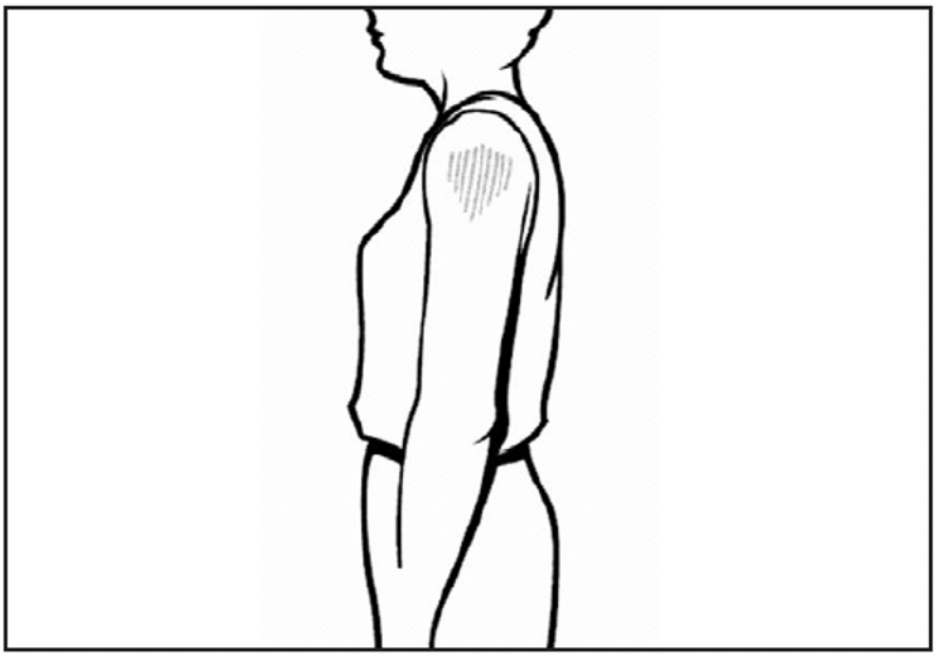
for the changes needed to prevent vaccine storage and administration errors.

To address the wrong patient and wrong vaccine errors, several checks can be implemented as a standard practice prior to administration. The ISMP recommends verifying the patient with their EMR or the immunization registry to ensure that it is the correct patient and the vaccine is indicated for the patient.[5] Although during the process of preparing the vaccine order the patient's name and date of birth should be verified, it is also good practice to verify the full name and date of birth of the patient directly again before administration to identify the correct patient. Because some vaccine formulations look or sound very similar to one another, it is imperative to verify the correct vaccine is chosen out of the stock to administer. Table 2 itemizes the most frequent vaccines that cause errors related to the wrong vaccine given due to similar formulations. Verifying with the patient and WIR before administration will establish that there is an indication for the vaccine, and verifying the product again immediately before administration can help prevent the wrong vaccine from being administered.

According to the 2017 ISMP study, the diphtheria, tetanus, and pertussis (Tdap, DTaP, DT, and Td) vaccines accounted for 23% of wrong vaccines administered to patients due to similarity in names and packaging.[5] The ISMP recommends placing pediatric and adult vaccines into separate storage containers within their respective storage units.[12] These bins could either be color-coded for the patient population for which they are indicated, or the bins can simply be labeled "adult" and "pediatric." Note that these distinctions remain somewhat problematic as Tdap and Td are indicated for individuals aged 7 years and older, and therefore may require further separation. Some pharmacies have gone to lengths of separating each individual vaccine formulation into its own separate bin based on age requirements, which can make for a lot of containers in a refrigerator or freezer, but it is one step further in preventing errors. For example, pharmacies have a designated bin for Engerix-B® and Recombivax HB® pediatric hepatitis B vaccines, and then another bin for Engerix-B®, Recombivax HB®, and Heplisav-B® adult hepatitis B vaccines. Another safeguard to be implemented could be labeling each individual vaccine package or vial with an "A" or "P" for adults and pediatrics. A fifth option suggested by the CDC is placing adult and pediatric vaccines on different shelves to minimize confusion.[13] Each pharmacy is responsible for implementing its own safeguards to avoid confusion with vaccine names and packaging, but these are just a few suggestions offered to help avoid error.

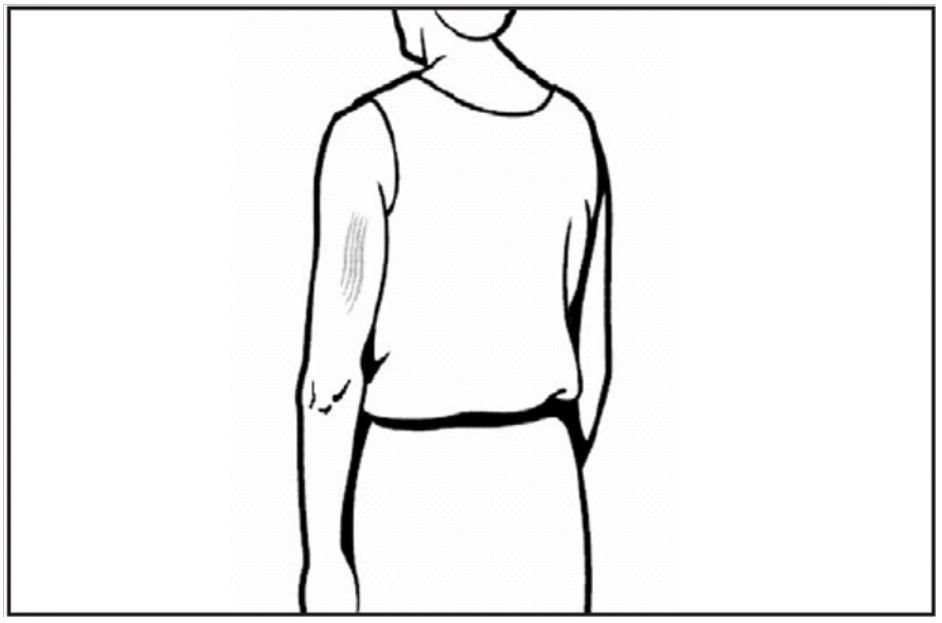
Community pharmacies can get quite busy with vaccinations, especially during flu season when a multitude of vaccines are administered. To avoid the chaos of multiple patients requesting vaccines at the same time resulting in errors, a useful strategy would be to only manage one

FIGURE 1. Site of Intramuscular Injection for an Adult



Adapted from Ezeanolue et al.[8]

FIGURE 2. Site of Subcutaneous Injection for an Adult



Adapted from Ezeanolue et al.[8]

TABLE 4. Recommended Needle Lengths and Sites of Injection Based on Patient Age and Weight

Age and/or weight	*Needle length*	*Recommended site of injection*
Neonates (0-28 days old)	5/8 inch[a]	Anterolateral thigh
Infants (1-12 months old)	1 inch	Anterolateral thigh
Toddlers (1-2 years old)	1-1.25 inch	Anterolateral thigh[b]
	5/8 inch	Deltoid muscle
Children (3-10 years old)	5/8-1 inch	Deltoid muscle[b]
	1-1.25 inch	Anterolateral thigh
Children (11-18 years old)	5/8 -1 inch	Deltoid muscle[b]
	1-1.5 inch	Anterolateral thigh
Men and women < 60 kg (130 lbs)	1 inch[c]	Deltoid muscle
Men and women 60-70 kg (130-152 lbs)	1 inch	Deltoid muscle
Men 70-118 kg (152-260 lbs)	1-1.5 inch	Deltoid muscle
Women 70-90 kg (152-200 lbs)	1-1.5 inch	Deltoid muscle
Men > 118 kg (> 260 lbs)	1.5 inch	Deltoid muscle
Women > 90 kg (> 200 lbs)	1.5 inch	Deltoid muscle

[a]Skin stretched tightly and subcutaneous tissues not bunched.
[b]Preferred site.
[c]Option to use 5/8-inch needle, but skin must be stretched tightly and subcutaneous tissues not bunched.
Adapted from Gabler et al[14] and Ezeanolue et al.[8]

patient's vaccine administration at a time.[5] Complete one patient's vaccine preparation, administration, and documentation before starting the next patient. Lastly, a final check of the vaccine product or pre-filled syringe immediately prior to administration is helpful to avoid administering expired product or the incorrect vaccine. To summarize, a final verification on patient name, date of birth, and the vaccine being given all directly before administration are excellent safety precautions to avoid vaccine errors.

Vaccine Administration Adverse Events

Many patients can experience some pain and tenderness for a short while after receiving an intramuscular (IM) vaccine – which is expected – but there are some occurrences of more severe injury as well. Shoulder injury related to vaccine administration (SIRVA) is an adverse effect related to the administration of the vaccine into the shoulder joint too high in the deltoid muscle.[14] For patients, this could result in potentially permanent injury which can alter the ability to perform activities of daily living such as putting on clothes and lifting household objects. A study was published evaluating reports of SIRVA after administration of inactivated influenza vaccines, and it showed that the majority of reported SIRVA cases occurred when receiving the vaccine from a pharmacy, demonstrating the importance of pharmacists needing to follow best practices to prevent this from occurring.[15]

To avoid injuries such as SIRVA, it is imperative to know the correct site where the needle should be inserted into the arm. For most IM injections administered to patients aged 3 years and older, the needle should be inserted into the deltoid muscle in the upper arm (Figure 1). The precise location should be about 2 inches below the acromion process but just above the level of the armpit, and the needle should be inserted at a 90-degree angle. Best practices include both the patient and the immunizer in a seated position to optimize injection into the appropriate site.[16] A more detailed description of how to administer IM injections can be found in Table 3. Needle lengths are chosen based on the age and weight of the patient.[8] Table 4 shows the options for needle sizes that can be used in patients of various ages and weights, and gauge sizes range from 22- to 25-gauge needles. Following these best practices can help avoid shoulder injury, a very preventable error for patients receiving vaccines.

Vaccine Route of Administration

Due to the many types of vaccine formulations available, vaccination errors can be caused by delivering a vaccine via the incorrect route of administration. Morse-Brady and Hart found that vaccine administration errors, which include the incorrect route of administration, made up the third-most prevalent type of error in the systematic review.[6] The live attenuated viral vaccines that can be used per injectable routes are MMR, varicella, zoster, and yellow fever, and the preferred route of administration for each of them is subcutaneous (SQ) injection (Figure 2).[17] The package insert should be checked before administration if the specific vaccine is not frequently given by the pharmacist.

Several vaccine errors with the zoster vaccine preparations were reported shortly after the recombinant vaccine became available. The newer recombinant zoster vaccine (Shingrix®) is given IM, compared to the live attenuated zoster vaccine (Zostavax®) which was delivered SQ. Two studies have been conducted on the adverse events reported on the recombinant zoster vaccine since its licensure in October 2017. According to Shimabukuro et al, after the first four months of the recombinant zoster vaccine being on the market, 155 adverse events were reported with nine of them being the

incorrect route of administration.[18] The second study evaluated the post-marketing safety of the recombinant zoster vaccine and reported that 16.4% of the vaccination errors reported were due to incorrect route of administration.[19] The results from these studies highlight the importance for pharmacists to know the proper administration method for each vaccine.

Vaccine Documentation Errors

Although vaccine documentation errors only constituted 0.01% of errors reported in the Morse-Brady and Hart review, it is likely that more occurred and were not reported.[6] Once a vaccine has been administered to a patient, documentation is the last step. The documentation process allows other providers to view a patient's immunization history and prevents over- and under-vaccination. It is essential that the documentation step occurs promptly at the end of the vaccine administration process to prevent error. The WIR was created for these exact reasons – to track immunizations received and immunizations needed to stay on-schedule for residents of Wisconsin to prevent both over- and under-immunization. Starting in 2000 the WIR was accessible for use. One can find the WIR online (www.dhfswir.org), and it is available at no cost for all providers and patients to access.

Pharmacy-based immunization services are now required by law to use the WIR.[3] Prior to administering a vaccine, the pharmacist should reference the WIR to confirm the intended vaccine is indicated for the patient. If vaccination records are missing, the ISMP suggests following employer policies and procedures, such as contacting current and previous healthcare providers.[12] Next, the ISMP recommends determining who will be responsible for the documentation post-administration and creating a plan to ensure documentation occurs. This plan could include highlighting the sections of the documentation sheet that need to be completed for the specific vaccine being administered, ensuring the information is filled out in its entirety, and uploading documents in a timely manner to the patient's profile and WIR. To ensure no information is omitted, the pharmacist should immediately write down the required information for documentation, such as which arm the patient received the vaccine in and the lot number and expiration date of the vaccine. Once completed, all immunization administration data must be entered in the WIR as soon as practical, but strictly within seven days of administration.[3] Whoever is in charge of ensuring the documentation is completed should verify the information is uploaded for other providers to see. With these simple solutions, the small amount of documentation errors that do occur should hopefully become extinct.

Errors in Vaccine Storage

Vaccines are fragile biologics that require strict adherence to storage requirements.[8] There are many different vaccine storage errors that can happen before the vaccine reaches the patient, and could potentially result in patient harm. Essential aspects to vaccine storage include maintaining recommended storage temperatures, having adequate equipment to store vaccines, and assuring vaccines are not expired or inappropriately prepared.

According to the CDC's Vaccine Storage and Handling Toolkit, one of the first steps to ensuring appropriate vaccine efficacy is maintaining an effective vaccine cold chain.[13] Vaccines must be stored at recommended temperatures; venturing outside these temperature ranges can compromise the integrity of the product and require costly re-vaccination for patients. Vaccines stored in the refrigerator should be kept between 35°F to 46°F (2°C and 8°C), and vaccines stored in a separate freezer unit should be kept at -58°F to 5°F (-50°C to -15°C). The Immunization Action Coalition (IAC) recommends posting their "Vaccine Handling Tips" document on the refrigerator and the freezer, which lists which vaccines to store in the refrigerator versus freezer.[20] This simple act is a great strategy to prevent storing vaccines incorrectly.

In order to maintain the proper temperatures, a pharmacy must have the recommended equipment. As recommended by the CDC and IAC, pharmacies should use purpose-built or pharmaceutical grade units designed specifically for storing vaccines.[13,20] These units should have microprocessor-based temperature control with a digital temperature sensor and fan-forced air circulation that maintain uniform temperature, and can conduct quick temperature recovery if there is any out-of-range temperatures. If a pharmacy stores frozen vaccines, a separate freezer unit should be used instead of using the freezer compartment within a household-type refrigerator. A specific temperature monitoring device called a digital data logger within these units records temperatures throughout the day and records the amount of time a unit is outside of the recommended range. A designated individual should record the current temperature at the beginning and end of the work day. To decrease temperature fluctuations associated with frequent door openings, large water jugs and ice packs can be placed in the door racks and on the top and bottom shelves of the unit. Although these units are reliable, power failures can occur. The water jugs and ice packs

TABLE 5. Protocols and Standing Orders to Have for Vaccine Administration Processes

The full generic name, brand name (if applicable), and current standard abbreviation approved by the Centers for Disease Control and Prevention
Indication and vaccine schedule for routine and catch-up vaccination
Criteria for screening patients for contraindications and precautions
A reminder to provide the most current Vaccine Information Statement to patients or caregivers prior to immunization
Directions for preparing and administering the vaccine, including the dose, vials or containers to use, route of administration, and any special precautions
Details regarding what (e.g., lot number, expiration date), where (e.g., vaccination record, vaccination registries), and how to document vaccine administration and distribution of the Vaccine Information Statement
An emergency protocol to follow if the patient develops an adverse reaction
Information about reporting adverse vaccine events

Adapted from the Institute of Safe Medication Practices.[12]

can help maintain temperature for short periods of time, but each pharmacy should always have a backup storage plan.

Additionally, among vaccine storage errors are improper diluent storage and expired vaccines. Vaccine component omission accounted for 4% of vaccine preventable errors in the 2017 ISMP study, with the majority resulting from administering the diluent to the patient without mixing it with the active vaccine components or administering only one component of a two-component vaccine.[5] One example that frequently causes error is Pentacel®, a DTaP-IPV-Hib vaccine, which is supplied as one vial containing the lyophilized Hib component and one vial containing the DTaP-IPV components. The contents of the liquid DTaP-IPV vial are mixed with the Hib component to make a suspension which is then administered to the child, and error occurs by only administering one of the two components. The ISMP recommends applying labels to both the vaccine and diluent vials, or both components of a two-component vaccine, to differentiate the two and remind the pharmacist they need both vials in order to prepare the vaccine.[12] Another suggestion is to keep vaccine components together in their original packaging or put a rubber band around both vials to remember one is not to be used without the other. Lastly, aside from checking the vaccine and diluent vials when preparing the vaccine, the IAC suggests checking the labels three times before reconstituting the vaccine.[21]

Expired vaccines accounted for 19% of vaccine preventable errors in the 2017 ISMP study, although this statistic may not apply to pharmacies as most pharmacies check for expired products on a monthly basis.[5] Vaccines were found to be expired after they were administered to patients and during documentation. To combat this, the ISMP and CDC both recommend placing the vaccines that are to expire the earliest toward the front of the storage unit and putting the most recent vaccines acquired behind the rest of the stock.[12,13] The CDC suggests weekly checks for vaccines that expire soonest are placed in the front of the stock. If a pharmacy wants to take a step further in preventing expired vaccines from being administered, they can label the vials that are to expire soonest with their month and year of expiration. For example, if a vaccine is to expire in October 2020, the vaccine is safe to use until the last day of October 2020. Labeling the vial "10/20" or "10/31/20" allows the pharmacy to easily organize vaccines by expiration date and avoid administering expired vaccines to patients.

While there are many preventable vaccine errors that can occur when administering a vaccine to a patient, proper vaccine storage is where preventing errors begins. Knowing recommended storage temperatures for each vaccine and properly keeping track of expiration dates are essential for proper vaccine storage.

Conclusion

As evidenced from the studies mentioned, vaccine errors do occur, possibly more frequently than what is documented but serious consequences rarely result from the errors. With community pharmacies being the most accessible location to administer vaccines, pharmacists have the potential to have a big impact on preventing vaccine errors and avoiding patient harm. To prevent vaccination errors, it is crucial that pharmacists participate in frequent re-education of both self and staff, and immunization continuing education is completed to ensure adequate skills are implemented in the pharmacy to limit patient harm. If vaccine errors do occur in the pharmacy, they should always be submitted to ISMP VERP for data to be collected. The IAC provides example protocols and standing orders that can be used during vaccine administration, and these are good references for pharmacists to use within their pharmacy (Table 5). With these protocols and the suggestions offered by the CDC, IAC, and ISMP, pharmacists should be well equipped to combat preventable errors.

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Assessment Questions

1. **True or False:** The most prevalent vaccine preventable error found in the Morse-Brady and Hart study was the wrong vaccine administered.
   a. True
   b. False

2. Which of the following is not a way to separate adult and pediatric vaccines stored in a refrigerator to minimize errors?
   a. Label the vaccine vials with an "A" for adult and "P" for pediatric
   b. Place the vaccines into color-coordinated bins
   c. Place the vaccines on different shelves in the refrigerator or freezer
   d. All pediatric vaccines should be stored in the freezer and adult vaccines should be stored in the refrigerator

3. Which of the following was the prevalence of expired or contaminated vaccines given to patients reported in 2017 to the ISMP VERP?
   a. 23%
   b. 19%
   c. 82%
   d. 4%

4. Which of the following is not an important item to check to ensure a vaccine is indicated for a patient?
   a. The patient's electronic medical record, if accessible
   b. The WIR
   c. The patient's medical history or screening questionnaire to evaluate the possibility for contraindications to vaccines
   d. Assess the patient's family history for vaccine intolerances

5. Which of the following is the appropriate temperature for vaccine storage in a refrigerator?
   a. 35 - 46°F
   b. 55 - 66°F
   c. 2 - 8°F
   d. -15 - 5°F

6. Which of the following is not a suggested strategy for ensuring the correct vaccine is given to the correct person?
   a. Complete one patient's vaccine preparation, administration, and documentation before starting another patient
   b. Verify patient name, date of birth, and the vaccine to be given immediately prior to administration
   c. Complete all patients' paperwork and preparation first, then administer all patients their respective vaccines, then document everything afterward
   d. Verify which vaccine the patient should receive with the immunization registry

7. **True or False:** Shoulder injury related to vaccine administration (SIRVA) is when a patient gets tenderness at the administration site for a few hours to days after receiving the vaccine.
   a. True
   b. False

8. Which of the following vaccines is administered by the IM route?
   a. Shingrix®
   b. Zostavax®
   c. Measles, mumps, rubella
   d. Varicella

9. Which of the following describes the appropriate site for IM administration of a vaccine?
   a. An inch below the acromion process
   b. Higher in the deltoid to avoid hitting the bone
   c. In the fatty tissue over the triceps
   d. In the thick part of the deltoid just above the level of the armpit

10. Which of the following is an action that is recommended to prevent vaccine errors?
   a. Limit hours for vaccine administration
   b. Detailed and up-to-date policies and procedures
   c. Store frozen vaccines in the freezer compartment of a household-type refrigerator
   d. Avoid consulting in the vaccine registry

11. Did the activity meet the stated learning objectives? (if you answer no, please email sarahs@pswi.org to explain)
   a. Yes
   b. No

12. On a scale of 1 – 10 (1-no impact; 10-strong impact), please rate how this program will impact the medication therapy management outcomes or safety of your patients.

13. On a scale of 1 – 10 (1-did not enhance; 10-greatly enhanced), please rate how this program enhanced your competence in the clinical areas covered.

14. On a scale of 1 – 10 (1-did not help; 10-great help), please rate how this program helped to build your management and leadership skills.

15. How useful was the educational material?
   a. Very useful
   b. Somewhat useful
   c. Not useful

16. How effective were the learning methods used for this activity?
   a. Very effective
   b. Somewhat effective
   c. Not effective

17. Learning assessment questions were appropriate.
   a. Yes
   b. No

18. Were the authors free from bias?
   a. Yes
   b. No

19. If you answered "no" to question 18, please comment (email info@pswi.org).

20. Please indicate the amount of time it took you to read the article and complete the assessment questions.

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September/October 2020
Vaccine Preventable Errors: Current Prevalence and Solutions to Minimize Future Errors

ACPE Universal Activity Number: 0175-0000-20-137-H06-P

Target Audience: Pharmacists & Technicians
Activity Type: Knowledge-based
Release Date: September 1, 2020
(No longer valid for CE credit after September 1, 2023)

Quiz Answer Form

circle one answer per question

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2) a b c d
3) a b c d
4) a b c d
5) a b c d
6) a b c d
7) a b
8) a b c d
9) a b c d
10) a b c d
11) a b
12)_____
13)_____
14)_____
15) a b c
16) a b c
17) a b
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