By M. Kathleen Murphy, DNP, RN

Emergency Anaphylaxis at School

Nurses in the Milwaukee Public Schools implement a lifesaving response protocol.

As the number of children with food allergies in the United States increases, so does the risk of emergency anaphylaxis on school campuses. School nurses often have treatment plans in place for students with diagnosed allergies, but many children will experience their first reactions at school, where a specific medication may be unavailable and a response protocol not already in place.

As the health services director for the Milwaukee Public Schools, the largest school district in Wisconsin, I witnessed nurses caring for children who had symptoms of anaphylaxis but no allergy diagnosis and for children with diagnoses whose parents or guardians hadn't supplied emergency epinephrine to the school. Because it was clear these school nurses needed better preparation to provide a critical first response to anaphylaxis, I helped to develop and initiate an emergency anaphylaxis response protocol that ensured nurses had access to stock epinephrine autoinjectors.

The development of a protocol like this is a complex administrative process for school districts, and the experience of the Milwaukee Public Schools in negotiating this process can serve as a model for others. Moreover, this protocol can also potentially be adapted for use by nonmedical personnel and applied in other settings in which children may experience anaphylaxis, such as child care and recreational facilities.

School nurse Diane Voelker returns an EpiPen to its convenient place on the wall of her office at Stone Bridge High School in Ashburn, Virginia. Photo by Karen Kasmauski / New York Times.

FOOD ALLERGIES AND ANAPHYLAXIS

In the school-age population, food is the primary source of allergic reactions and anaphylaxis.[1] Eight foods account for 90% of all allergic reactions: milk, eggs, peanuts, tree nuts (such as walnuts and cashews), fish, shellfish, soy, and wheat.[2]

According to Branum and Lukacs, the prevalence of food allergy in children (less than 18 years) in the United States increased by 18% between 1997 and 2007.[3] In 2011, Gupta and colleagues reported that approximately 8% of all U.S. children have food allergies—and 38.7% of these were found to have a history of severe reaction.[4] Based on data from the National Health Interview Survey, the Centers for Disease Control and Prevention (CDC) indicated in a 2013 data brief that the prevalence of food allergies had increased among children from 3.4% in the 1997–99 reporting period to 5.1% in 2009–11.[5]

Variation in the reported prevalence of food allergies may result from differences in the geographic location, dietary exposure, age, and gender of study populations, as well as differences in methodologies. Some of the increased prevalence may be attributable to improved recognition and diagnosis of food allergies. Contributing factors to food allergy or anaphylaxis include obesity, genetics, or endocrine changes; dietary factors, such as vitamin D deficiency or reduced consumption of omega-3 fatty acids or antioxidants; and the timing or route of food exposure.[6]

Sheetz and colleagues noted that approximately 16% to 18% of students with known food allergies have allergic or anaphylactic reactions at school.[7] In a 2001 study of fatalities resulting from food anaphylaxis, Bock and colleagues noted 32 deaths, 17 of which occurred in children two to 18 years of age.[8] Allen and colleagues surveyed 2,049 school nurses about their experience with medical emergencies, and nearly half said they'd responded to an anaphylaxis emergency at some point in their school nursing career.[9]

MILWAUKEE PUBLIC SCHOOLS (MPS) EMERGENCY ANAPHYLAXIS PROTOCOL

DEFINITION: A systemic allergic reaction (anaphylaxis) is a severe response resulting in cardiovascular collapse (shock) after the introduction of an antigen (e.g., bee or other insect sting), ingestion of a food or *medication*, or exposure to other allergens, such as animal fur, chemical irritants, pollen, or molds, among others. Anaphylactic allergic reactions require emergent treatment.

ANAPHYLAXIS SIGNS AND SYMPTOMS: Any of the symptoms may occur within seconds. The more immediate the reactions, the more severe the reaction may become.

- Skin: warmth, itching, and/or tingling of underarms/groin, flushing, hives
- Abdominal: pain, nausea and vomiting, diarrhea
- Oral/Respiratory: sneezing, swelling of face (lips, mouth, tongue, throat), lump or tightness in the throat, hoarseness, difficulty inhaling, shortness of breath, decrease in peak flow meter reading, wheezing reaction
- Cardiovascular: headache, low blood pressure (shock), lightheadedness, fainting, loss of consciousness, rapid heart rate, ventricular fibrillation (no pulse)
- Mental status: apprehension, anxiety, restlessness, irritability, feeling of impending doom

EMERGENCY PROTOCOL:

1. **CALL 911**.
2. Check airway patency, breathing, respiratory rate, and pulse.
3. Administer medication (EpiPen) per standing order.
4. Monitor vital signs (pulse, respiration, etc.).
5. Contact parents immediately and physician as soon as possible.
6. Any individual treated for symptoms with epinephrine at school will be transferred to a medical facility via EMS. Send used EpiPen with EMS.
7. Side effects of epinephrine include: tremor, nervousness, palpitations, headache, nausea, and vomiting.
8. Serious adverse effects are uncommon. It is better to administer epinephrine in error than to risk death through its omission; never underestimate the potential seriousness of an allergic reaction.
9. If the only EpiPen available is past the expiration date, it may be used as long as it is not discolored and does not have obvious precipitate. Advise EMS and send used EpiPen with EMS.

STANDING ORDERS FOR RESPONSE TO LIFE-THREATENING ANAPHYLAXIS:

- Administer EpiPen Jr according to MPS Nursing Policy and Procedure Manual for an individual less than 60 pounds or EpiPen for an individual over 60 pounds.
- EpiPen may be administered to adults according to the above orders.
- Administer CPR, if indicated.

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THE SCHOOL NURSE'S ROLE

Students with identified food allergies are generally well known to school nurses. Their individualized management plans include strategies for minimizing exposure to allergens and postexposure protocols with orders for epinephrine autoinjector administration in response to life-threatening reactions.[10] The National Association of School Nurses has published a position statement entitled "Allergy/Anaphylaxis Management in the School Setting" that emphasizes how school nurses are uniquely prepared to develop and implement individualized health plans for students with allergies and to coordinate resources, training, and allergy and anaphylaxis education, ensuring a safe school environment for all students.[11]

In a comparison of school nurse food allergy emergency plans with the standard plan of the Food Allergy and Anaphylaxis Network (which has since merged with the Food Allergy Initiative to form Food Allergy Research and Education), Powers and colleagues found that only 15% of school plans were consistent with the standard plan.[12] Moreover, only

23% of the student-specific emergency plans that included epinephrine actually identified the symptoms that, if observed in a child, should trigger the administration of the medication. Epinephrine autoinjector instructions were included in 53% of the plans. The authors concluded that the wide variability in food allergy management plans can lead to uncertainty and delayed treatment.

Students with undeclared food allergies are at particular risk. Gupta and colleagues described racial and income-related disparities in the diagnosis of food allergies, noting that black and Asian children in the United States are more likely to have food allergies but substantially less likely to be formally diagnosed.[4] Some 25% of children with undiagnosed food allergy experience their first, or declarative, allergic reactions in school.[12] Because these children don't have the benefit of an individualized emergency response protocol or appropriate medication, they are vulnerable to the morbidity and mortality associated with anaphylaxis. In addition, some may experience anaphylaxis for which no discernable cause is identified,[13] making the avoidance of triggers impossible.

The consequences for any student experiencing an anaphylactic reaction can range from difficulty breathing to cardiovascular collapse and death. Therefore, management protocols must allow school nurses to administer an epinephrine autoinjector after assessing for anaphylaxis in any child, regardless of allergy history.

FEDERAL AND STATE LAWS AND GUIDELINES

School districts can stock epinephrine if they have a protocol in place, have obtained a prescription from a physician, and intend for nurses to act within their scope of practice regarding emergency epinephrine administration. However, because it's not always easy to obtain undesignated epinephrine (medication that is not prescribed for a particular person), and because of concerns about the liability of the staff members who administer this medicine, several states have passed legislation that affords civil liability protection and makes it easier for school districts to purchase and stock epinephrine autoinjectors. Districts that opt to do so under such laws typically obtain a prescription from their medical advisor. Designated emergency caregivers—usually school nurses, but this varies by state—then receive special training in emergency procedures and the administration of epinephrine. (So far, there has been a lack of widespread support for laws *requiring* the stocking of epinephrine in schools, perhaps because of the associated costs, which include annual replacement of the medicine.)

In a 2011 survey of 171 school nurses in California, where state law permits school districts to stock emergency epinephrine autoinjectors, nearly 73% reported having had students with a history of allergy or prior use of epinephrine for whom parents or guardians hadn't provided medication to treat a severe allergic reaction at school.[14] In addition, nearly 30% of the nurses reported having administered one student's epinephrine to another child in response to an emergency.

The federal School Access to Emergency Epinephrine Act, which was signed into law on November 13, 2013, encourages but doesn't mandate that states adopt its provisions, which call for trained personnel to administer epinephrine when needed and for schools to maintain a supply of epinephrine for such emergencies. As of June, only five states (Maryland, Michigan, Nebraska, Nevada, and Virginia) require their school districts to maintain a stock of epinephrine autoinjectors.[15] Another 34 states have passed laws or adopted guidelines giving schools the option to do so, six states have pending legislation, and five have no current or pending legislation addressing stocking epinephrine in schools.[15]

Some 25% of children with undiagnosed food allergy experience their first allergic reactions in school.

In the survey of school nurses conducted by Allen and colleagues, the ratio of nurse to students varied; in some cases, as many as 500 to 3,500 students were cared for by a single school nurse.[9] One respondent reported that her district employed only one nurse to care for all students from kindergarten through 12th grade. Because a single school nurse may be responsible for many students across multiple campuses, voluntary guidelines for the management of food allergies in schools and child-care programs released by the CDC in late 2013 include the designation and training of nonmedical personnel (such as classroom teachers, counselors, bus drivers, and others) in the recognition and emergency response to anaphylaxis.[16]

State laws and guidelines allowing schools to stock epinephrine autoinjectors usually include provisions that protect anyone who administers epinephrine in good faith from civil liability.[17] This type of protection ensures that nonmedical school personnel won't hesitate to respond to an anaphylaxis emergency in the absence of a school nurse or other medical personnel.

Table 1. Milwaukee Public Schools Emergency Anaphylaxis Training Plan

Learner Objective	Knowledge or Action Required	Teaching Strategies	Evaluation Methods or Actions Taken	Instructional Materials
Correctly identify the signs and symptoms of anaphylaxis, including atypical presentation.	Recognize generalized flush, urticaria, angioedema, paroxysmal coughing, severe anxiety, dyspnea, wheezing, orthopnea, vomiting, cyanosis, shock, and feeling of impending doom.	Lecture and discussion.	Pre- and posttraining surveys to assess content mastery, which is indicated by 95% accuracy in identifying anaphylaxis symptoms.	PowerPoint, computer, and LCD projector.
Correctly determine when to use EpiPen or EpiPen Jr according to standing order protocol.	When signs and symptoms of anaphylaxis are present, school nurses will administer EpiPen, contact EMS, provide airway support, and begin CPR, if needed.	Lecture, discussion, and group role-play.	Pre- and posttraining surveys to assess content mastery, which is indicated by 95% accuracy in identifying protocol steps.	PowerPoint, computer, and LCD projector; case study scenarios.
Demonstrate effective EpiPen administration technique.	EpiPen is administered to the lateral thigh with a firm jab, through clothing if necessary. The pen is held firmly to the thigh for 10 seconds, followed by a 10-second massage of the injection site.	Demonstration and return demonstration.	Observation of accurate return demonstration.	An EpiPen trainer (an EpiPen that doesn't contain a needle or medication).
Identify potential sources of stress and anxiety related to implementation of the protocol, as well as strategies to decrease stress and anxiety.	Understanding and anticipating that emergent situations produce anxiety, which will help during an actual emergency.	Discussion and values-clarification techniques.	Small groups of nurses generate a list of potential anxieties and reduction strategies that can be shared with the larger group of nurse trainees.	None
Explain the importance of conducting a staff debriefing after an emergency situation that necessitates using the protocol and correctly explain the debriefing procedure.	Even successful rescues are stressful, particularly for non–health care providers. Debriefing decreases stress and can help to improve how nurses use the protocol to respond to future emergencies.	Values-clarification techniques.	Discussion groups will produce a debriefing list to share with the larger group that correctly identifies at least five major components.	None

THE NEED FOR A NEW APPROACH

The Milwaukee Public Schools seeks to identify students with life-threatening food allergies and maintain a computerized database of care plans; however, the number of students with undeclared allergies is unknown. Two fatal anaphylactic reactions occurred within the school system's population between 1998 and 2009. The number of emergency care plans (for all life-threatening conditions) increased from 588 in 2001 to 4,717 in 2008, although it's unknown how many of these plans were related to food allergies. If prevalence rates cited in the literature are applied to the 90,000 students in the Milwaukee Public Schools, then 4,590 to 7,200 students could have life-threatening food allergies.

In 2009, we began developing an emergency anaphylaxis response protocol in the Milwaukee Public Schools to allow school nurses—there is one in each of the approximately 165 schools in the district—to assess for anaphylaxis and administer stock epinephrine to children with

- unidentified allergies.
- identified allergies for whom prescription epinephrine autoinjectors had not been provided to the school.

The school system's medical advisor—a physician volunteer—supported the implementation of this district-wide management protocol. At the time, Wisconsin didn't have a state law regarding having stock epinephrine in schools, but we chose to initiate the protocol regardless, to ensure student health and safety. Legislation was subsequently introduced in Wisconsin, and in late 2013 a state law was enacted that allows for the use of epinephrine autoinjectors by both licensed and unlicensed school staff in emergency situations and provides immunity from liability for those acting in good faith.

Formally known as the Milwaukee Public Schools Emergency Anaphylaxis Protocol, this project was implemented in two steps. First, a policy change was required: the medical advisor issued standing orders that all school nurses who observe anaphylaxis in previously undiagnosed children treat them according to the protocol. (Other school personnel are trained to administer epinephrine only in situations in which a child has already been diagnosed, the anaphylaxis symptoms are documented, and the child's prescribed autoinjector is at school.) Second, the new policy was put into effect. This required the purchase of epinephrine autoinjectors (the Milwaukee Public Schools use EpiPen and EpiPen Jr) and the development of a staff training program.

Purchase and maintenance. The cost of buying a two-pack of both EpiPen and EpiPen Jr for all schools in the district was estimated to be approximately $15,000 annually; these medications typically expire within 12 to 14 months and need to be replaced at the beginning of each school year. This cost was included in the district's nursing budget. The EpiPens would be distributed to each school nurse, who would then be responsible for maintaining the supply and reordering more, if necessary, during the school year.

Training program. The school nurses were required to receive special training in the typical and atypical presentations of anaphylaxis, to familiarize themselves with the protocol and its accompanying forms (such as the postincident debriefing report, which collects data on the presenting symptoms, the response to the incident, and the outcome of the case), and to practice their assessment and intervention skills.

Members of the nursing staff were asked to complete an anonymous survey, providing information about their experiences as school nurses, experiences with anaphylaxis in school, levels of licensure, and perceived staff development needs relative to implementing the protocol. The Emergency Anaphylaxis Training Plan was created based on the information gleaned from this survey, particularly regarding the professional development needs the nurses identified (see Table 1).

The anaphylaxis protocol underscores the importance of having a nurse in every school building.

After the school nurses attended a training session, a posttraining survey was distributed to gauge their knowledge of the signs and symptoms of anaphylaxis and their perceptions about the training. They received additional training and practice opportunities two months later, when the EpiPens were distributed to each school campus.

SURVEY DATA AND RESULTS

The pre- and posttraining surveys helped to assess the nurses' knowledge, preparedness, and attitudes about anaphylaxis and the response protocol. Comparison of the survey results indicated improved awareness of anaphylaxis symptoms, greater confidence in their ability to respond effectively to an anaphylaxis emergency, and more positive attitudes about the new response protocol.

Pre- and postsurvey data were analyzed using Pearson's χ^2 test, and descriptive statistics were used to summarize the population. Of the 77 respondents to the pretraining survey, 25 were LPNs and 52 were RNs. Among the LPNs, there was a range of seven to 48 years of nursing experience, with a mean of 25 years. Among the RNs, nursing experience ranged from one to 40 years, with a mean of 15 years. The combined group reported one to 18 years of school nursing experience, with a mean of seven years. The elapsed time since their last anaphylaxis training ranged from one to 12 years, with a mean of three years.

Of all respondents, 23% had treated students with known anaphylaxis and 12% had treated students for previously undiagnosed anaphylaxis. The nursing staff overwhelmingly expressed a preference for using an EpiPen as the method of

Table 2. Pre- and Posttraining Anaphylaxis Symptom Recognition Results

Symptom	Correct on Pretraining Survey, %	Correct on Posttraining Survey, %	Pearson's χ^2	*P* Value
Angioedema	92	98	1.98	0.16
Anxiety	84	95	4.2	0.04
Bradycardia	33	73	19.1	< 0.001
Cough	59	100	27	< 0.001
Cyanosis	72	93	9.08	0.003
Dyspnea	97	100	1.32	0.249
Flush	77	100	12.9	< 0.001
Hypervigilance	35	73	17.85	< 0.001
Orthopnea	47	90	23.84	< 0.001
Sense of doom	79	100	12	0.001
Shock	92	93	0.155	0.694
Urticaria	95	100	2.7	0.1
Vomiting	68	100	19.44	< 0.001
Wheeze	79	100	12	0.001

epinephrine administration (97%). Of all training opportunities identified, the nursing staff indicated they would benefit most from symptom management until the arrival of emergency medical services (EMS) (88%), professional development regarding symptom recognition (81%), and postincident debriefing of school staff (71%), which typically involves a discussion between the nurse and a supervisor or other school personnel.

Comments shared by respondents about anaphylaxis and the burden of ensuring a safe school environment can be grouped into three main categories:

- difficulty in ensuring that epinephrine autoinjectors prescribed for students with known allergies are brought to school
- ensuring that a protocol for emergency anaphylaxis response does not take the place of parental responsibility
- concern about being able to adequately implement the protocol with fidelity

The following is a sampling of respondent comments:

> Someone who has not seen anaphylaxis has no idea how quickly it can progress or the different signs/symptoms that can be manifested.

> I still have students with EpiPen orders who don't have pens and students with fish and/or nut allergies with no orders because parents don't feel it's necessary.

> Several of my students have had severe reactions in the past but never brought in EpiPens, which makes me nervous.

Both RNs and LPNs completed the pretraining survey, but only RNs completed the posttraining survey, because LPNs have a shorter contract year and were not working when the training took place. The only item that was the same on both surveys was a list of signs and symptoms from which respondents were asked to identify those indicating anaphylaxis, such as generalized flush, urticaria, angioedema, bradycardia, paroxysmal coughing, severe anxiety,

sense of impending doom, hypervigilance, dyspnea, wheezing, orthopnea, vomiting, cyanosis, and shock. Of the 14 signs or symptoms, none was recognized as an indication of anaphylaxis by all of the nurses taking the pretraining survey after the in-service training, seven symptoms were recognized by all respondents. The results of symptom identification are summarized in Table 2.

Respondent comments on the perceived ability to identify anaphylaxis and implement the protocol after training included the following:

> I thought it was an informative in-service regarding what the protocol and "in stock" medication means in our school and to our role as the nurse.

> I think this is a great protocol. It will enable us to take lifesaving measures until EMS arrives.

PROTOCOL IMPACT AND COST

The Milwaukee Public Schools Emergency Anaphylaxis Protocol affects public education health services in Milwaukee in three ways:

- by ensuring a safe school environment for the children
- by guaranteeing safe practice for the school nurses
- by establishing a foundation on which comparable school-based interventions for other life-threatening conditions, such as asthma, can be developed and implemented

In addition, the protocol creates greater awareness about allergy prevalence and intervention among the staff and students of the school system.

The school nurses have directly benefited from the implementation of this protocol, which provides them with a medical order for an intervention they would feel compelled to provide anyway in the event of an anaphylaxis emergency. It also promotes ongoing professional development, ensuring that these nurses better understand and identify anaphylaxis symptoms, improve their anaphylaxis assessment skills, and intervene with definitive therapy. The protocol has highlighted the school nurse's role in ensuring student health and safety and underscores the importance of having a nurse in every school building.

The sustainability of the protocol is dependent on building the cost of the epinephrine into the school budget annually. In addition, continuing professional development of the nursing staff must be planned. While allocating $15,000 annually for an ongoing protocol may be challenging during a fiscal downturn, the overall value of this protocol reduces the likelihood that it will become a victim of budget cuts in subsequent years. In fact, the value of the protocol was demonstrated within three days of its implementation, when a school nurse successfully used it to recognize and treat anaphylaxis in a child stung by a bee with no previous history of this allergy.

EXPANDED USE

Every child has the right to attend school in a safe and secure environment, and every school nurse should practice in an environment that supports her or his skills, ability, and licensure at the highest level. The successful implementation of the Milwaukee Public Schools Emergency Anaphylaxis Protocol expands the notion of what is considered a safe school environment, and its principles can be applied to the treatment of children with other life-threatening conditions that are amenable to rapid intervention and would otherwise lead to significant morbidity or mortality.

The primary strength of the protocol is that it addresses a clinical event that is low in frequency but high in morbidity and mortality with an effective, recognized intervention. Implementing a standardized nursing protocol in a public school system minimizes variability in its delivery. The simplicity of the protocol design also lends itself to replication in other large urban school districts. However, because the cost of the program may be a limitation for some districts, additional research is needed to identify and evaluate if an acceptable alternative means of epinephrine delivery (such as inhaled or subcutaneous delivery) can be used instead.

Although the protocol was designed and implemented as a school-based intervention, it could easily be adapted for use in corporate, occupational, child-care, and recreational settings, many of which are also nursing practice environments. The safety of employees, customers, and the community can be enhanced through the assessment and rapid intervention called for in such a protocol. Moreover, each time the protocol is used, there will be an opportunity to collect data about the intervention, review the procedure, and evaluate the outcome. As this cycle is repeated, the protocol's strengths will be reinforced and adaptations can be made, further enhancing its effectiveness. Eventually, the protocol could be adapted to address the management of other conditions and even redesigned to allow for delegation to nonnursing staff. This relatively simple protocol developed for the Milwaukee Public Schools has the potential to make a significant difference in the lives of many people every day. ▼

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