


# The Evaluation of a Food Allergy and Epinephrine Autoinjector Training Program for Personnel Who Care for Children in Schools and Community Settings

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The Journal of School Nursing  
2015, Vol. 31(2) 91-98  
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sagepub.com/journalsPermissions.nav  
DOI: 10.1177/1059840514526889  
jsn.sagepub.com  


## Abstract

With the dramatic increase in the incidence of food allergies, nurses and other school personnel are likely to encounter a child with food allergies. The objectives of this study were to assess the effectiveness of in-person training on enhancing knowledge about food allergies and improving self-confidence in preventing, recognizing, and treating food allergy reactions and to collect information about prior training and participation in response to food allergy incidents. A total of 4,818 individuals at 247 schools and community sites participated in the training program, which was delivered by a licensed registered nurse. Written evaluations, online surveys, and phone interviews were used to measure the impact including content retention, confidence, and behavior changes. The results of this study show that in-person training can increase participant's knowledge about food allergies and improve self-confidence in preventing, recognizing, and treating allergic reactions and that these gains were sustained over time.

## Keywords

food allergies, anaphylaxis, epinephrine pen, EpiPen<sup>®</sup>, school nurse, emergency action plan, food allergy action plan, individual health plan, training program, school-aged children

## Introduction

Recent studies show that the prevalence of childhood food allergies in the United States is increasing (Boyce et al., 2010; Burks et al., 2011; Fenton & Sampson, 2011; Fleischer et al., 2012; Sicherer, Munoz-Furlong, Godbold, & Sampson, 2010). The Centers for Disease Control and Prevention reported an 18% increase in food allergies among school-aged children from 1997 to 2007, and results of several studies of children with food allergies indicated that 16–18% have experienced a reaction in school (Nowak-Wegrzyn, 2012a; Sicherer, Furlong, Munoz-Furlong, Burks, & Sampson, 2001). Food allergies are now estimated to affect 1 (8%) in 13 children in the United States (Gupta et al., 2011). Given the prevalence of allergies, it is likely that most school personnel will work with a child with the potential for severe or life-threatening reaction.

Although allergy can arise to almost any substance, the proteins in cow's milk, eggs, peanuts, tree nuts, wheat, soy, fish, and shellfish are responsible for 90% of all food allergic reactions (Boyce et al., 2010). Peanut allergy is now estimated to affect 1% of all children in the United States

and allergies to peanuts and tree nuts are the leading cause of fatal reactions in children in the United States (Sicherer et al., 2010). Reactions range from mild to severe and can lead to anaphylaxis, a severe, potentially fatal, systemic allergic reaction that is rapid in onset and may cause death (Boyce et al., 2010). Prompt recognition and management of food allergy reactions are essential to ensure a good outcome, with immediate epinephrine administration as the primary medical therapy (Sampson et al., 2006).

Education about allergen avoidance and early recognition of the symptoms of an allergic reaction are of primary importance to help prevent fatal outcomes (Sicherer & Mahr, 2010). To this end, we developed a training program

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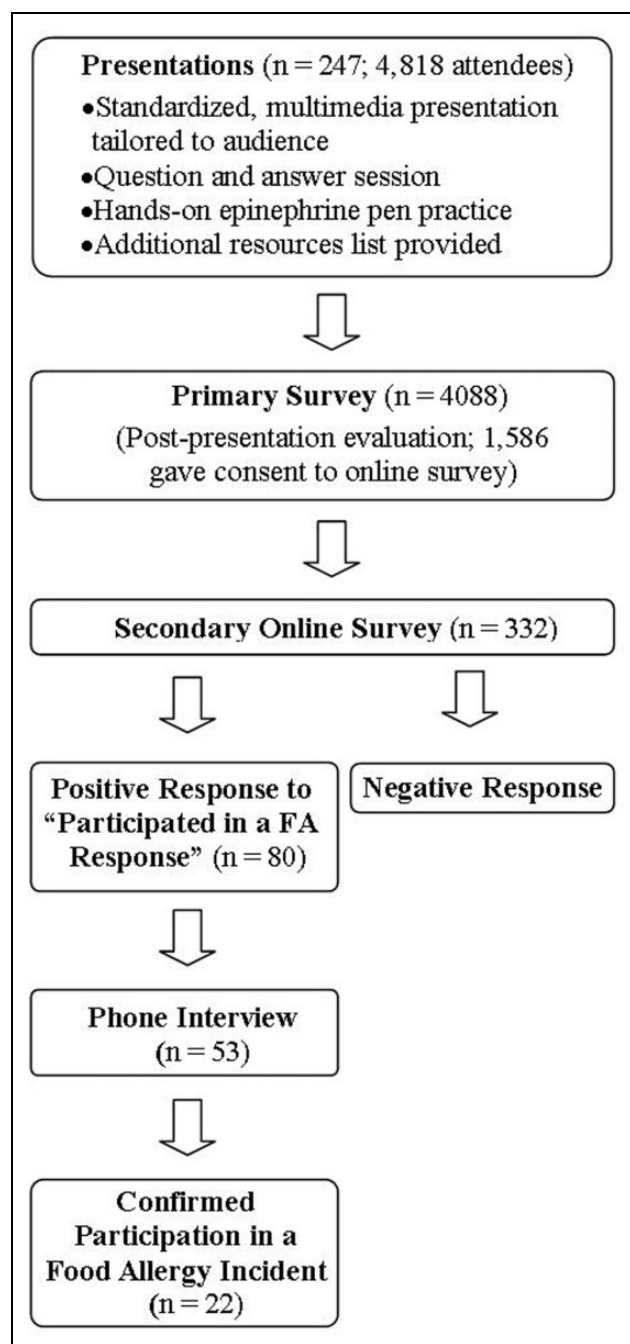
intended to help create a safer environment for children with food allergies. This study describes the development, implementation of the program, and evaluation of its effectiveness.

## Method

The training program included a 45-min standardized presentation delivered by a Food Allergy Educator who is a licensed registered nurse. The presentation was designed to teach participants key facts about food allergies, how to avoid an allergic reaction, recognize the signs and symptoms of an allergic reaction, and the importance of immediate treatment. It also included epinephrine autoinjector training using EpiPen<sup>®</sup> trainers and a demonstration using a viable EpiPen used on an injectable surface. A list of supplemental resources listing key facts and sources for additional information was created and distributed to all participants and a web page for the program was created ([www.seattlechildrens.org/foodallergy](http://www.seattlechildrens.org/foodallergy)). Information about availability of the program was mailed to school nurses, school administrators, and child care centers located in the greater Seattle/King County/Metropolitan area. School nurses and public and private school principals were sent the information prior to the beginning of the new school year so that they could plan to have us present the information at their staff trainings in late August and early September. Summer camp nurses and administrators with site locations within a 3-hr drive from Seattle were sent information each spring in advance of mid-June staff trainings. Whenever possible, presentations were geographically clustered. Child care providers who attended the presentation were eligible to receive one continuing education credit through the Washington State Department of Early Learning, and school nurses and dietitians were eligible for continuing education credit through their professional organizations. Seattle Children's Institutional Review Board approved the study.

## Data Collection and Analysis

The study design is shown in Figure 1. Three evaluation tools were developed; a primary survey to be completed immediately following the presentation, a secondary online survey, and a phone interview survey. Presentations were delivered and data were collected between March 2009 and April 2012. The primary survey was completed immediately following the presentation and asked attendees about their role, whether they had received prior food allergy training and whether they had ever administered an epinephrine pen to a child under their care. The survey also asked whether attending the presentation resulted in an increase in knowledge about food allergies, and in their ability to prevent, recognize, and respond to an allergic reaction by administering epinephrine. Finally, attendees were asked whether they were likely to change the way they managed children with food allergies as a result of the presentation. Response options for that question



**Figure 1.** Study design.

included “Rather likely,” “Not likely—already following best practices,” “Not likely—material not relevant,” or “N/A—children not under my care.” In the initial stages of the study, a small number of surveys included other options such as “Very likely” and “Somewhat likely.” Those response choices were eliminated from later surveys and were into one category called “likely” in order to simplify the survey and analysis of the data collected.

Three to twelve months following the presentation, attendees who gave consent for follow-up on the primary survey

were sent an online survey that asked about whether they still felt more confident in their ability to prevent, recognize, and treat allergic reactions, whether they had participated in a response to a food allergy incident since attending the presentation, and whether the information they received during the presentation helped them to respond appropriately. To determine whether the time interval since the presentation affected how well the increased confidence persisted, the responses were grouped by the following time intervals since the presentation: 0–3 months, 3–6 months, 6–12 months, and 12+ months. Respondents were also asked to recall three messages from the presentation to test retention of the information.

Phone interviews were done with respondents who indicated on the secondary online survey that they had participated in a response to a food allergy incident and had volunteered to be contacted for further follow-up. Three attempts at contact were made by e-mail or phone. Phone interviewees were asked to provide details about the incident, the response and whether an emergency plan was in place, and the value of the presentation we provided in helping the person to respond to the incident. Prior to asking the interview questions, interviewees were instructed not to provide identifying details such as the name of the site where the incident occurred or the name of the child involved. Specific questions about the incident included the age of the child, whether they had asthma, whether the allergen was known, and whether they had experienced a serious allergic reaction in the past. Questions about the response included describing the steps that were taken to help the child, whether epinephrine or another medication was administered, and whether the child was transported to the emergency room. Finally, the interviewee was asked to describe which part, if any, of the food allergy presentation was most helpful in responding to the incident.

All data were analyzed using contingency tables. Response frequencies were calculated for each individual question in the primary written and secondary online surveys based on the number of respondents answering the question. The FREQ procedure within SAS Version 9.2 was used to create the contingency tables.

## Results

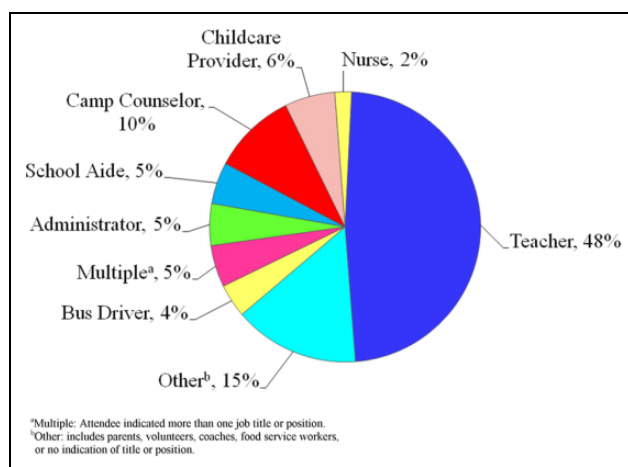
### Primary Survey Data

The locations of the presentations are shown in Table 1. Presentations occurred at 247 schools, community, and educational settings throughout Washington state between March 2009 and April 2012. The majority of sites were visited only once but repeat visits did occur for training of new staff and in the case of a food allergy incident occurring. As seen in Table 1, schools were the most common presentation site, followed by summer camps. Presentations to school nurses were distinct from presentations at schools, as they

**Table 1.** Presentations ( $n = 247$ ).

|                                 | Count |
|---------------------------------|-------|
| Schools                         | 159   |
| Preschools/child care providers | 82    |
| Montessori schools              | 9     |
| Elementary schools              | 60    |
| Middle Schools                  | 7     |
| High schools                    | 1     |
| Summer camps                    | 40    |
| School nurse training           | 22    |
| School transportation           | 3     |
| Government agencies             | 2     |
| Other <sup>a</sup>              | 21    |

<sup>a</sup>Other category includes parents, coaches, parent groups, community centers, children's museums, environmental learning centers, health centers, Head Start leadership conferences, before- and after-school programs, and food service personnel.



**Figure 2.** Position/title of presentation attendees who completed the postpresentation evaluation ( $n = 4,088$ ).

occurred during district-sponsored, in-service trainings and district and regional conferences.

All attendees ( $n = 4,818$ ) were asked to complete the primary survey following the presentation. A total of 4,088 (84%) individuals completed some or all of the survey. Respondents were asked to identify their role or position. As seen in Figure 2, teachers were the largest group receiving the presentation and made up 48% of the attendees. Camp counselors were the next most common attendee and represented 10% of attendees. Child care providers were the third largest group representing 6% of the total, followed by program administrators (5%), school aides (5%), and people reporting that they had more than one role or position (5%). Attendees whose position or role was not listed as an option on the survey represented 15% of the respondents. The most common role or position for people in this category, which was designated as “Other” included parent, volunteer, food service worker, and coach.

The survey asked whether attendees had received food allergy training prior to the presentation we provided.

**Table 2.** Attendees With Prior Food Allergy Training ( $n = 2,156$ ).

| Role                 | % (n)      |
|----------------------|------------|
| School nurses        | 94 (92)    |
| Administrators       | 69 (141)   |
| Teachers             | 59 (1,102) |
| School aides         | 54 (96)    |
| Food service         | 51 (32)    |
| Child care providers | 42 (105)   |
| Camp counselors      | 32 (135)   |
| Other <sup>a</sup>   | 21 (453)   |

<sup>a</sup>Other includes bus drivers, parents, volunteers, coaches, and respondents with more than one position/title.

**Table 3.** Rate of Epinephrine Use and Prior Training by Role ( $n = 163$ ).

| Role                        | % (n)   | Prior Training, % (n) |
|-----------------------------|---------|-----------------------|
| Nurse                       | 29 (25) | 96 (24)               |
| Administrator               | 9 (16)  | 94 (15)               |
| School aide <sup>a</sup>    | 5 (9)   | 89 (8)                |
| Teacher                     | 4 (62)  | 77 (48)               |
| Child care provider         | 1 (3)   | 100 (3)               |
| Camp counselor <sup>b</sup> | 1 (5)   | 80 (4)                |
| Multiple <sup>c</sup>       | 10 (17) | 82 (14)               |
| Other <sup>d</sup>          | 16 (26) | 69 (18)               |

<sup>a</sup>School aide includes health, lunchroom, classroom, and playground aides.

<sup>b</sup>Camp counselors include before and after school programs and summer camps.

<sup>c</sup>Attendees identifying with more than one position/title. <sup>d</sup>Other category includes parents, coaches, bus drivers, and so on.

Overall, only 55% of primary survey respondents reported prior training on the recognition and prevention of food allergy reactions. Table 2 shows the percentage of attendees in various roles who reported having prior training. Not surprisingly, most school nurses who completed the survey reported having prior training (94%). This training was typically received at in-service trainings, regional conferences, or all staff trainings. Fifty-nine percent of the teachers and 54% of school aides reported having prior training. Only 32% of camp counselors and 42% of child care providers reported prior food allergy training.

A total of 163 people (4.6% of respondents) reported administering epinephrine to a child under their care. The rates of epinephrine administration among individuals in the various roles or positions are shown in Table 3. Not surprisingly, the rate of administration was highest for nurses (29.1% of nurses who completed the survey), followed by administrators (8.9%) and school aides (5.3%). Sixty-two (3.6%) teachers reported administering epinephrine.

As seen in Table 3, prior training among people reporting that they had administered epinephrine ranged from 69.2% to 100% depending on their position or role. Ninety-six percent of the nurses (24 of 25) who reported administering epinephrine reported prior training as did 93.8% (15 of 16) of administrators and 88.9% (8 of 9) of school aides. Of the

62 teachers who reported administering epinephrine, 48 (77.4%) reported prior food allergy training. Of note is that 7.0% of the 2,156 people who reported having previous food allergy training also reported administering an epinephrine pen to a child under their care. In contrast, only 1.3% of the 1,835 people who reported no previous training reported administering an epinephrine pen to a child under their care.

Table 4 shows the opinion statements on the primary survey and the percentage of people who responded positively. For all statements, more than 94% of respondents indicated that as a result of the presentation, they felt more confident in their ability to prevent, recognize, and respond to a food allergy reaction. The person's role did not significantly impact their response and the ranges of positive responses for the roles described in Figure 2 are also presented in Table 4. Of note, the positive responses to the opinion statements were independent of whether the person had received prior training.

The survey also asked whether attendees were likely to change the way they managed or supervised children with food allergies who were under their care as a result of the presentation. Overall, 66% ( $n = 2,566$ ) of the respondents reported that they were likely or somewhat likely to change the way they managed children with food allergies. Table 5 shows the percentage of respondents by role who indicated that they were likely to change their management strategies. The groups most likely to change the way they managed or supervised children with food allergies were camp counselors (80%) and school aides (70%). For those respondents who indicated that they were unlikely to change their management strategies, the survey asked whether that was due to the fact that they were already following best practices, whether they felt the information was not relevant to their situation, or whether there was another reason. We were encouraged by the fact that 89% of those who reported that they were not likely to change their management strategies stated that it was due to the fact that they were already following best practices.

### Secondary Online Survey

Three to 12 months following the presentation a secondary online survey was sent to 1,586 attendees who gave permission for us to contact them. A total of 332 (21%) people completed part or all of the secondary survey. Fourteen people received the survey more than 12 months following the presentation. Their responses were included in the analysis.

The secondary survey asked respondents their position or title and several questions intended to measure retention of the information and about any responses to food allergy incidents they had participated in since the presentation. Table 6 shows the percentage of respondents who reported positive responses to survey questions about confidence in their ability to prevent, recognize, and respond to a food allergy incident. Overall, 95% of people who completed the survey responded positively to the statements. To determine whether the time interval since the presentation affected how



**Table 4.** Percentage of Respondents Responding Positively to Primary Survey Questions About Confidence.

| Survey Question   | % Responding Positively (Range for Role Categories Described in Figure 2) | Prior Training, % (range)        |
|---|---|----------------------------------|
| I feel more confident in my ability to prevent a food allergy reaction by controlling contact with allergens in the child's environment | 94% ( <i>n</i> = 3,812; 92–100%)  | 94% ( <i>n</i> = 2,013; 92–100%) |
| I feel more confident that I could recognize the signs and symptoms of a food allergy reaction in a child under my care                 | 96% ( <i>n</i> = 3,870; 94–100%)  | 96% ( <i>n</i> = 2,033; 91–100%) |
| I feel more confident that I know what to do in the event of a severe food allergy reaction   | 97% ( <i>n</i> = 3,880; 93–100%)  | 97% ( <i>n</i> = 2,045; 92–100%) |
| I feel more confident that I could successfully administer an epinephrine pen to a child  | 94% ( <i>n</i> = 3,724; 87–100%)  | 95% ( <i>n</i> = 1,985; 67–100%) |

**Table 5.** Respondents Likely to Change the Way They Manage or Supervise Children With Food Allergies.

| Role                 | % ( <i>n</i> ) |
|----------------------|----------------|
| Camp counselors      | 80 (331)       |
| School aides         | 70 (122)       |
| Administrators       | 66 (132)       |
| Teachers             | 65 (1,187)     |
| Child care providers | 62 (153)       |
| Nurses               | 59 (57)        |

**Table 6.** Percentage of Respondents Retaining a Positive Response to Primary Survey Questions Over a Period of 3–12+ Months.

| Survey Question   | % Responding Positively (Range for Time Interval Groupings) |
|---|---|
| I feel more confident in my ability to prevent a food allergy reaction by controlling contact with allergens in the child's environment | 95 ( <i>n</i> = 315; 90–99%)                                |
| I feel more confident that I could recognize the signs and symptoms of a food allergy reaction in a child under my care                 | 95 ( <i>n</i> = 312; 89–100%)                               |
| I feel more confident that I know what to do in the event of a severe food allergy reaction   | 95 ( <i>n</i> = 313; 90–98%)                                |

well the increased confidence persisted, the responses were grouped by the following time intervals since the presentation: 0–3 months, 3–6 months, 6–12 months, and 12+ months. The ranges of positive responses for the various time intervals are also shown in Table 6. The time interval since the presentation did not appear to affect the persistence of increased self-confidence.

As another way to assess how well the knowledge was retained, we asked respondents to provide three key messages that they could remember from the presentation. A total of 188 (57%) survey respondents were able to provide three correct messages. The most common messages that respondents recalled were how to administer an epinephrine

pen (provided by 99 respondents), strategies for avoiding allergens (91 respondents), treat immediately (91 respondents), signs and symptoms of an allergic reaction (81 respondents), call 911 after treatment (57 respondents), most common food allergens (55 respondents), and the importance of following a food allergy action plan (30 respondents).

We also sought to determine whether the information provided in the presentation had helped attendees respond in the event of food allergy incident so the secondary survey included questions about whether they had participated in a response to a food allergy incident since attending the presentation and whether the information provided helped them to respond.

Ninety-four people (28.7% of secondary survey respondents) reported that they had participated in a food allergy incident since the presentation, 91 (91.9%) of whom said that the information provided in the presentation helped them to respond appropriately. Eighty of those people consented to a phone interview so that we could learn more about the nature of the incidents and how they responded.

### Results of Phone Interviews

Phone interviews were completed with 53 people. The interviews revealed that 22 of the 53 people had participated in a confirmed response to a food allergy incident, which we defined as any of the following: detectable symptoms of allergic reaction such as hives, rash, breathing difficulties, or anaphylaxis, administration of medication including Benadryl or epinephrine, and exposure to known allergen. The remaining individuals misunderstood the question on the secondary survey, could not remember details, or declined to provide sufficient detail to allow confirmation. The roles or positions of the 22 people who participated in the responses included eight teachers, eight program administrators, and one each of child care provider, administrative assistant, and a cook. All but one person directly participated in the response. Of the 22 individuals, 18 (81%) who directly participated in a response to a food allergy incident reported having prior training on the primary survey in addition to attending our presentation. Additionally, according to the primary survey results, three of these individuals had

previously administered epinephrine to a child under their care prior to this food allergy incident.

Of the 21 incidents, 12 occurred at preschools or child care centers. The other incidents occurred at Head Start programs (2), private elementary schools (3), public elementary schools (2), a parent meeting (1), and a summer camp (1). Two survey respondents participated in the same incident. Of significance is that of the 21 incidents, 9 reactions were to previously unknown allergens. In these incidences, participants reported that they recognized the signs and symptoms of an allergic reaction and provided first aid treatment and/or called either 911 or the child's parent. For the incidents where the allergen was previously documented, the allergens were peanuts (2), tree nuts (3), fruit (4), milk (2), and egg (1). Of the 21 people, 13 stated that the information we presented about how to recognize the signs and symptoms of an allergic reaction was useful in helping them to respond to the incident, and 11 of 21 people stated that the hands-on epinephrine pen training had helped them to respond appropriately to the incident.

## Discussion

The objectives of this study were to assess the effectiveness of an in-person food allergy education presentation on increasing knowledge about food allergies and perceived self-confidence in preventing, recognizing, and treating allergic reactions. We also assessed whether the positive effects of attending the presentation were sustained and whether the knowledge and confidence gained helped participants respond appropriately to food allergy incidents.

Collectively, our data show that training from a nurse educator that includes a presentation and hands-on demonstration of the correct use of EpiPen can be an effective strategy for helping individuals who work with children feel more confident that they can prevent, recognize, and treat severe allergic reactions and increase knowledge. The positive results were independent of whether the participant had received prior training and were sustained for up to 12 months following the presentation. We were particularly encouraged that so many presentation attendees reported that they were likely to change the way they managed or supervised children with food allergies under their care as a result of the presentation, suggesting that the content we delivered would result in the creation of a safer environment for children with food allergies.

Our study revealed that only 55% of presentation attendees reported having prior training about food allergies. Not surprisingly, almost all nurses reported having prior training. We were surprised, however, to find that only 59% of teachers and 54% of school aides reported having prior training despite the fact that in Washington state, the Office of the Superintendent of Public Instruction Guidelines for Anaphylaxis, published in 2009, state that life-threatening allergy awareness training for all school staff should occur each school year. This suggests that providing food allergy

training to school personnel should continue to be an area of emphasis and that school nurses should be given the resources and support needed to accomplish this.

The incidence of prior training was low among camp counselors (32%), child care providers (42%), and food service workers (51%). This may be due in part to the fact that these jobs can be seasonal and/or have high rates of turnover. However, it does represent a significant safety concern and emphasizes the importance of providing regular ongoing training sessions, particularly in these types of settings.

In our study, the overall rate of prior administration of epinephrine among presentation attendees was 4.6%. Although most school districts track food allergic children internally, at present there is no national database for tracking food allergy incidents, epinephrine usage, or anaphylaxis so we do not know how this rate compares to that in other areas. Interestingly, the rate of epinephrine administration appeared higher among attendees reporting prior training (7.0%) compared to attendees who did not report prior training (1.3%). Although we could not assess statistical significance of this result due to the limitations of the study, the findings could suggest that receiving food allergy training increases the likelihood that a person will administer epinephrine if called upon. Although the rate of epinephrine administration was highest among nurses, in our study, 8.9% of school and program administrators, 5.3% of school aides, and 3.6% of teachers also reported administering epinephrine. Since a variety of individuals work with students throughout the day and may be called upon to help with emergency situations, particularly in the absence of a nurse, this further emphasizes the need to provide mandatory, comprehensive food allergy training to all personnel in schools, camps, day cares, and other community settings.

In this study, we were able to collect information about 21 confirmed allergic reactions that occurred subsequent to attending our food allergy presentation using phone interviews. Of particular significance is that 9 of 21 reactions were to unknown allergens, which further emphasizes the importance of personnel who care for children being able to identify the early signs and symptoms of an allergic reaction, even when there is no exposure to a previously documented allergen. The most common responses to the question about which part of the training was most helpful in responding were clear descriptions of the signs and symptoms of an allergic reaction and hands-on epinephrine pen training.

## Limitations

This is a descriptive observational study and as such had no control group. All data were self-reported and responses rely heavily on respondent's recall of past occurrences and willingness to provide information about incidents. Additionally, 23 of the 247 presentation sites received more than one visit so it is possible that we collected multiple responses from the same person. Since our data were collected anonymously, it was not possible to remove duplicate survey responses.

## Implications for School Nursing Practice

Our study reinforces that training provided by a nurse which includes a presentation and hands-on demonstration of the correct use of EpiPen can be an effective strategy for increasing knowledge about food allergies and confidence to prevent, recognize, and treat severe allergic reactions in people who work with children. Among the data collected in this study were details about 21 confirmed food allergy incidents. Emergency plans were in place for most of the children with documented food allergies, although plans were not always followed due to lack of prescribed medication, calling parents or health care providers first, or because the reaction was to an unknown allergen. School nurses should be provided with the resources and time to ensure that all staff at facilities that care for children are familiar with existing emergency plans for all of the children under their care and that they also know how to respond in the case of a first reaction or reaction to a previously unknown allergen. Although staff may resort to calling parents first for guidance, this could result in a delay in necessary and potentially life-saving treatment. Additionally, the inability of school staff to recognize symptoms and to follow an emergency plan is a well-documented source of treatment delay (Sicherer et al., 2001). Practicing food allergy drills that include using epinephrine pens and potential real-life scenarios could help prepare staff for the specific steps that they may need to take to help children who are experiencing food allergic reactions at their site. Since food allergy reactions can happen anywhere and anytime, real-life case studies relevant to the classroom, lunchroom, school events, and field trips, should be incorporated into the training sessions.

One challenge that school nurses throughout the United States continue to face is that health care providers may write specific emergency action plans for their patients that conflict with their current school district and the American Academy of Asthma, Allergy and Immunology guidelines, which can create both confusion and potential increased risk of anaphylaxis due to delay in appropriate treatment. Several recent studies identify undertreatment of severe reactions with epinephrine as a significant safety concern (Boyce et al., 2010; Carlisle et al., 2010; Fleischer et al., 2012; Nowak-Węgrzyn, 2012b). School nurses are in a unique position to be able to work with both providers and parents to ensure the safety of children under their care.

## Declaration of Conflicting Interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

## Funding

The author(s) disclosed receipt of the following financial support for the research, authorship, and/or publication of this article: Financial support for this project was provided by a grant from Food Allergy Research and Education (Formerly Food Allergy Initiative). The EpiPen<sup>®</sup> training devices used in this study were

provided by Dey<sup>®</sup>, Inc. Napa, California. The Twinject<sup>®</sup> and Adrenaclick<sup>®</sup> training devices were provided by Shionogi<sup>®</sup> Inc.

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