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Epinephrine Auto-Injectors for Anaphylaxis Treatment in the School Setting: A Discussion Paper

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Abstract

Introduction: Anaphylaxis is a serious, life-threatening systemic allergic reaction that may occur in individuals not previously diagnosed with an allergy. Emergency first-line treatment of choice for acute anaphylaxis is intramuscular administration of epinephrine via an auto-injector. In the school setting, students with known allergies typically keep or carry an epinephrine auto-injector (EAI). For students who do not have a known allergy or for those whose personal EAIs are unavailable, an anaphylactic event could have serious adverse outcomes if an EAI is not available via an undesignated stock supply in the school.

Methods: We searched the published literature from 2000 through 2018 in CINAHL, MEDLINE, and PubMed using the following search terms: *anaphylaxis*, *school setting*, *epinephrine auto-injector*, and *food allergies*. Throughout this article, undesignated stock EAIs, stock EAIs, EAI stock, and open-order EAIs are used interchangeably.

Conclusion: Anaphylaxis is increasing worldwide as the incidence of food allergies increases. Although stock EAIs for students in schools can have important benefits, the availability of EAIs in the school setting is limited. Barriers to undesignated stock EAIs include the lengthy administrative process for developing school policies and protocols; gaps in nurses' self-perceived knowledge versus objective knowledge on the topic of anaphylaxis; limited resources in many school districts; and complex role demands, lack of confidence in trained staff, or insufficient school nurse staffing. It is important that epinephrine be readily available in schools. Barriers to facilitating stock EAIs include those that can be addressed directly by nurses and those that may require policy changes. Nurses, particularly those working in school settings or pediatrics, could take the lead in discussions about the benefits of stock EAIs in schools, advocating for policy changes as warranted. Fully informed nurses can be better prepared to serve as advocates in ensuring that EAIs are available in school settings.

Keywords

anaphylaxis, epinephrine auto-injectors, food allergies, policy, school nursing, school setting

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Introduction

Anaphylaxis is a serious and life-threatening systemic allergic reaction, with a sudden onset and the potential for serious or fatal progression (Sicherer & Simons, 2017). Although anaphylaxis can be triggered by foods, insect stings, medications, latex, or an unknown source, the most common cause of anaphylaxis in children and adolescents is food ingestion (Campbell, Li, Nicklas, & Sadossty, 2014; Simons et al., 2015). In fact, food triggers account for about 30% of all fatalities due to anaphylaxis (Lieberman, Nicklas, Oppenheimer, Kemp, & Lang, 2010). Although a previous history of allergies and asthma increases the risk of anaphylaxis, nearly 25% of student episodes of anaphylaxis occur in individuals who have not been previously diagnosed with an allergy (Greenhawt et al., 2018; McIntyre, Sheetz, Carroll,

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& Young, 2005). Because a student's day typically includes eating and potential exposures to other allergic triggers, schools need to be prepared for anaphylactic emergencies (DeSantiago-Cardenas et al., 2015) by having undesignated stock epinephrine auto-injectors (EAIs) readily available as the first-line treatment for anaphylaxis (Sheikh, Simons, Barbour, & Worth, 2012; Simons et al., 2015; Song, Worm, Lieberman, 2014; White et al., 2015).

Anaphylaxis is a global concern and will likely increase with the escalating appearance of food allergies worldwide in the last 10 to 15 years (Prescott et al., 2013). Although the type of food allergy may vary among nations, the concern about possible anaphylaxis is a constant. National and international organizations and authorities consistently endorse the prompt use of EAIs for the immediate treatment of a systemic anaphylactic reaction in the community setting (Simons et al., 2015; Song et al., 2014). Studying the occurrence and treatment practices and barriers in one country could contribute to a better understanding of these factors in other countries (DaSilva & Castro, 2014).

In the United States, 2013 federal legislation known as the School Access to Emergency Epinephrine Act laid the national groundwork for incentivizing states to mandate emergency supplies of stock EAIs in the school (Tanner & Clarke, 2015; Wright, 2015). Subsequently, 12 states have passed legislation mandating undesignated stock EAIs in the schools (Food Allergy Research & Education [FARE], 2016a). In the remainder of the states, except for Hawaii, laws allowing stock EAIs have made it optional for school districts to stock EAIs, but not all districts have exercised this option (Daniels, 2015). It will require a coordinated effort to effect change in states and school districts so that stock EAIs are readily available for emergency use. Nurses, especially those with a policy or health policy background, could lead the effort for establishing stock EAIs in the schools, given that the clinical course of anaphylaxis is unpredictable and "preparedness promotes optimal outcomes" (Wang & Sicherer, 2017, p. e1).

Methods

A review of the literature was conducted through Internet and database searches and focused on publications written in English from 2000 through 2018. CINAHL, MEDLINE, and PubMed were the primary databases used for the literature search. The following keywords were used: *anaphylaxis*, *school setting*, *EAIs*, and *food allergies*. Although management of anaphylaxis in the school setting was the primary focus of the literature search, some recent references for food allergies and anaphylaxis were included to provide a more comprehensive review.

Review and Discussion

Overview of Anaphylaxis

Anaphylaxis is the likely diagnosis if there is a rapid progression of symptoms, typically within 30 minutes of allergen exposure, involving multiple body systems: the skin and respiratory, gastrointestinal, and central nervous systems (Esquivel & Busse, 2017). Lieberman et al. (2010) described the reaction as involving the skin, mucosa, or both, and at least one of the following: respiratory compromise, reduced blood pressure, or gastrointestinal symptoms. The failure to recognize anaphylaxis leads to its undertreatment (Campbell et al., 2014). Table 1 summarizes the target organs and subsequent manifestations of anaphylaxis related to those systems.

It is important to note that at the time of onset, there is no diagnostic test for anaphylaxis (Simons et al., 2015); in fact, not all cases may present the same clinically (Campbell et al., 2014). In anaphylaxis of children, the most common initial presentation is cutaneous symptoms (Lieberman et al., 2015); additionally, young pediatric patients have the potential for unusual self-reporting descriptions of oral and respiratory symptoms (Schoessler & White, 2013). Robinson and Ficca (2012) described young children explaining early symptoms as "my tongue (or mouth) burns," "my tongue (or mouth) is tingling," "it feels like there's bugs in my ears," or "there something's stuck in my throat" (p. 191). Neurologic symptoms can manifest as anxiety or a sense of doom; additionally, symptoms such as vocal

Table 1. Manifestations and Effects of Anaphylaxis.

Target organs	Manifestation
Skin/mucosal tissue	Warmth, flushing, swelling, widespread erythema, angioedema, itchiness, and hives
Respiratory system	Coughing, shortness of breath, rhinitis, wheezing/bronchospasm, chest pain or tightness, tightening of throat, and difficulty swallowing
Cardiovascular system	Faint, pale, or blue color; hypotension; lightheadedness (presyncope); syncope; weak pulse; dysrhythmias; angina; and shock
Gastrointestinal system	Nausea, vomiting, diarrhea, stomach pain, and cramps
Central nervous system	Headache, confusion, anxiety, altered level of consciousness, tunnel vision, feeling of impending doom, and seizure

Adapted from Esquivel and Busse (2017); Greenberger, Wallace, Lieberman, and Gregory, (2017); Tam and John (2017).

hoarseness from laryngeal edema or impaired speech from lingual edema may not be readily recognized as anaphylaxis (Schoessler & White, 2013). Although a key feature in the "differential diagnosis of anaphylaxis is the sudden onset of multisystem symptoms" (Schoessler & White, 2013, p. 410), Simons et al. (2015) noted that a mild onset of symptoms or a previous self-limiting episode may not accurately predict the severity of the current reaction.

Epidemiology of Food Allergies and Anaphylaxis

Over the last 20 years, the increase in prevalence and severity of food allergies is well documented (Gupta et al., 2011; Montosue, Bellolio, Van Houten, Shah, & Campbell, 2017) and is currently recognized as affecting up to 8% of the U.S. pediatric population (Gupta et al., 2011). This translates to 1 in 13 children or approximately 2 children per classroom (FARE, 2016b). Of food-allergic children, 30.4% have multiple allergies and 38.7% have a previous history of severe food reactions or anaphylaxis (Gupta et al., 2011). Food allergens are the most common cause of pediatric anaphylaxis in the outpatient setting, with the most frequently offending foods in the United States being peanuts, tree nuts, fish, shellfish, milk, and eggs. Those at greatest risk for fatal or near-fatal food-induced anaphylaxis include adolescents, patients with asthma, those with peanut or tree nut allergy, or a history of anaphylaxis (Lieberman et al., 2015).

The incidence of anaphylaxis in the schools is not uncommon; 11% of schools with stock EAIs reported an anaphylactic event (Hogue, Goss, Hollis, Silvia, & White, 2016; White et al., 2016). In addition, hospital admissions from anaphylaxis are increasing (Simons et al., 2015). Lieberman et al. (2006) estimated that anaphylaxis occurs in up to 2% of the population. Montosue et al. (2017) analyzed post-emergency department (ED) diagnostic codes for anaphylaxis, as well as codes related to symptom analysis, in more than 17 million ED visits from 2005 to 2014. The authors concluded that there was an overall increase of 101% in ED visits for anaphylaxis from any origin. Of particular note are the increased rates of food-related anaphylaxis. In all age groups, food-induced anaphylaxis increased by 124%; yet, in the 5-to-17-year-old age-group, food-triggered anaphylaxis rose by 285%. Even with diagnostic criteria enhancement and administrative coding evolutions, Sclar and Lieberman (2014) concluded that in the United States, anaphylaxis is underdiagnosed and under-recognized.

Standard of Care for Anaphylaxis in the School Setting

The standard of care in an anaphylactic event is the recognition of the occurrence and the rendering of the appropriate intervention, an intramuscular, weight-based EAI (0.15 mg pediatric EAI for 33–66 pounds; 0.3 mg adult EAI) (Dudley, Mansour, & Merlin, 2015; Sicherer & Simons, 2017). Following EAI administration, emergency medical services (EMS)/911 must be activated, and all patients should be transported to the hospital ED for observation and possible further treatment (Sicherer & Simons, 2017; Tanner & Clarke, 2015). Carrillo, Hern, and Barger (2016) noted the lack of anaphylaxis identification and the reluctance to administer epinephrine as the two major reasons for treatment delay. For the initial treatment of anaphylaxis, "epinephrine is the medication of choice" (Sicherer & Simons, 2017, p. e8), and schools must be prepared with the first-line treatment on hand (Gregory, 2012).

Because nurses in the school setting are called on to be the leaders in the comprehensive management approach to school-based anaphylaxis events, it is critical that school nurses be well versed in the early recognition of anaphylaxis and respond with the current evidence-based treatment (Russell & Schoessler, 2017). Although state laws vary regarding which staff members can administer epinephrine, in the words of Schoessler and White (2013), anaphylaxis prevention and management must be a "shared responsibility among all personnel" (p. 407), because it is highly likely school nurses and personnel will one day encounter a student with the potential for a life-threatening reaction (Wahl, Stephens, Ruffo, & Jones, 2015). School nurses assume a key role as interventionists by planning, responding, educating personnel, and advocating for and developing policies, which includes establishing anaphylaxis emergency responses for students with known or unknown allergies (Russell & Schoessler, 2017). Thus, implementing and maintaining stock EAIs as an emergency anaphylaxis intervention is appropriate (Gregory, 2012).

Epinephrine produces rapid vasoconstriction, thus decreasing or preventing upper and lower airway edema, hypotension, and shock (Sicherer & Simons, 2017). Prompt treatment is advised because mild symptoms can escalate rapidly (Sclar & Lieberman, 2014). If symptoms are ongoing or progressive, an additional EAI dose may be necessary 5 to 15 minutes after the first injection (Song et al., 2014). Although this has been documented in less than 20% of pediatric patients (Sicherer & Simons, 2017), with White et al. (2015) noting the use of a second dose in 8.5% of school anaphylactic events, EAIs are prescribed and dispensed with a second dose available to those with a known allergy (Lieberman et al., 2015; Song et al., 2014). Epinephrine for initial treatment of anaphylaxis is the only medication that reduces the odds of hospitalization or death (Simons et al., 2015). Furthermore, Lieberman et al. (2015) noted that the most consistent risk factor for

fatal or near-fatal anaphylaxis is the lack of prompt administration of epinephrine.

Administering a weight-specific EAI is a safe intervention: complications are rare (Campbell et al., 2014), and the benefits far outweigh any risks (Gregory, 2012). Notably, there are no absolute contraindications for administering epinephrine to treat anaphylaxis (Campbell et al., 2014; Sicherer & Simons, 2017). Its effects, including pallor, tremors, anxiety, and heart rate acceleration, are similar to those experienced during the innate release of epinephrine in the *fight or flight* response and are not true adverse reactions (Sicherer & Simons, 2017). Gregory (2012) described the transient effects of anxiety or cardiac palpitations as not harmful and well tolerated by school-age children. Because a delay or failure to treat with an EAI could have serious or fatal consequences (Dudley et al., 2015; Song et al., 2014), erring on the side of prompt administration is advisable (Sicherer & Simons, 2017). Therefore, when in doubt, it is better to administer the EAI (Song et al., 2014).

After treatment with an EAI, it is critical for patients to be assessed for further treatment needs in an ED (Sicherer & Simons, 2017). Clinical guidance supported by the American Academy of Pediatrics directs caregivers and school personnel to activate EMS/911 services following EAI administration (Wang & Sicherer, 2017). In addition, the Centers for Disease Control and Prevention (CDC, 2013) guidelines urge staff to have the child transferred to the hospital by emergency vehicle, not waiting for parents to arrive before activating EMS/911. Sicherer and Simons (2017) encourage educating staff and families that seeking post-EAI medical care is not because the intervention is unsafe. Instead, it is to assess and monitor the episode.

The anaphylaxis practice parameters of Lieberman et al. (2015) recommend postanaphylactic medical observation for 4 to 8 hours depending on the episode severity. It is estimated that 4.7% to 23% of children who experience anaphylaxis have the potential for a biphasic or rebound reaction several hours later (Lieberman et al., 2015; Simons et al., 2015). Education concerning post-administration protocols must increase for all school nurses, staff, and parents. In the most recent 2014–2015 school studies, over 27% of students meeting the criteria for emergency treatment were not transported to the hospital, leaving them at risk (White, Silvia, Muniz, Herrem, & Hogue, 2017).

Need for EAIs in the School Setting

Although epinephrine is the treatment of choice for anaphylaxis, and its occurrence in school-age children and adolescents is on the rise, its availability in the school setting is limited. It is important to note that without the availability of epinephrine, substandard treatments for anaphylaxis might be initiated. These include H_1 antihistamines and inhaled asthma medications (Sicherer & Simons, 2017), but they have no impact on the cardiovascular and respiratory manifestations of anaphylaxis (American Academy of Allergy, Asthma & Immunology [AAAAI], 2014). Furthermore, the onset of oral antihistamine action is delayed in anaphylaxis (Russell & Schoessler, 2017) and can, in fact, mask the skin manifestation of anaphylaxis, thus delaying treatment with epinephrine (Dudley et al., 2015). It is also substandard treatment to use one student's prescribed EAI to treat another student's anaphylactic event. This treatment option was included on a survey of National Association of School Nurses (NASN) by Odhav, Ciaccio, Serota, and Dowling (2015). Of the 2,439 respondents, 41.3% indicated they would not use another student's EAI, even if nothing else were available, with the majority citing fear of legal repercussions.

EAIs in the school setting are available in two ways, student-specific EAI or undesignated stock EAI. In all states in the United States, current laws allow for licensed providers to prescribe a student-specific EAI to be kept at school or carried by the said student with an allergic history (Wang & Sicherer, 2017). By contrast, undesignated or stock EAIs are prescribed by a provider for a school or district and can be used for anyone in case of a first-time anaphylactic event (DeSantiago-Cardenas et al., 2015; Gregory, 2012), in cases where personnel cannot access the prescribed EAI or for additionally needed doses (FARE, 2016b).

The case for emergency stock EAIs in schools has a lengthy history. As early as 1998, the AAAAI position on anaphylaxis in the schools stressed allergen avoidance, treatment of anaphylaxis with an EAI, and formal EAI training for all personnel (AAAAI, 1998). The landmark U.S. school survey study by McIntyre et al. (2005) identified life-threatening allergic reactions as a significant health issue in schools and called for protocols allowing for EAI administration to any individual exhibiting signs of anaphylaxis, along with a readily available epinephrine supply for such events. By 2012, the NASN published an impassioned article by Gregory (2012), detailing the case for stock EAIs in schools as a potentially lifesaving intervention needed nationwide. Thereafter, in 2013, the CDC (2013) published *Voluntary Guidelines for Managing Food Allergies in Schools and Early Care and Education Programs*, which recommended, where legally allowable, the stocking of EAIs for anaphylaxis emergencies for use by licensed or delegated trained staff regardless of a student's allergic history.

Stock EAIs in the School Setting

The open order with readily available stock EAIs is a critical element of early anaphylaxis intervention. According to White et al. (2016), 47.5% of students treated for anaphylaxis with epinephrine were administered an EAI from the school's undesignated stock EAIs. Frequently, school nurses have established treatment plans and EAIs for previously diagnosed allergic students (Murphy, 2014). Although this may be ideal, protocols and availability of stock EAIs are beneficial (Sicherer & Simons, 2017) because evidence exists that not all high-risk patients with a previous anaphylactic history have been prescribed an auto-injector (Sclar & Lieberman, 2014). The studies by Clark et al. (2004) and Clark, Long, Gaeta, and Camargo (2005) demonstrated that less than 30% of patients treated in the ED for anaphylactic reactions to food or insect stings were given an EAI prescription; likewise, less than 20% were referred to an allergist. Although Huang, Chawla, Jarvinen, and Nowak-Wegrzyn (2012) noted postanaphylaxis ED discharge prescribing as improved to 63%, the ED anaphylaxis practice parameters of Campbell et al. (2014) noted the lack of EAI prescribing and allergist referral as still problematic.

Undesignated stock EAIs are of benefit to students or staff who have no previous allergic history. In the White et al. (2015) survey, 21.9% of EAI use occurred in those with no allergic history or unknown history. Since then, the most recent EpiPens4Schools survey study data indicated that 24.5% of events were reported in students with no documented history of allergies (White et al., 2017). In the Chicago Public Schools study, DeSantiago-Cardenas et al. (2015) identified 55% of EAI use in the school setting as first-time events with no previous allergic history. Although White et al. (2017) reported the etiology for the anaphylaxis trigger in 21.8 % of school events as unknown, DeSantiago-Cardenas et al. (2015) noted that unknown triggers accounted for a third of the incidents. Without stock EAIs, the intervention might not be available for such cases.

Undesignated stock EAIs could be of particular aid to vulnerable populations, who lack a food allergy diagnosis. Despite food triggers causing the greatest percentage of school anaphylactic events, as seen in 66.3% of respondents to the survey by White et al. (2016), data suggest that disparities exist in the clinical diagnosis of food allergies according to race and ethnicity (Gupta et al., 2011). The likelihood of having a food allergy is highest among Asian and African American children compared with White children; yet, the odds of having a diagnosed food allergy is significantly lower in Asian, African American, and Hispanic children than in Whites (Gupta et al., 2011). Furthermore, Mahdavinia et al. (2017) reported that African American and Hispanic children have more than twice the rates of food-induced anaphylaxis than their White counterparts.

Vulnerable populations that lack a food allergy diagnosis include children who are economically disadvantaged. The frequency of food allergy diagnosis in children from homes with an annual income of $25,000 or less was half as often as in children from households where income ranged from $50,000 to $99,999 (Gupta et al., 2011). A study of the Houston Independent School District found disparity in the number of EAIs available between schools of high versus low socioeconomic status (Shah, Parker, Smith, & Davis, 2013). Schools with higher socioeconomic status had 6 times the number of EAIs, stocked or prescribed, than schools with lower socioeconomic status. Although the exact reasons for these disparities are unknown, two hypotheses have been proposed: the inability to access regular medical services and a lack of health literacy regarding food allergy signs and symptoms (Shah et al., 2013).

Stock EAIs can provide backup protection for students who cannot or do not maintain a device at school (Greenhawt & Weiss, 2012). Despite a diagnosed allergy and prescribed EAI, the World Allergy Organization noted the compliance rates of patients and caregivers carrying EAIs and remaining competent in their use decreases significantly over time (Simons et al., 2013). This is a particular problem with adolescents where the risk of anaphylaxis morbidity and fatality is disproportionately high (Greenhawt et al., 2018; Nwaru & Sheikh, 2015). Spina, McIntyre, and Pulcini (2012) found that only half of adolescents prescribed an EAI carried an unexpired auto-injector.

Although the purpose of the stock EAIs is not to replace parental responsibility, in some instances, parents do not provide the school with a student's prescribed EAI (Murphy, 2014). Greenhawt et al. (2018) stated that the original case for stock legislation as a safety net was bolstered by the publicity surrounding the anaphylaxis death of an elementary school student whose family could not afford an EAI at both home and school. Ben-Shoshan et al. (2008) found that only 52% of children prescribed an EAI had one available at school. Parents not providing the school with the prescribed EAI was reported by 72% of California school nurses (Morris, Baker, Belot, & Edwards, 2011). In Chicago Public Schools, which predominantly serve lower income and minority students, Gupta et al. (2014) noted that only 50.9% of students with physician-documented food allergies had a current comprehensive health management plan, with personalized EAI directives on file. Furthermore, in 2018 the Food and Drug Administration acknowledged a national

shortage of EAIs (FARE, 2018), which could temporarily complicate maintaining a prescribed EAI at school.

Barriers to Stock EAIs in the School Setting

Before the 2013 federal legislation encouraging states to require stock EAIs, only 23 states had laws allowing for open-order EAIs in the schools (Allergy & Asthma Network, 2016). By 2016, 49 states adopted laws allowing for or requiring stock EAIs in the school, but each state was left in charge of crafting its own rules and regulations which are influenced by, but not limited to, nursing, pharmacy, and medical practice rules and boards; Departments of Education and Public Health; and legal liability consultants (FARE, 2016b). In turn, school districts then must adopt formal policies and protocols, compatible with state laws, pertaining to school anaphylaxis preparedness and the EAI stock (Tanner & Clarke, 2015). The administrative process for developing school policies and protocols can be lengthy and can involve multiple entities, thereby delaying or preventing schools from having undesignated stock EAIs.

Thorough and standardized education for anaphylaxis recognition by school nurses and staff is critical. A survey of experienced NASN school nurses demonstrated a gap in nurses' self-perceived knowledge versus objective knowledge on the topic of anaphylaxis (Allen, Henselman, Laird, Quiñones, & Reutzel, 2012). The nurses scored lowest on anaphylaxis compared with asthma and diabetes. A third of these nurses were unaware that a second EAI dose should be administered if the original symptoms had not abated. Without training, the initial presentation of anaphylaxis may be difficult to interpret (Schoessler & White, 2013). Hogue, Muniz, Herrem, Silvia, and White (2018) noted the lack of primary and secondary staff training on established protocols as a persistent process barrier to the appropriate recognition and treatment of school anaphylactic episodes, even where EAIs are available.

Early legislative support for stock EAIs met with opposition. For example, the American Association of School Administrators officially lobbied against the 2013 Federal legislation citing costs as a barrier and suggesting alternative legislation requiring first responders, not schools, to be EAI equipped (Ellerson, 2013). The California Teachers Association (2014) opposed stock law and teacher training, calling it an attempt to turn teachers into nurses, and also objected to stock EAI costs and disposal fees (Trigueiro, 2014). Despite current legislative authority, policy implementation may still prove challenging without support from administrators, school boards, and staff.

Funding for stock EAIs can be an important consideration because most state legislation was passed without state funding allocations for stock acquisition, maintenance, and epidemiologic data reporting (Wright, 2015). Many school districts have limited resources, which could be of concern given the six-fold price increase in the dominant market leader EpiPen®, from 2007 to 2016 (The EpiPen Shortage, 2018), and the relatively short shelf-life and need for stock EAI replacement in 12 to 18 months (Amneal Pharmaceuticals, Inc., 2018; Murphy, 2014). It may be possible for some schools to obtain stock funding through donations and community support (Schoessler, Albert, Levasseur, & Owens, 2013). As of 2018, Mylan Specialty continues to provide free or reduced-fee auto-injectors via the EpiPen4Schools program in the United States (Mylan, 2018). Some suggest, however, there is a problematic potential of paying for stock EAIs if donation programs are discontinued (Greenhawt et al., 2018). In 2017, Kaleo introduced their Kaléo Cares Product Donations Program which donates Auvi-Q® EAIs to U.S. elementary schools (Kaleo, 2017); however, at the time of this writing the program is currently not accepting donation applications until the web portal is upgraded (Kaleo Cares, 2019).

Indirect costs associated with stock implementation, training, and maintenance are incurred as well. Although Murphy (2014) stated that stock EAI direct costs were included in the Milwaukee Public School District's nursing budget, indirect costs, such as nursing administrative time and staff training, were not specifically noted. Wealthier districts seem to have fiscal advantages in regard to the undesignated EAI stock. An abstract published from a survey conducted at the 2015 Kansas School Nurse Association conference indicated that 60% of schools that stocked EAIs were in the top 10% of the wealthiest Kansas counties (Love et al., 2016). Although these early findings are not generalizable, such results warrant further investigation.

To facilitate the acquisition of stock EAIs, most school districts obtain an open-order prescription from their medical advisor (Murphy, 2014). However, not all schools have a physician consultant, which may make it necessary to seek out assistance from the district's workmen's compensation physician or a physician volunteer (Schoessler et al., 2013). Problems obtaining the open order have arisen when prescribing doctors were not granted specific liability coverage. California overcame this by amending its original legislation to include liability protection for prescribers (Daniels, 2015). But as recently as 2016, prescriber liability concerns remained in Florida, because it was required for a physician to have a patient relationship in order to prescribe (Allergy & Asthma Network, 2016).

Complex role demands, lack of confidence in trained staff, or insufficient school nurse staffing may negatively influence EAI stock establishment. School nurses serve populations with multiple and sometimes competing

health needs. With regard to anaphylaxis preparedness, the caseloads of typical school nurses can involve multiple schools and include direct care and case management of students with specific allergy and asthma action plans, in addition to schoolwide preparedness for any first-time events (Wahl et al., 2015). In the absence of a nurse, adequate training of unlicensed staff and task delegation to act with best practices is vital (Schoessler & White, 2013). In a survey of NASN members, however, although 92.4% expressed high confidence in their own ability to use EAIs, only 56.4% expressed confidence in the ability of non-nurses to do so (Allen et al., 2012).

Implications for Practice

The critical role of the nurse in preparation for and treatment of anaphylaxis in the school setting is one that includes advocacy. In the American Nurses Association (2015) definition of nursing, advocacy is a key component when providing care, whether to individuals, families, groups, communities, or populations. The International Council for Nurses (2012) also addressed the nurse's responsibility to support actions to meet the health needs of the public, paying special attention to vulnerable populations. Nurses are probably most familiar serving as patient advocates for individuals and families, but advocacy takes on a different form when dealing with communities and populations. In these matters, nurses may need to step outside their comfort zone to make a difference in the well-being of a community or population. Leadership, advocacy, and standards of practice efforts are clearly supported by The Framework for 21st Century School Nursing Practice (National Association of School Nurses et al., 2015). Nurses working in schools that do not have stock EAIs have an opportunity to play an important role in ensuring that the first-line treatment of choice for anaphylaxis is readily available. In addition, nurses can play a role in public education campaigns to recognize symptoms of anaphylaxis, the importance of early intervention, and the need to activate emergency medical services (Andrew, Nehme, Bernard, & Smith, 2018).

School nurses could be instrumental in national reporting and data collection related to EAI stock preparedness. Because state school nurses are often responsible for collecting data related to EAI administration, nursing leadership could help guide existing programs into a nationally uniform effort (Greenhawt et al., 2018). Historically, the NASN collected voluntary demographic data related to students with chronic health conditions such as asthma and life-threatening allergies (NASN, 2017). Because these are the common comorbidities seen in anaphylaxis (Lieberman et al., 2015), any future data collection projects might be adaptable to include pertinent preparedness information.

School nurses play a key role in staff education related to school anaphylaxis prevention and management using evidence-based interventions (NASN Learning Center, 2016; Schoessler et al., 2013). Formalized staff training must be considered and addressed in all EAI policy and procedure development. NASN continues to provide preparation training in order for nurses to then effectively educate unlicensed staff on EAI administration at their respective schools (NASN, 2018). Establishing plans for emergency treatment of anaphylaxis in the school setting and a coordinated and multidisciplinary approach led by the school nurse (CDC, 2013) are key to ensuring that students with known or unknown allergies are safe at school so that they can focus on learning (National School Boards Association, 2012).

The authors recognize that early intervention in anaphylaxis with the use of an EAI varies worldwide, with consistent access to EAIs limited in some countries (DaSilva & Castro, 2014). At a minimum, nurses in all countries need to be better able to recognize anaphylaxis, its first-line treatment with an EAI, and the serious adverse effects that may result without this intervention. Strategies for successfully implementing a stock supply of EAIs in a school should be shared at national and international conferences so that nurses can learn from each other and determine what might work best in their own school.

Conclusion

Despite current best-practice guidelines, there is evidence that in the United States, school anaphylaxis preparedness differs substantially across states (Hogue et al., 2016), and the establishment of emergency stock EAIs may not be widespread. Although the original strategy of implementing an undesignated stock EAI supply first and collecting data later may have been pragmatic, it has resulted in a paucity of knowledge and evidence, leading to an incomplete picture of school preparedness, EAI stock locations, utilization, and bona fide cost-benefit analysis. Anecdotal evidence from the EpiPens4Schools (Mylan, 2017) programs suggests that overall nationally, U.S. school stock EAI participation is increasing. Published success stories by state or district with accompanying data are limited. Although state or local data, which currently exist in isolation, could be collected and interpreted to facilitate a more comprehensive understanding of school anaphylaxis preparedness and evaluation of the stock EAI safety net, further investigation and studies are needed.

Access to a potentially lifesaving EAI intervention is of clinical relevance to school nursing as well as nursing

as a whole. Although the incidence of fatal anaphylaxis is reported to be low, the stakes are high. School nurses are in the ideal leadership position to advocate for the creation of anaphylaxis policies, treatment protocols, and the acquisition and maintenance of undesignated stock EAIs. Although the CDC term *voluntary guidelines* and the legislative implications of stock EAI laws *allowing* versus *mandating* infer optionality, the terminology should not diminish the role or significance of stock EAI program establishment in conjunction with a comprehensive anaphylaxis plan. Appropriate management of anaphylaxis in the school setting must include a coordinated approach led by the school nurse, which includes undesignated *stock* EAIs for use in accordance with evidence-based standards of care, state laws, and established school district policies.

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