



Letter

Effectiveness of a computer module to augment the training of school staff in the management of students with food allergies

Food allergies have increased dramatically in children, affecting approximately 1 in 25 school-age children,^{1,2} with delays in treatment contributing to increased death,³ which can occur in school or daycare.⁴ The presence of nurses in schools varies greatly,⁵ suggesting a role for school staff with appropriate training. However, current training is informal and evidence-based training consistent with the Centers for Disease Control and Prevention guidelines is scarce. The purpose of this study was to evaluate the effectiveness of a computer-based learning module as an additional teaching tool to increase the knowledge and confidence of school staff in the recognition and management of food allergies.

This pre- and post-test study was implemented during the 2012 through 2013 school year by school nurses of the Massachusetts School Nurse Research Network interested in participation. The nurses presented the study at the beginning of the school year at orientation or a staff meeting as an option to the usual nurse-led didactic training. Usual nurse-led epinephrine administration demonstration was scheduled after the post-test. The voluntary convenience sample of school staff was at least 18 years of age; able to read, write, and speak English; and able to operate a computer. No one was excluded from participation.

The intervention was a 30-minute, self-directed, noninteractive computer module, including visual PowerPoint (Microsoft Corp, Redmond, Washington) slides with audio presenting the fundamentals of food allergies; prevention, symptoms, and management of reactions; auto-injector administration; and social emotional issues. The program was created by pediatric allergists with guidance from the Massachusetts Department of Public Health School Health Services and reviewed by national experts and organizations to help school nurses deliver to staff content consistent with the Centers for Disease Control and Prevention and Massachusetts food allergy guidelines. This freely available online program has been edited twice since this study and can be accessed at <http://www.allergyhome.org/schools/management-of-food-allergies-in-school-what-school-staff-need-to-know/>.

The authors created paper pre- and post-tests with school nurses and pediatric allergists to measure knowledge, confidence, and attitude. The 11-item knowledge test was adapted from a test used by a Massachusetts school district and was scored 1 point for each correct answer. Confidence was measured by 4 items and attitude by 7 items on a 5-point scale, with a higher score suggesting greater confidence and a favorable attitude. A written evaluation described the location and timing of the module,

comparison with prior allergy training, and whether new allergy issues were raised. Pre- and post-test differences were tested by paired *t* tests (eMethods).

Most participants (88%) were women and teachers (68%), with the remaining participants reported as administrators, secretaries, or cafeteria staff (eTable 1). The sample included 85 participants from 6 schools (eTable 2). Response rates ranged from 8% to 36%, possibly owing to the start of the academic year and many professional commitments.

Participants reported significant increases in knowledge, confidence, and attitude scores ($P < .001$; Table 1, eTables 3–5). The sensitivity of change was tested by stratifying the sample into teachers ($n = 58$) and all other staff ($n = 27$). No significant difference was noted between the 2 groups by paired *t* tests or independent *t* tests. The 2 groups showed a significant increase in pre- and post-test scores. A regression was run to control for the variation of nursing hours, student enrollment, and staff experience. After controlling for full-time equivalent of nurses, student enrollment, and experience, the significant differences in knowledge, confidence, and attitude remained. On average, the knowledge pretest scores were 1.57 U lower than post-test scores ($P < .001$), confidence pretest scores were 3.09 U lower than post-test scores ($P < .001$), and attitude pretest scores were 2.92 U lower than post-test scores ($P < .001$).

In particular, the item regarding the risk of bullying increased from 29.4% of participants at pretest agreeing that children with food allergies are at risk of being bullied to 85.9% agreeing with the risk at post-test.

The significant increase in knowledge is important because of the large percentage of staff with previous training in a state that requires emergency anaphylaxis protocols and the reporting of anaphylaxis and epinephrine administration. The ease, flexibility, time of training, and positive experience suggest the feasibility of the program for school staff. The increase in scores, although significant, was small and the clinical significance is unclear; however, the staff reported learning new information, including allergens in nonfood school products; auto-injector insertion; anaphylaxis symptoms; effective surface cleaning; and hand washing. The increase in score of even 1 item can affect the prevention, recognition, or reaction in a child with an allergy. The clinical significance could be even greater in schools without a school nurse or other training program.

The increased recognition that children with food allergies are at risk for being bullied was not an anticipated finding and one that requires further study. In a study of individuals with food allergies reporting experiences with bullying, 21.4% reported staff as the perpetrators.⁶ This particular training appeared to influence staff's perception of the risk for being bullied and has implications to

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Table 1
Changes in knowledge, confidence, and attitude^a

	Pretest, mean (SD)	Post-test, mean (SD)	SEM
Total group (N = 85)			
Teachers (n = 58)			
Other staff (n = 27)			
Knowledge	8.6 (1.3)	10.1 (1.1)	0.15734
Teachers	8.6 (1.3)	10.2 (1.1)	0.18115
Other staff	8.2 (1.2)	9.9 (1.1)	0.31038
Confidence	11.5 (3.3)	14.6 (1.6)	0.30889
Teachers	11.4 (3.2)	14.5 (1.7)	0.35086
Other staff	11.4 (3.4)	14.7 (1.4)	0.62382
Attitude	23.0 (2.9)	26.0 (2.1)	0.25426
Teachers	22.9 (2.9)	26.1 (2.0)	0.30629
Other staff	22.9 (2.9)	25.4 (2.3)	0.45407

^aP < .001 by paired t test.

decrease bullying, recognize children at risk for bullying, and intervene sooner if a child is being bullied.

Limitations of this study include its homogeneity, the small convenience sample, lack of a control group, self-selection bias such as facility with computers, and the unique characteristics of the schools and state. The study measurements were not previously validated, and although the pre- and post-test differences were significant, the clinical significance was not statistically measured.

These findings are encouraging and novel in showing the feasibility, practicality, and effectiveness of this computer-based model and provide evidence for larger-scale evaluation and consideration of dissemination in other school settings to determine its effectiveness.

This online module could enhance school preparedness in addressing the needs of students with food allergies. Awareness in adult learners regarding the increased risk for bullying of children with food allergies also could arise from this training.

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Supplementary Data

Supplementary data related to this article can be found at <http://dx.doi.org/10.1016/j.anai.2014.11.020>.

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eMethods

The Massachusetts School Nurse Research Network, a group of more than 100 school nurses interested in developing evidence-based health care in schools, was approached by pediatric allergists in June 2012 about testing a computer module to help train school staff in the prevention, recognition, and management of children with food allergies. Owing to the necessity to prepare a pilot study for implementation in 2 months at the start of the academic year, the procedure to recruit interested school nurses was amended. Rather than the usual electronic request for school nurses who might be interested in the research topic, several nurses most directly involved with the Massachusetts School Nurse Research Network requested involvement of the nurses in their respective school districts, resulting in the participation of 6 schools (eTable 2).

Approval for the study of human subjects was obtained by the Boston College institutional review board with written permission from the school principals. Written, voluntary informed consent was obtained from all participants. The nurses followed a prepared script to recruit staff at the new employee orientation or staff meeting at the beginning of the school year. The charter school director required the use of the intervention module for the entire school staff; however, participation in the study was voluntary. Staff who would be in the position to administer epinephrine would be required to demonstrate EpiPen administration to the school nurse regardless of whether they participated in the study and would receive the nurse-led EpiPen teaching and demonstration after the post-test. The usual format for training consisted of basic information about the most common symptoms of anaphylaxis, auto-injector administration, and transport protocol led by the school nurse with a short PowerPoint presentation and auto-injector demonstration in the charter school. The other schools used the instruction video accompanying the EpiPen with a nurse demonstration of EpiPen administration and nurse-led teaching based on the Massachusetts Department of Elementary and Secondary Education and Department of Public Health guidelines. The computer module contains more details about symptoms of an allergic reaction, sources of allergens, prevention, and psychosocial issues such as bullying.

The sample size was based on a voluntary convenience sample of school staff scheduled for employment within the designated schools. A power analysis with a power of 0.80, an α value equal to 0.05, an estimated effect size of 0.50 for a single group, and paired *t* tests required a minimum total sample size of 34. At the 6 schools, 409 staff members were eligible. One hundred five staff members agreed to participate. After accounting for missing data at the pretest ($n = 2$) and post-test ($n = 18$), the analyzed sample included 85 staff members. We acknowledge that the small number of participants could reflect the competing mandatory demands for staff at the start of an academic year. However, by modifying the timing of these trainings, future piloting and surveying of staff could help

minimize this burden. Furthermore, if larger-scale studies determine benefit, then policy changes could help improve implementation of this program.

The pretest was administered immediately before viewing the module if it was viewed in the school setting or 24 to 48 hours before viewing the module offsite. When the pretest was returned, the school nurse sent an email with the link for the module to the individual staff member. The participants were asked to bring the online completion certificate to the nurse's office. The post-test needed to be completed within 1 to 2 weeks of viewing the module.

Measurements

The measurements were developed by the consensus of school nurses and pediatric allergists. The knowledge test was based on the currently used evaluation tool developed by a Massachusetts school district, which represented the knowledge perceived most important for the safety of children consistent with Massachusetts guidelines. This school district did not participate in the study. The test was reviewed by 8 school nurses and 2 pediatric allergists and adapted to include salient information presented in the module. The confidence and attitude scales were developed by the authors with school nurses to identify the most important factors with which staff should feel confident to keep students safe and attitudes perceived to contribute to student and family support.

Confidence was measured by 4 items measured on a 5-point scale (0 = not at all confident; 4 = very confident), for a total possible score of 0 to 16, with a higher score suggesting greater confidence in the recognition and management of food allergies. Attitude was measured by 7 items measured on a 5-point scale (0 = strongly disagree; 4 = strongly agree), for a possible score of 0 to 28, with a higher score suggesting a favorable attitude to the issues affecting children with food allergies (eTables 2–4).

The internal consistency of the confidence and attitude scales was tested by the Cronbach α , a statistical test to evaluate whether the items were correlated enough to reflect an adequate measurement of the construct. The Cronbach α coefficient of a new scale is considered adequate with a coefficient greater than 0.70. The confidence scale pre- and post-test Cronbach α values were adequate (0.88 and 0.82, respectively). The attitude scale pre- and post-test Cronbach α values were adequate (0.70 and 0.72, respectively). Therefore, the Cronbach α values reflect the adequacy that the confidence and attitude scales were likely measuring the respective constructs of confidence and attitude.

Data were analyzed using IBM SPSS Statistics 21 (IBM, Armonk, New York). Descriptive analyses were used to describe the study participants and data evaluated for missing values, outliers, and skewness. Paired *t* tests were used to test the differences in knowledge, confidence, and attitude pre- and post-test. A regression was run to evaluate the effect of school nurse hours (full-time equivalent), student enrollment, and staff school experience.

eTable 1
Demographic characteristics

Characteristic (N = 85)	n, (%)
Sex	
Men	10 (11.8)
Women	75 (88.2)
Role	
Teacher	58 (68.2)
Administrator	3 (3.5)
Secretary	2 (2.4)
Support	15 (17.7)
Custodian	0
Cafeteria	3 (3.5)
Coaching	0
Transportation	0
Other	4 (4.7)
Number of years	
0–5	19 (22.4)
6–10	27 (31.8)
11–15	21 (24.7)
16–20	10 (11.8)
>21	8 (9.4)

eTable 3
Percentage of correct items on knowledge pre- and post-training module test

Item	Pretest, %	Post-test, %
Which method is an effective way to clean hands of allergens?	22	55
Which method is an effective way to clean tables of allergens?	57	69
Which classroom item could be a source of a potential food allergen?	64	81
Which of the following sequences of actions is in an appropriate order in the event that a child with a known allergy is experiencing anaphylaxis (a life-threatening reaction)?	74	84
It is okay to wait and see if a mild anaphylactic reaction will resolve before giving epinephrine?	71	83
If you know a child has previously a food safely, you do not need to read the label again.	80	84
Using a sponge is a preferred method to clean tabletops in the cafeteria.	83	85
For the EpiPen, does the needle come out the blue or the orange end?	58	81
After injecting the epinephrine, how long does the EpiPen need to be held in place against the thigh?	59	72
Epinephrine auto-injectors are given in the:	80	83
Students with anaphylaxis should be transported to the hospital by:	81	83

eTable 2
Study settings by individual schools

School completion	Staff, total	Student, total	School type	Nurse FTE	Participants, n (%school staff)
K–5	74	344	public	1	6 (8.1)
Pre-K	30	164	public	0.8	3 (10.0)
K–5	35	267	public	1	4 (11.4)
K–5	88	671	public	1	10 (11.4)
6–8	134	1,216	public	2	8 (7.0)
K–12	148	1,203	public charter	2	54 (36.5)

Abbreviations: FTE, full-time equivalence; K, kindergarten.

eTable 4
Pre- and post-test perceived confidence scores (N = 85)

Confidence items	Pretest, n (%)	Post-test, n (%)
How confident do you feel in your ability to manage students with life-threatening allergies?		
Very confident	20 (23.5)	50 (58.8)
Fairly confident	38 (44.7)	34 (40)
Somewhat confident	17 (20)	1 (1.2)
Not too confident	8 (9.4)	—
Not confident	2 (2.4)	—
How confident do you feel in your knowledge about how to prevent exposure to food allergies?		
Very confident	33 (38.8)	67 (78.8)
Fairly confident	33 (38.8)	18 (21.2)
Somewhat confident	19 (22.4)	—
How confident do you feel in your ability to recognize the symptoms of anaphylaxis (a life-threatening allergic reaction)?		
Very confident	24 (28.2)	53 (62.4)
Fairly confident	36 (42.4)	30 (35.3)
Somewhat confident	15 (17.6)	2 (2.3)
Not too confident	8 (9.4)	—
Not confident	2 (2.4)	—
How confident do you feel in your ability to treat anaphylaxis (a life-threatening allergic reaction)?		
Very confident	19 (22.4)	54 (63.5)
Fairly confident	37 (43.5)	29 (34.1)
Somewhat confident	17 (20)	2 (2.4)
Not too confident	8 (9.4)	—
Not confident	4 (4.7)	—

eTable 5

Pre- and post-test perceived attitude scores (N = 85)

Attitude items	Pretest, n (%)	Post-test, n (%)
It is reasonable to keep allergens out of a classroom where there are students with food allergies.		
Strongly agree	56 (65.9)	69 (81.2)
Agree	24 (28.2)	14 (16.5)
Not sure	4 (4.7)	—
Disagree	1 (1.2)	2 (2.3)
It is reasonable not to allow outside food (eg, baked goods, candy, or fruit) in the classroom for celebrations or parties.		
Strongly agree	37 (43.5)	60 (70.6)
Agree	32 (37.6)	23 (27.0)
Not sure	10 (11.8)	1 (1.2)
Disagree	6 (7.1)	—
Strongly disagree	—	1 (1.2)
Students with food allergies are at risk of being bullied by others in school.		
Strongly agree	7 (8.2)	31 (36.5)
Agree	18 (21.2)	42 (49.4)
Not sure	19 (22.3)	5 (5.9)
Disagree	35 (41.2)	5 (5.9)
Strongly disagree	6 (7.1)	2 (2.3)
If you witness food allergy-related bullying, it is your responsibility to intervene.		
Strongly agree	69 (81.2)	80 (94.1)
Agree	16 (18.8)	5 (5.9)
Yearly food allergy staff training is important.		
Strongly agree	53 (62.4)	71 (83.5)
Agree	28 (32.9)	14 (16.5)
Not sure	4 (4.7)	—
Food allergies in school are an important issue.		
Strongly agree	60 (70.6)	75 (88.2)
Agree	23 (27.1)	10 (11.8)
Not sure	2 (2.3)	—
Families in your school have reasonable concerns and expectations about the management of their child with food allergies.		
Strongly agree	42 (49.4)	61 (71.8)
Agree	30 (35.3)	22 (25.9)
Not sure	10 (11.8)	2 (2.3)
Disagree	3 (3.5)	—