continuing education for pharmacists

Volume XXXV, No. 6

Recognizing and Preventing Vaccine Errors

Donald L. Bennett, R.Ph., MBA, Clinical Assistant Professor, The Ohio State University, College of Pharmacy

Professor Donald Bennett has no relevant financial relationships to disclose.

Goal. The goal of this lesson is to provide information on identification of vaccine errors, including "errors of omission," and strategies to prevent them.

Objectives. At the completion of this activity, the participant will be able to:

1. demonstrate an understanding of the process to submit errors to the Institute for Safe Medication Practices (ISMP) National Vaccine Errors Reporting Program (VERP);
2. list types of vaccine errors reported and commonly associated with vaccines;
3. recognize strategies to minimize vaccine-related errors;
4. identify workplace policy and procedures and strategies that can help minimize the risk of errors; and
5. list missed opportunities related to potential vaccine-related errors.

Background

According to the World Health Organization (WHO), immunizations prevent between two and three million deaths per year. Despite this success, many children and adults in the U.S. remain vulnerable to the 24 vaccine-preventable diseases that are targeted by 45 different single and combination vaccines available today. Failure to vaccinate due to lack of information or misinformation is the primary reason for the existence of susceptible populations in the U.S. However, errors with vaccines can result in unintended and unrecognized sources of vulnerability. While the immediate impact of a vaccine-related error may not be serious for the patient, an error may leave the patient unprotected or under-protected against a potentially serious vaccine-preventable disease.

Vaccine Error Reporting Programs

In an attempt to gather details needed to understand vaccine errors and their contributing causes, the Institute for Safe Medication Practices (ISMP) collaborated with the California Department of Public Health Immunization Branch in September 2012 to develop the National Vaccine Errors Reporting Program (VERP). The reporting process attempts to collect key information including details of what went wrong, what were any causes or contributing factors, how the error was identified, and the patient outcome. The website for reporting is http://verp.ismp.org/. ISMP is also interested in collecting reports for situations where an error was caught before it reached the patient, in addition to hazardous conditions that could contribute to a potential error, e.g., similar or confusing labeling.

The intent of VERP is to share information on improving processes and to educate key stakeholders, primarily healthcare practitioners and manufacturers.

ISMP regularly forwards all reports received by VERP to the Vaccine Adverse Event Reporting System (VAERS) used by the Centers for Disease Control and Prevention (CDC) and the U.S. Food and Drug Administration (FDA) (http://vaers.hhs.gov). The VAERS program was created in 1990 in response to the National Childhood Vaccine Injury Act. The primary intent of the VAERS program is a post-marketing surveillance system designed to collect and analyze adverse events associated with vaccines. The VAERS program does receive a small number of vaccine error reports that have not been reported to the ISMP VERP program.

If a vaccine-related error does occur, it should be reported to VERP or VAERS. It is not necessary to submit the error to both systems. Both programs have easy-to-use online submission forms that can be accessed at http://verp.ismp.org/, or http://vaers.hhs.gov. The VAERS program also collects vaccine adverse event reports that are unrelated to a vaccine error. Healthcare professionals, manufacturers, or any member of the general public may submit a report to either program.

When completing the online form, it is very important to provide as much information as possible related to the error. This will permit these medication error experts to evaluate the error and

identify contributing factors. Note that because VERP is a quality assurance tool, the report template specifically highlights in the description of events: PLEASE DO NOT SUBMIT ANY PROVIDER OR PATIENT IDENTIFIABLE INFORMATION. By analyzing vaccine errors, system-wide solutions can be developed to improve the safety and appropriate use of vaccinations by developing strategies to prevent errors.

FDA also has a MedWatch program that was established in 1993 to collect reports of unexpected side effects, adverse events or other problems associated with the products they regulate. This includes drugs, biologics, medical devices, dietary supplements, infant formulas, and cosmetics. However, healthcare professionals and the public are encouraged to report vaccine-related errors to either the VERP or VAERS programs.

Under-Reporting Issues

Because the VERP and VAERS reporting programs rely on voluntary reporting of vaccine errors, the total number of reported errors is probably only a fraction of the total errors that occur. Contributing factors for under-reporting may be due to:

1. lack of knowledge of the existence of VERP and VAERS programs, or lack of understanding on how to report;
2. lack of awareness that a vaccine-related error actually occurred;
3. "minor" errors may have occurred and were corrected and deemed not worthy of reporting; or
4. a conscious decision not to report an error because of a misconception that the reporting will lead to some punitive action.

Types of Errors Reported

In July 2016, ISMP provided a summary of errors reported to VERP from September 2012 through June 30, 2016. During this time frame, a total of 1,754 reports were submitted. Not surprisingly, because of the need for annual vaccination, influenza vaccine represented 20 percent of all reported cases.

Errors reported with highest frequency were:

1. wrong vaccine (23 percent of all case reports);
2. wrong age for vaccination (20 percent);
3. wrong vaccine dose (12 percent);
4. extra vaccine dose (9 percent); and
5. wrong vaccine timing interval (7 percent).

Influenza Vaccines Errors

In addition to being the most frequently administered vaccine, influenza vaccine is associated with the most errors. This is attributable to the many manufacturers with various formulations, and specific product labeling that defines the age-range for each product. This is especially confusing because there are not separate adult and pediatric formulations.

These factors, coupled with the recommendations that essentially everyone six months of age and older receive the influenza virus vaccine annually, it is not surprising that the influenza vaccine was the most common type of vaccine implicated in age-related errors according to the ISMP three-year summary.

Why Errors Occur. Many errors appeared to involve knowledge deficits regarding the individual product recommendations, e.g., giving the high-dose formulation (Fluzone® High-Dose) to an individual younger than 65 years of age or administering the live, intranasal formulation to a child younger than two years or an adult older than 49 years.

The ISMP summary also included comments that manufacturer labeling and packaging issues, and the FDA requirements to list the generic name before the brand name contributed to many age-related errors.

Other potential errors associated with influenza vaccines include administering the live, attenuated influenza vaccine (LAIV) FluMist® intranasal product to pregnant females. From 2000 to 2013, the CDC VAERS program received 120 reports involving pregnant women receiving a contraindicated vaccine. Of the 120 reports, 111 (93 percent) involved live, attenuated influenza vaccine. Although clear cause and effect relationships were not established for each case, six cases of spontaneous abortions and one case of vaginal bleeding were reported.

Errors have also been reported with live, attenuated influenza intranasal product being inappropriately administered to individuals with asthma or other chronic respiratory conditions. [*Note that the Advisory Committee on Immunization Practices (ACIP) recommended that the LAIV intranasal product not be administered for the 2016-2017 influenza season because of poor effectiveness during the three previous seasons*].

Other reported errors involving live vaccines have included administration to individuals with immunodeficiency conditions — either underlying disease conditions or medication-induced.

Age-Related Vaccine Errors

In addition to the age-related errors that occur with influenza vaccines, age-related errors have been reported with hepatitis A and hepatitis B vaccines. Two brands of hepatitis A vaccine are available in pediatric/adolescent (0.5 mL) and adult (1 mL) doses. Errors have occurred with the adult formulation (1 mL) being given to pediatric/adolescent patients and vice versa.

ISMP reports that product labeling contributes to some of these errors. Both the HAVRIX® (GlaxoSmithKline) and Vaqta® (Merck) products use color-coding labeling on prefilled syringes and vials in an attempt to differentiate the age-related formulations. ISMP reports also reflect that the primary label color and text on Merck product cartons are similar, and the text font on the individual syringes and vials is small. The age notations on

the GlaxoSmithKline vials are easy to miss, and the medication name on the syringe is no longer visible when the syringe is rotated to view the dose, whether it is an adult or pediatric/adolescent dose.

Similar labeling issues have led to errors with the hepatitis B vaccine. Two vaccine products, Engerix-B® (GlaxoSmithKline) and Recombivax HB® (Merck), are also available in pediatric/adolescent and adult doses. ISMP reports that label notations for the age-based formulations are not prominent and color-coding has not prevented errors. One of the most frequently reported errors with hepatitis B vaccines involved giving a child an adult dose and giving an adult a child's dose.

Tetanus, diphtheria, and pertussis combination vaccine products are also associated with age-related errors. There are many different vaccines and various combinations of vaccines in this category targeted at different age groups. In the ISMP summary published in July 2016, 60 reported errors involved DTaP (diphtheria and tetanus toxoids, acellular pertussis) being given instead of Tdap (tetanus toxoid, reduced diphtheria toxoid, acellular pertussis), or vice versa. The DTaP product (Daptacel®, Infanrix®) is indicated for children two months of age up to seven years. The adult Tdap products (Adacel®, Boostrix®) actually contain smaller quantities of diphtheria toxoid and acellular pertussis than the pediatric formulations. Adding to the potential for age-related confusion is that the Tdap product Adacel® is approved for use in persons 10 years of age through 64 years. The Boostrix product is approved for ages 10 and older. The DTaP vaccines are also available in many different combination products with inactivated polio vaccine (IPV), hepatitis B vaccine (HBV), and/or *Haemophilus influenzae* type b (Hib). Examples of combinations include DTaP-IPV; DTaP-HepB-IPV; and DTaP-IPV-Hib. These various combination products were formulated to decrease the total number of injections that infants and pediatric patients receive. Vaccination schedules are complex with varying age group indications and specific sequential timing requirements. The potential for errors is further complicated when children are following an alternative or delayed schedule for immunizations. See Table 1 for a more extensive list of combination vaccines.

Strategies to Minimize Vaccine-Related Errors

Age. Prior to prescribing, dispensing, or administering a vaccine, the age of the patient should be verified by asking the patient (or parent/guardian) for the birth date and then cross reference it against the patient's medication profile, immunization record or health record. Any discrepancies should be clarified. The appropriate immunization schedule and the most recent Vaccine Information Statement (VIS) should be used to confirm the appropriate ages for each vaccine. It is important to have the most up-to-date immunization schedules readily available for use. The most current immunization schedules for children, adolescents, and adults can be found on the CDC website (www.cdc.gov). The most current VIS can be found on the CDC website and the Immunization Action Coalition website (www.immunize.org). Vaccine Information Statements are available in over 40 languages. The patient or parent/guardian can read the VIS and help verify the appropriate vaccine prior to administration. It is helpful if the provider underlines or highlights the appropriate age range on the VIS.

If available, purchasing different age-specific formulations of the same vaccine from different manufacturers will help distinguish inventory. Point-of-care barcode scanning is also useful to verify the correct age-specific vaccine for the patient prior to administration. It may be possible to build alerts into the medication order entry system as a warning if the vaccine selected is outside the recommended age parameters.

Table 1
Selected combination vaccine products*

- Comvax (Merck) = Hep B + Hib
- DTaP = Infanrix (GSK) & Daptacel (Sanofi Pasteur)
- Tdap = Adacel (Sanofi Pasteur) & Boostrix (GSK)
- Td (various)
- DTaP + IPV = Kinrix (GSK) & Quadracel (Sanofi Pasteur)
- Pentacel (Sanofi Pasteur) = DTaP + Hib + IPV
- Pediarix (GSK) = DTaP + Hep B + IPV
- Twinrix (GSK) = Hep A + Hep B
- ProQuad (Merck) = MMR + Varicella
- MenHibrix (GSK) = MenCY + Hib

**Consult package inserts for age indication and dose sequences.*

Multiple Dose Vaccines. Many vaccines require multiple doses to produce optimal protection. Examples include hepatitis A, hepatitis B, and human papillomavirus (HPV) vaccines. In general, extending the time interval between doses beyond the recommended time frame does not decrease the effectiveness; however, it does lengthen the time that the patient is not completely protected. Doses given sooner than the scheduled time may increase the incidence and or severity of adverse reactions, or may decrease the overall effectiveness of the vaccine regimen. Setting up a schedule with the patient at the time of each vaccine administration for the subsequent vaccine dose and/or instituting a call-back reminder system will help avoid missing doses.

Routes of Administration. Some errors have been reported related to wrong routes of administration. One example is administering the herpes zoster vaccine (Zostavax®) intramuscularly instead of subcutaneously. It may be helpful to label the outside storage bin in the freezer with an auxiliary label that emphasizes the *subcutaneous*

Table 2
Weight criteria for needle length selection

Male Weight	Female Weight	Needle Length
Less than 60 kg (130 lbs)	Less than 60 kg (130 lbs)	5/8 – 1-inch
60-70 kg (130 – 152 lbs)	60-70 kg (130 – 152 lbs)	1-inch
70-118 kg (153 – 260 lbs)	70-90 kg (153 – 200 lbs)	1 – 1.5-inches
118 kg+ (260 lbs+)	90 kg+ (200 lbs+)	1.5-inches

Adapted from The Pink Book, 13th edition

route.

Rotavirus vaccine is administered to infants to prevent rotavirus gastroenteritis and potentially life-threatening diarrhea. This is an oral vaccine that has been inadvertently administered via the intramuscular route, risking introduction of a systemic infection and rendering the vaccine ineffective for its intended use. Two companies manufacture live oral vaccines. Merck manufactures RotaTeq® and GlaxoSmithKline manufactures Rotarix®. The RotaTeq® product is packaged as a squeeze applicator; the Rotarix® product is packaged as a prefilled oral syringe. It has been reported that some healthcare practitioners have withdrawn the oral solution into a parenteral syringe and administered it intramuscularly. Again, a separate bin in the vaccine refrigerator clearly marked *Oral Vaccines Only* may prevent this type of error.

Injection Technique. The preferred site for intramuscular injection of vaccines to patients three years of age and older is the deltoid muscle in the upper arm. Poor injection technique with administration too high on the deltoid muscle has resulted in temporary, and sometimes permanent, damage to the shoulder joint. Injection into the acromion or subacromial bursa can result in severe pain and loss of range of motion. Additionally, vaccines administered outside of the deltoid muscle may result in diminished vaccine effectiveness. Poor injection technique can result in the patient losing confidence in the provider and never returning for subsequent vaccines.

To minimize the risk of shoulder injuries during vaccine administration, the patient and the vaccinator should be at the same level — preferably both sitting. The vaccine should be injected into the thickest central part of the deltoid muscle avoiding the upper one-third of the muscle. Another technique that is acceptable with small pediatric patients or frail geriatric patients is to grasp the tissue surrounding the deltoid muscle and "bunch up" the muscle. The needle should be inserted fully into the muscle at a 90-degree angle.

Although selecting the proper site in the deltoid muscle is more important, appropriate needle selection is also critical in administering an effective vaccine. For optimal immune response to occur, the needle should be long enough to reach the desired tissue, but not so long as to involve underlying nerves, blood vessels, or bone. Using a needle that is longer than needed or using a larger gauge needle than necessary can cause tissue damage resulting in pain and or swelling, separate from the vaccine itself.

Typically vaccines are not highly viscous, so a fine gauge needle (22-25 gauge) is preferred. The length of the needle selected should be based on the route of administration (usually intramuscular or subcutaneous) and the size of the individual. See Table 2.

For children and adolescents ages three through 18, the deltoid is the preferred intramuscular site. The needle size for deltoid injections for this age group is usually 5/8-inch to 1-inch. In general, older children require a 1-inch needle. One study found that obese adolescents may need a 1.5-inch in order to reach the muscle tissue.

Vaccine Storage. Most vaccines must be stored under refrigeration or frozen. Failure to store and handle vaccines properly can reduce vaccine potency, leading to no or diminished immune responses. This results in patients having poor or no protection against disease.

If the storage error goes undetected, the patient is unaware that he/she is not covered adequately against the disease. If the storage error is discovered, all vaccine inventory stored improperly will need to be replaced, which will incur financial loss to the organization. In addition, these patients will need to be revaccinated, resulting in additional financial loss (product and time) and patients' loss of confidence in vaccines and providers.

From 2000 to 2013, the CDC VAERS program received 4,983 "storage errors" reports. Approximately 55 percent of the cases involved the administration of an expired vaccine. Approximately 44 percent of the cases involved vaccines stored outside of proper temperatures, and/or refrigerators or freezers not maintaining the proper temperature.

Using vaccine manufacturer product information and best practices from scientific studies, the Advisory Committee on Immunization Practices developed a very useful resource, the *Vaccine Storage and Handling Toolkit* (www.cdc.gov/vaccines/hcp/admin/storage/toolkit/storage-handling-toolkit.pdf). Updated in June 2016, this CDC toolkit provides information and resources to assist with the proper storage and handling of vaccine supplies, including:

- vaccine procurement, inventory management, transport, and preparation;
- storage and temperature monitoring equipment and setup;
- vaccine temperature and storage equipment monitoring;
- vaccine organization and storage including examples of auxiliary labels;
- emergency storage, handling,

and transport;

• vaccine storage and handling standard operating procedure development.

Safe Vaccine Practices to Incorporate into Operations

• Purchase refrigeration and freezer storage units that are large enough to store, organize and label stock.

• If possible, store vaccines in their own dedicated refrigeration and freezer units.

• CDC recommends the use of a continuous monitoring and recording digital data logger (DDL) with a current and valid *Certificate of Calibration Testing* (also known as a *Report of Calibration*), set at a minimum recording interval of at least every 30 minutes. CDC's *Vaccine Storage and Handling Toolkit* has numerous recommendations for monitoring equipment.

• Use stand-alone units, meaning units that either freeze or refrigerate. Stand-alone units maintain the required temperatures better. Research has found that freezers in household combination units cannot hold required temperatures for frozen vaccines, especially during the defrost cycle.

• Store water bottles in the refrigerator and frozen water bottles in the freezer to stabilize temperatures and to help maintain temperatures longer during power outages.

• Do not store food items with biologics. Frequent opening and closing of the doors can create temperature variances, especially in smaller units.

• Train staff to recognize vaccine deliveries from manufacturers or distributors, and promptly unpack, check in, and place them in the proper storage unit.

• Be aware that some vaccines come with separate diluents that must be stored under different conditions, e.g., the vaccine component may be a lyophilized powder that must be frozen, but the diluent should be stored at room temperature.

• Be sure that there is clear labeling as to where the product-specific diluent is located and that it must be used with that specific vaccine.

• Always use the manufacturer-provided diluent and not a standard diluent such as 0.9 percent sodium chloride. Errors have been reported when the diluent only was administered. Some diluent vial product labeling emphasizes the active vaccine name, thus contributing to the potential to administer the diluent alone.

Proper storage bin labeling is also important. See Figure 1 for a sample label for a freezer storage bin.

• Be alert to the two-component vaccine products where there are active vaccine components in each of two vials. Examples are Pentacel® where vial #1 contains a lyophilized powder of ActHIB and vial #2 is a liquid containing DTaP and IPV. The contents of the two vials must be combined to deliver the full vaccine dose. Another example is Menveo®, a quadrivalent meningococcal vaccine. In this case, vial #1 contains the meningococcal A component as a lyophilized powder and vial #2 is a liquid containing the components C, Y, and W-135. In both cases, each vial must be refrigerated. A strategy to keep the vials together and avoid the administration of only part of total vaccine dose is to use a rubber band to keep the vials together or place them in a sealed bag together, and affix a label to remind staff to administer both vials.

• Check all vaccine expiration dates on a regular basis. Vaccine expiration dates should be checked upon receipt from the manufacturer and immediately prior to preparation and administration.

• Rotate vaccine products based upon expiration dates.

• Remove expired vaccines from regular storage areas, clearly label them as expired, and sequester them well away from any in-date vaccines or other medications.

• Do not store vaccines with look-alike/sound-alike names, labels, abbreviations, or overlapping components (e.g., DTaP, Tdap, DT, Td) immediately next to each other.

Figure 1
Sample label for freezer storage bin

HZV (Zostavax)
Recommended ages: 60 years and older (May use for 50 years and older)
Use for: Single dose
Route: Subcutaneous injection.
Reconstitute HZV powder ONLY with manufacturer-supplied sterile water diluent.
Beyond Use Time: Discard reconstituted vaccine if not used within 30 minutes.

• Separate adult formulations from the pediatric vaccines and store in well-labeled storage bins.

• Consider removing vials from their outer cartons (unless it provides the only protection from light) to avoid the risk of misplacing a vial back into the wrong carton. Selecting the vial from the carton without reading the vial label could lead to an error.

System and Procedure Problems. In many practices, one pharmacist may be the only person to determine the need for a vaccine, obtain and prepare the dose, and administer the dose without another check in the process. If at all possible, have another pharmacist or a pharmacy intern/technician check that the appropriate age-specific vaccine was selected. If the vaccine is drawn into a syringe, keep the vial and syringe together throughout the administration and documentation processes. If the syringe must be separated from the vial, the syringe should be properly labeled. Patients or parents/guardians/caregivers can participate in the verification process immediately prior to vaccine administration. As mentioned earlier, the patient can read the VIS and verify that he/she is within the specific ages for the intended vaccine by comparing the name of the vaccine on the VIS with the label on the vaccine vial or syringe. The "Some people

should not get this vaccine" section of the VIS should be reviewed. Immunization records and/or vaccine logs in which the vaccine name, dose, lot number, and expiration date have been recorded immediately before vaccination can also be verified by the patient or parent as the information on the vaccine label is read aloud.

Numerous studies have identified that distractions and interruptions contribute to medication errors in general. Having processes and procedures designed to minimize distractions and interruptions in place and having all staff follow the procedures can reduce errors. If the vaccinator is interrupted during the process, the vaccination process should be restarted to minimize the risk of an error.

Errors of Omission

A final area of potential vaccine-related errors is not tracked by either the ISMP VERP or the CDC VAERS – the missed opportunities to evaluate the need for and to recommend needed vaccines. These can also be refered to as "errors of omission." The National Vaccine Advisory Committee's (NVAC) recommendation is that every healthcare provider, in all settings, has a fundamental responsibility in ensuring that all patients are up-to-date with respect to recommended immunizations. The purpose of the NVAC standards for adult immunization practice is to provide guidance to healthcare providers across the spectrum of healthcare. Their standards, outlined below, address the role of all providers to conduct routine assessments of vaccination needs for their patients, recommend needed vaccines, and either administer needed vaccines or, for providers who currently do not stock all recommended vaccines, refer patients to providers and sites where they can receive recommended vaccines. These standards are intended for all, both those who do and do not provide immunization services.

Part of routine clinical care for all providers should include an assessment of their patients' immunization status and a recommendation to the patient and/or their caregiver for needed vaccines. This can be accomplished using the following practices:

1. ASSESS immunization status of all patients at every encounter. Using the latest CDC recommendations, emphasize the importance of the needed immunizations. There are a number of tools available to assist with the assessments. *What Vaccines Do You Need*, an interactive web-based tool on the CDC website, is designed for the patient to answer a series of 10 questions about age, gender, chronic disease conditions, and lifestyles. After submitting the information, a list of recommended vaccines appears. Then each vaccine recommendation can be evaluated to determine if it has already been received, if a booster is recommended, or if there is a new vaccine need.

2. Strongly RECOMMEND vaccines that patients need.

a. Share tailored reasons why vaccination is right for the patient.

b. Highlight positive experiences with vaccinations.

c. Address patient questions and concerns. Use the *Vaccine Information Statement* for the specific vaccine(s) to assist, and/or the CDC *Screening Checklist for Contraindications to Vaccines for Adults*.

d. Remind patients that vaccines protect them and their loved ones against a number of common and serious diseases.

e. Explain the potential costs of getting sick.

3. ADMINISTER needed vaccines or REFER patients to a vaccination provider.

a. Offer vaccines stocked in the facility. Vaccine uptake is much higher among patients when the vaccine is recommended and offered at the same visit. For vaccines that require multiple administrations for complete protection, e.g., HPV, hepatitis A and hepatitis B, have a reminder system for subsequent doses in place. It is useful to give patients something in writing about when to return for the next dose. To supplement this, have a telephone, text, or email reminder system in place as well.

b. Refer patients to nearby providers who offer vaccines not stocked by your facility.

4. DOCUMENT vaccines received.

a. In addition to documenting in patient records, participate in the state's immunization information registry. This helps other healthcare providers identify the current vaccination status of patients.

b. When a patient is referred to another immunization provider, follow up with the patient to confirm that he/she has received the recommended vaccines.

Summary

It is imperative that each person involved in determining what vaccines a patient needs and/or administrating vaccines maintains a current knowledge base. The most current vaccination schedules are available from CDC (www.cdc.gov), along with directions on how to load a free app onto your mobile device.

Annually, there are changes to the ACIP-recommended vaccine schedules, age-range for existing vaccines, need for booster doses, or new vaccine formulations. Methods that can be used to stay current include professional meetings, webinars, written continuing education programs, and automatic updates from organizations such as the Immunization Action Coalition (IAC) at www.immunize.org or the APhA Academy of Pharmacy Practice and Management (APhA-APPM) Immunizing Pharmacists Special Interest Group (SIG).

Ensure that pharmacists, pharmacy interns, pharmacy technicians, and other pharmacy employees are current with their own vaccinations consistent with ACIP recommendations. All of these individuals need to serve as positive examples for improved immunization rates and serve as vaccine advocates. Many profes-

sional associations have guidelines that address healthcare workers' vaccination status. The American Pharmacists Association (APhA) recommends that all members be up-to-date on their immunizations as part of a professional standard. The American Medical Association (AMA) policy supports vaccination of all healthcare providers to prevent communicable disease transmission to their patients. The Infectious Diseases Society of America (IDSA) recommends that all healthcare workers be fully immunized according to ACIP recommendations.

Analyzing vaccine errors is an important component of vaccine safety research and surveillance that contributes to understanding risk factors and the development of vaccine error risk prevention strategies. It is important for the general public to have confidence in the safety and effectiveness of vaccines. Vaccine errors, including "near misses," should be reported to VERP or VAERS.

Patients trust their pharmacists to give them the best advice on how to protect their health. Vaccine-preventable diseases can result in serious illness, hospitalization, and even death. Pharmacists should make vaccinations a standard of care in their professional practice.

References

1. ISMP: Recommendations for practitioners and manufacturers to address system-based causes of vaccine errors, March 13, 2014.

2. ISMP: Recommendations for practitioners to prevent vaccine errors Part 2: Analysis of ISMP Vaccine Errors Reporting Program (VERP), March 26, 2015.

3. ISMP: National Vaccine Errors Reporting Program; One in three vaccine errors associated with age-related factors, July 28, 2016.

4. Vaccine administration: Preventing serious shoulder injuries, S. Foster and M. Davis, *Journal of the American Pharmacists Association* 53:2, March/April 2013.

5. Vaccination Errors Reported to the Vaccine Adverse Event Reporting System (VAERS), 2000-2013, NetConference, May 20, 2015, Centers for Disease Control and Prevention (CDC).

6. Centers for Disease Control and Prevention. Epidemiology and Prevention of Vaccine-Preventable Diseases, Hamborsky J, Kroger A, Wolfe S, eds, *The Pink Book,* 13th ed.

7. Recommendations from the National Vaccine Advisory Committee: Standards for Adult Immunization Practice, September 10, 2013.

• • • • • • • • • • • • • • • • • •

This lesson is a knowledge-based CPE activity and is targeted to pharmacists in all practice settings. Disclosure: The OPF trustees and other individuals responsible for planning OPF continuing pharmacy education activities have no relevant financial relationships to disclose.

Program 0129-0000-17-006-H05-P
Release date: 6-15-17
Expiration date: 6-15-20
CPE Hours: 1.5 (0.15 CEU)

The Ohio Pharmacists Foundation Inc. is accredited by the Accreditation Council for Pharmacy Education as a provider of continuing pharmacy education.

continuing education quiz

Recognizing and Preventing Vaccine Errors

1. Which of the following is the primary intent of VAERS?
   a. To collect information on errors that were caught before reaching the patient
   b. To identify specific providers who have been involved with a vaccine-related error
   c. To collect and analyze adverse events associated with vaccines

2. All of the following are contributing factors to under-reporting of vaccine errors EXCEPT:
   a. reluctance to identify the provider.
   b. lack of awareness of error.
   c. when a "minor" error was corrected.

3. In ISMP's July 2016 summary report, errors reported with highest frequency involved the:
   a. wrong dose.
   b. wrong age.
   c. wrong timing interval.
   d. wrong vaccine.

4. Most vaccine errors are related to influenza vaccine because of all of the following reasons EXCEPT:
   a. many manufacturers produce the vaccine.
   b. it is the most frequently administered vaccine.
   c. various formulations of the vaccine are available.
   d. there are separate adult and pediatric formulations.

5. Which of the following statements is true?
   a. The adult Tdap products are approved for use in persons 18 to 64 years old.
   b. The pediatric formulation of DTaP contains higher concentrations of diphtheria and pertussis than the adult formulation.
   c. DTaP should never be administered with inactivated polio vaccine.

6. The most current VIS can be found on the website of:
   a. CDC.
   b. FDA.
   c. IDSA.
   d. ISMP.

7. Strategies to minimize age-related vaccine errors include all of the following EXCEPT:
   a. use point-of-care barcode scanning.
   b. purchase age-specific vaccines from the same manufacturer.
   c. verify appropriate age for the vaccine from the VIS.

Completely fill in the lettered box corresponding to your answer.

1. [a] [b] [c]	6. [a] [b] [c] [d]	11. [a] [b] [c]
2. [a] [b] [c]	7. [a] [b] [c]	12. [a] [b] [c] [d]
3. [a] [b] [c] [d]	8. [a] [b] [c] [d]	13. [a] [b] [c] [d]
4. [a] [b] [c] [d]	9. [a] [b] [c]	14. [a] [b]
5. [a] [b] [c]	10. [a] [b]	15. [a] [b] [c] [d]

❑ **I am enclosing $5 for this quiz made payable to: Ohio Pharmacists Association.**

1. Rate this lesson: (Excellent) 5 4 3 2 1 (Poor)
2. Did it meet each of its objectives? ❑ yes ❑ no
   If no, list any unmet_____
3. Was the content balanced and without commercial bias?
   ❑ yes ❑ no If no, why?_____
4. Did the program meet your educational/practice needs?
   ❑ yes ❑ no
5. How long did it take you to read this lesson and complete the quiz? _____
6. Comments/future topics welcome.

Please print.

Program 0129-0000-17-006-H05-P
0.15 CEU

Name_____

Address_____

City, State, Zip_____

Email_____

NABP e-Profile ID_____Birthdate_____ (MMDD)

Return quiz and payment (check or money order) to Correspondence Course, OPA, 2674 Federated Blvd, Columbus, OH 43235-4990

8. All of the following are true in regard to multiple dose vaccines EXCEPT:
   a. hepatitis B vaccine requires multiple doses.
   b. extending the interval between doses beyond the recommended time frame does not decrease vaccine effectiveness.
   c. doses given sooner than recommended may increase incidence or severity of adverse events.
   d. doses given sooner than recommended may increase overall effectiveness of the vaccine.

9. All of the following are true concerning proper intramuscular injection technique EXCEPT:
   a. the deltoid muscle should never be "bunched."
   b. it is preferable for the vaccinator and patient to both be sitting during vaccine administration.
   c. the preferred needle length for a male weighing 60 to 70 kg is 1-inch.

10. The highest percentage of storage errors reported involved:
   a. freezers not holding proper temperature.
   b. expired vaccine.

11. All of the following are true in regard to safe vaccine practices EXCEPT:
   a. use dedicated stand-alone units for storing vaccines.
   b. rotate vaccine products based on expiration dates.
   c. never store frozen water bottles in the freezer with vaccines.

12. All of the following ensure safe system and procedures for vaccine administration EXCEPT:
   a. keep the vial and syringe together throughout vaccine administration and documentation.
   b. one pharmacist should be responsible for preparing and administering the vaccine dose.
   c. use the patient to help verify correct age.
   d. minimize distractions and interruptions.

13. Which of the following vaccine errors are not tracked by ISMP VERP or CDC VAERS?
   a. Age
   b. Dose
   c. Missed opportunities
   d. Time interval

14. The purpose of the National Vaccine Advisory Committee standards is to provide guidance to healthcare providers.
   a. True
   b. False

15. All of the following groups recommend and support immunizations for all healthcare professionals EXCEPT:
   a. IDSA
   b. FDA
   c. AMA
   d. APhA

To receive CPE credit, your quiz must be received no later than June 15, 2020. A passing grade of 80% must be attained. CPE credit for successfully completed quizzes will be uploaded to the CPE Monitor. CPE statements of credit can be printed from the CPE Monitor website. Send inquiries to opa@ohiopharmacists.org.