

Evaluation of a training program on initial actions against anaphylaxis in children with food allergies in nursery schools

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Summary :

Objective : The present study aimed to evaluate the effectiveness of a training program on initial action to anaphylaxis for nursery school employees.

Methods : We developed and implemented a training program on initial actions against anaphylaxis aimed at compensating for a perceived knowledge deficit and reducing anxiety and lack of confidence among nursery school employees. A questionnaire survey was administered to nursery school employees who participated in the training program at pre-training, post-training, and 6 months post-training. Effectiveness of the program was evaluated using Kirkpatrick's Four Levels of Training Evaluation Model.

Results : 155 participants completed the questionnaire. The level of hesitancy among nursery school employees in anaphylactic emergency action decreased significantly at post-training and 6 months post-training compared with pre-training. Understandings of 13 symptoms for which EpiPen[®] use is recommended improved significantly, although this was not the case for the symptom "difficulty breathing". After simulation training, specific areas for improvement in the nursery schools' emergency action plans were identified. These improvements were actually implemented by 6 months post-training.

Conclusions : The training program, which included simulation training, improved and maintained the levels of knowledge and technique among nursery school employees and promoted improvements in the emergency action plan.

Key words : adrenaline auto-injector (EpiPen[®]), anaphylactic shock, food allergy, nursery schools, program evaluation

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INTRODUCTION

The prevalence of food allergies is high in

infants : more than 90% of nursery schools have children with food allergy¹⁾. Approximately 20% of nursery schools have children who carry an adrenaline auto-injector (EpiPen[®]), and incidents of accidental ingestion have occurred in approximately 50% of nursery schools¹⁾. Despite strict countermeasures, allergies can still occur when various factors in daily routine work converge, resulting in human errors such as accidental inges-

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tion or mistakes in meal provision. Thus, it is necessary to develop an emergency action plan under the recognition that accidents do occur. Yoshino et al. reported that anxiety over the possibility of accidental ingestion is particularly strong among nursery teachers compared with those in other occupations related to children, such as teachers, school nurses, dietitians, and cooks²⁾. Infants are unable to care for themselves and have difficulties in accurately conveying their own symptoms to others and self-administering an EpiPen[®]. Child-care staff experience strong anxiety and a lack of confidence associated with recognizing anaphylactic events in children and making a prompt determination of what actions to take in response³⁾⁴⁾. Nursery facilities also clearly lag behind in terms of readiness to respond to anaphylactic emergencies³⁾. We thus developed and implemented a training program on initial action for anaphylaxis aimed at compensating for perceived knowledge deficit, reducing anxiety and lack of confidence in nursery school employees on responding to anaphylactic shock, and to develop an anaphylactic emergency action plan.

In the present study, we have evaluated the effectiveness of a training program on initial action to anaphylaxis for nursery school employees.

SUBJECTS AND METHODS

1. Summary of the training program

The training program consisted of three parts : lecture, practical skill training, and simulation training (Table 1). The lecture was designed to provide knowledge on food allergies in general and to teach participants when to use an EpiPen[®] through a slide presentation of pictorial images depicting symptoms. The practical skill training utilized EpiPen[®] Trainers to demonstrate how to immobilize and restrain uncooperative children who struggle to avoid injection, followed by practice by the nursery school employees. The simulation training took place in the nursery room where routine childcare is provided and included role-

playing in a scenario where “a 3-year-old child had an anaphylactic shock due to accidental ingestion.” The participants wore numbers indicating their roles and played different roles in the simulation. They then reviewed what they did in a debriefing session and exchanged views on areas for improvement in their own nursery school’s emergency action plan.

2. Participants in the training program

Participants were 155 employees (e.g., principals, vice principals, nursery teachers, dietitians, and cooks) from seven licensed nursery schools and centers for early childhood education and care who were recruited through the Council on Childcare in Prefecture Gunma and wished to participate. Given that simulation training in the nursery room where routine childcare is provided was part of the training program, we selected facilities that allowed onsite training including lecture, practical skill training, and simulation training, in the form of visiting lectures.

3. Evaluation of the training program

1) Program evaluation protocol (Figure 1)

We performed a pleiotropic evaluation and examined the effectiveness of the program using Kirkpatrick’s Four Levels of Training Evaluation Model⁵⁾⁶⁾, which is widely used in the United States to evaluate education and training programs. Participants were surveyed three times using a self-administered questionnaire at pre-training, post-training, and 6 months post-training.

2) An outline of the training program evaluation by Kirkpatrick’s Four Levels of Training Evaluation Model (Table 2)

The program was evaluated on the following four levels : Level 1, reaction ; Level 2, learning ; Level 3, behavior ; and Level 4, results.

3) Survey items

Survey items included basic characteristics of each participant and elements chosen as the challenges based on our previous study³⁾⁴⁾.

(1) Level 1 (reaction) evaluation items

After the training, participants were surveyed on their satisfaction with 10 items of the training

Table 1 Training program summary

Stage	Duration	Aim	Contents	Evaluation Item
Introduction	10 min		Orientation on contents of the day's lecture Questionnaire (pre-training)	
Part 1 (Lecture)	50 min	To learn information on anaphylaxis and EpiPen [®] and to raise crisis management awareness	<ol style="list-style-type: none"> 1. Food allergy basics 2. What is anaphylaxis? 3. When to use EpiPen[®] 	Knowledge verification (pre-training, post-training, and 6 months post-training), 20 questions <ul style="list-style-type: none"> • When to use EpiPen[®] • EpiPen[®] use and management
Break	10 min			
Part 2 (Practical skill)	30 min	To reduce resistance to EpiPen [®] use and to build confidence in responding to anaphylactic shock	<ol style="list-style-type: none"> 4. How to use EpiPen[®] <ul style="list-style-type: none"> • Step-by-step demonstration of EpiPen use • Practical skill training using EpiPen[®] Trainers 	Performance test (post-training) <ul style="list-style-type: none"> • The 5 techniques proposed by Pfizer Japan Inc. in the EpiPen[®] guide book
Part 3 (Demonstration)	40 min	To bring attention to areas for improvement in the emergency action plan at one's own nursery school and to raise awareness on taking action to make improvements	<ol style="list-style-type: none"> 5. Simulation training <ul style="list-style-type: none"> • From making a determination that anaphylactic shock has occurred until handover of care to paramedics • Using example cases of children who carry EpiPen[®] and who developed symptoms indicative of suspected anaphylactic shock after accidental ingestion during meal provision (a young child unable to administer EpiPen[®]; a child who struggles to avoid injection; or a child who must be placed in an irregular position to administer injection) 	Free comments (post-training) <ul style="list-style-type: none"> • Areas for improvement in the emergency action plan of each facility (physical, personnel, fiscal, and organizational aspects) Free comments (6 months post-training) <ul style="list-style-type: none"> • Improvements made in the emergency action plan of each facility (physical, personnel, fiscal, and organizational aspects)
	20 min		<ol style="list-style-type: none"> 6. Debriefing <ul style="list-style-type: none"> • To review training using a simulation training evaluation training evaluation form 	
Conclusion	20 min		Question and answer Questionnaire (post-training)	Degree of satisfaction questionnaire (post-training) <ul style="list-style-type: none"> • A 10-item questionnaire on duration and contents of training, lecturer's attitude during the lecture, and desire to participate in the future, etc.

↑
Changes in awareness from pre-training to post-training and 6 months post-training

• Fear of occurrences of anaphylactic shock
• Resistance to using EpiPen[®]
• Anxiety on action to anaphylactic shock
• A sense of burden when accepting children who carry EpiPen[®]

↓

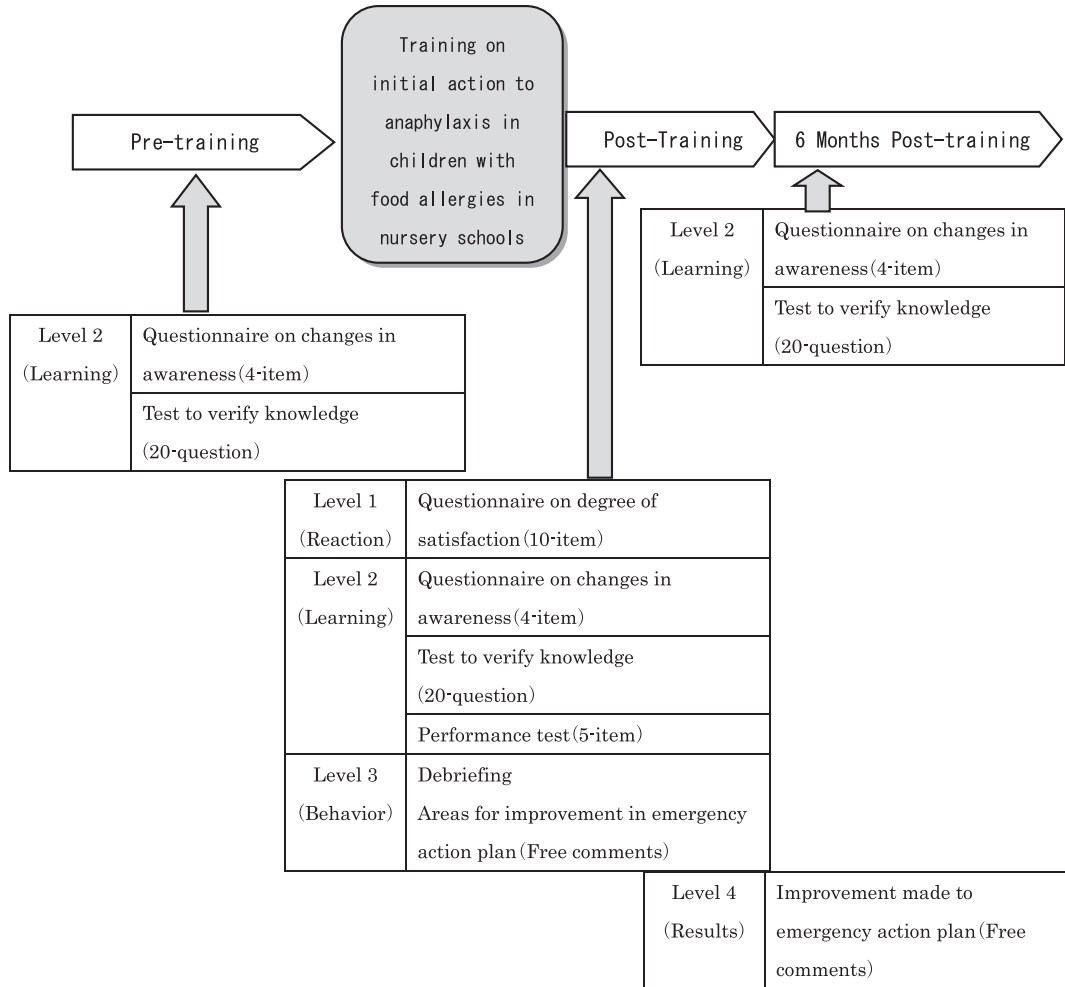


Figure 1 Program evaluation protocol

program, based on a 5-point Likert scale ranging from “1. Disagree” to “5. Agree.”

(2) Level 2 (learning) evaluation items

①Changes in awareness : The evaluation items selected consisted of the four challenges identified in our previous study³⁾: “fear of occurrences of anaphylactic shock (fear),” “resistance to EpiPen[®] use (resistance),” “anxiety in responding to emergencies (at occurrences of anaphylactic shock) (anxiety),” and “a sense of burden when enrolling children who carry an EpiPen[®] (sense of burden).” Participants were asked at pre-training, post-training, and 6 months post-training to assess these challenges based on a 5-

point Likert scale from “1. Yes” to “5. No.”

②Verification of knowledge : Participant knowledge regarding a total of 20 items was verified at pre-training, post-training, and 6 months post-training. They were asked to “circle all symptoms that they believe warrant an EpiPen[®] injection” from a list of 15 items that included all 13 items listed in the “EpiPen[®] for general population action plan”⁷⁾, as established by the Japanese Society of Pediatric Allergy and Clinical Immunology. This list also included two dummy symptoms (“skin rash” and “a strange irritating sensation in the mouth”). In addition, participants were asked to circle or place an x on five

Table 2 An outline of the training program evaluation by Kirkpatrick’s Four-Level Training Evaluation Model

Level	Specific Parameters Evaluated	Effectiveness/Evaluation
Level 1 (Reaction)	Degree of satisfaction with the training program immediately after program participation	Evaluation of the program
Level 2 (Learning)	Acquisition of awareness, knowledge, and techniques through training program participation	Measurement of effectiveness on participants
Level 3 (Behavior)	Behavioral changes after training program participation	
Level 4 (Results)	Benefits gained by organizations through training program participation by employees	Measurement of effectiveness on participating organizations

items pertaining to management of the EpiPen®.

③Verification of technique : Participants’ post-training performance of techniques were assessed (pass, fail) for 5 items concerning the three steps described in Pfizer’s EpiPen® guide-book⁸⁾ : 1. preparation, 2. injection, and 3. confirmation.

(3) Level 3 (behavior) evaluation items

After the simulation training, participants participated in a debriefing session on areas for improvement in their own nursery school’s emergency action plan (pertaining to physical, personnel, fiscal, and organizational aspects) and were asked to write what they noted in the format of free comments.

(4) Level 4 (results) evaluation items

At 6 months post-training, participants were asked to write free comments about specific improvements made to their own nursery school’s emergency action plan and overall organizational changes.

4) Period of data collection

The data were collected from January to November 2017.

5) Methods of data collection

The investigator collected survey questionnaires pre- and post-training. The surveys were deposited in a collection box placed in a location outside of the investigator’s view. The 6-month post-training survey questionnaire forms were each coded with an Identification (ID) number assigned to each of the training participants to allow linking of pre- and post-training responses and were sent with a

stamped envelope for returning the completed form by mail.

6) Methods for analysis

Subjects included in the Level 2 analysis of changes in awareness and knowledge verification were those who fully completed and returned their pre-training, post-training, and 6-month post-training questionnaire forms. The results of degree of satisfaction with the training (Level 1) and the results of technique verification (Level 2) in the performance test were tabulated by item. In terms of “changes in awareness” and “knowledge verification” (Level 2 items), changes at post-training and 6-month post-training from pre-training were analyzed by Friedman’s test and Cochran’s Q test. If a significant difference was detected, multiple comparisons were performed (Bonferroni correction). Changes in awareness were analyzed for four challenges in the Level 2 evaluation items. Knowledge verification was analyzed for subtotals of the 15 items pertaining to symptoms, the 5 items pertaining to management, the total score of all 20 items pertaining to knowledge verification, and the number of correct answers on the 13 symptoms listed in the “Indications for over-the-counter EpiPen®⁸⁾. All statistical tests were two-sided and a p value<0.05 was considered statistically significant and exported to IBM SPSS Statistics 25 for analysis. The Level 3 and 4 free comments were categorized by content analysis procedures⁹⁾.

4. Ethical considerations

The participants from the nursery schools

agreed to participate in the present study after receiving information on the purpose and summary of the study both orally and in writing. The Ethical Review Board of Gunma University (Study No. 2016-019) gave approval before the survey.

RESULTS

1. Subject selection and characteristics

A total of 155 employees (16 managers, 100 nursery teachers, 13 licensed nursery teachers, 6 dietitians, 3 registered dietitians, 8 cooks, and 9 other employees) from seven facilities participated in the training. Among the participants, one nurse and nine others for whom either pre-training or post-training responses were unavailable were excluded, and the remaining 145 employees were included in the analyses (Level 1, Level 2 [performance test], Level 3, and Level 4) (valid response rate, 93.5%). Furthermore, the 131 employees for whom all of the pre-training, post-training, and 6-month post-training responses were available were included in the Level 2 analyses of changes in awareness and knowledge verification (valid response rate, 84.5%). Subject characteristics are presented in Table 3.

2. Evaluation of the training program

1) Level 1 (reaction) : degree of satisfaction

With respect to each of the 10 questions that evaluated degree of satisfaction, those whose response was "agree" or "somewhat agree" accounted for more than 90% (Table 4).

2) Level 2 (learning) : pre-training, post-training, and 6-month post-training awareness and knowledge and post-training performance test

The Friedman test revealed a significant change in each of the items pertaining to changes in awareness (fear, $p < 0.001$; resistance, $p < 0.001$; anxiety, $p < 0.001$; sense of burden, $p < 0.001$) (Table 5). Multiple comparisons showed significant decreases from the pre-training level in the perceived fear and anxiety about anaphylaxis in nursery school employees at post-training and 6

months post-training. Nevertheless, the number of respondents who still "have" or "have slight" challenges with respect to each of the items was still high at post-training and 6 months post-training.

Cochran's Q test revealed significant changes in knowledge of all 13 anaphylactic symptoms listed in the "Indications for over-the-counter EpiPen[®]" except the symptom item of "difficulty in breathing" ($p < 0.001$ for each of the 12 symptom items). Multiple comparisons showed increases from pre-training in percentage of those who gave a correct response at post-training and 6 months post-training. With regard to the four symptoms of "unbearable abdominal pain," "hoarseness," "pale lips or nails," and "urinary or fecal incontinence," respectively, the percentage of correct answers increased at post-training compared with that at pre-training. However, the percentage at 6 months post-training was lower than that at post-training, but still higher than that at pre-training. On the other hand, with regard to the seven symptoms of "repeated vomiting," "tightening in the throat or chest," "barking cough," "persistent severe coughing," "breathing with wheeze," "hardly palpable pulse," and "lightheadedness," compared with the percentage of correct responses at pre-training, the percentage was higher at post-training and remained high even at 6 months post-training.

Subtotals of numbers of correct answers to the 15 questions concerning the "timing for EpiPen[®] use" showed significant changes ($p < 0.001$). While the subtotals were significantly higher at post-training and 6 months post-training compared with pre-training, scores decreased at 6 months post-training compared with post-training. Nevertheless, scores remained higher at 6 months post-training than at pre-training. In addition, subtotals of numbers of correct answers to the five questions on "management of EpiPen[®]" also showed significant changes ($p < 0.001$), with scores being significantly higher at post-training than at pre-training. Nevertheless, medians and quartiles at pre-training, post-training, and 6 months post-training showed no differences. Total score from

Table 3 Distributions of basic characteristics of subjects included in analyses
(*n* = 145)

	<i>n</i>	%
Job type/title		
Manager	16	11.1
Nursery teacher	91	62.8
Licensed nursery school teacher	13	8.9
Dietitian	6	4.1
Registered dietitian	3	2.1
Cook	8	5.5
Other	8	5.5
Age (Year)		
20 s	33	22.8
30 s	45	31.0
40 s	36	24.9
50 s	24	16.6
60 or older	6	4.1
Unkown	1	0.6
Sex		
Male	10	6.9
Female	135	93.1
Years of experience		
<1	2	1.4
1 to 10	68	45.5
11 to 20	48	33.1
21 to 30	21	14.5
31 to 40	5	3.4
Unknown	3	2.1
Prior participation in training on allergies		
Yes	69	47.6
No	76	52.4
Contents of training (may be duplicative)		
General information on allergies	32	22.1
Information on food allergies	50	34.5
Information on action to anaphylactic shock	44	30.3
Training using EpiPen® Trainers	32	22.1
Simulation training	18	12.4
Other	1	0.7

the 20 questions on knowledge was significantly higher at post-training compared with that at pre-training, but the 6-month post-training score was significantly lower than the post-training score, although still significantly higher than the pre-training score.

In the technique verification (Table 6), the post-training performance test showed that more than 90% of participants were able to follow all four required steps except "After injection, confirm that

the orange needle cover has extended."

3) Level 3 (behavior) : areas for improvement in the emergency action plan

The free comments from 141 respondents on areas for improvement in their own nursery school's emergency action plan (physical, personnel, fiscal, and organizational aspects) were considered valid responses. An analysis of 271 recording units (Table 7) identified 30 codes and 12 sub-categories, which were organized into the follow-

Table 4 Distribution of responses to questions evaluating degree of satisfaction

	<i>n</i> = 145	
	<i>n</i>	%
The length of the training was appropriate		
Agree	123	84.8
Somewhat agree	17	11.7
Don't feel one way or the other	4	2.8
Don't quite agree	1	0.7
Disagree	0	0.0
Contents of the training (lecture) were appropriate		
Agree	139	95.9
Somewhat agree	6	4.1
Don't feel one way or the other	0	0.0
Don't quite agree	0	0.0
Disagree	0	0.0
Contents of the training (practical skill training on EpiPen®) were appropriate		
Agree	138	95.2
Somewhat agree	6	4.1
Don't feel one way or the other	1	0.7
Don't quite agree	0	0.0
Disagree	0	0.0
Contents of the training (simulation training) were appropriate		
Agree	128	88.2
Somewhat agree	14	9.7
Don't feel one way or the other	1	0.7
Don't quite agree	2	1.4
Disagree	0	0.0
The distributed materials and teaching materials used were appropriate		
Agree	136	93.8
Somewhat agree	8	5.5
Don't feel one way or the other	0	0.0
Don't quite agree	0	0.0
Disagree	0	0.0
No answer	1	0.7
The training met the needs of my nursery school		
Agree	129	89.0
Somewhat agree	16	11.0
Don't feel one way or the other	0	0.0
Don't quite agree	0	0.0
Disagree	0	0.0
I learned a lot in the training		
Agree	140	96.5
Somewhat agree	4	2.8
Don't feel one way or the other	1	0.7
Don't quite agree	0	0.0
Disagree	0	0.0
The lecture was enthusiastic		
Agree	145	100.0
Somewhat agree	0	0.0
Don't feel one way or the other	0	0.0
Don't quite agree	0	0.0
Disagree	0	0.0
The contents of the training were easily understood		
Agree	143	98.6
Somewhat agree	2	1.4
Don't feel one way or the other	0	0.0
Don't quite agree	0	0.0
Disagree	0	0.0
The training was meaningful		
Agree	144	99.3
Somewhat agree	1	0.7
Don't feel one way or the other	0	0.0
Don't quite agree	0	0.0
Disagree	0	0.0

Table 5 Changes from pre-training in awareness and knowledge at post-training and 6months post-training

	a. Pre-Training		b. Post-Training		c. 6 months Post-Training		<i>p</i> -value*	Multiple Comparisons
	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%		
Changes in awareness [†]								
Do you have fear of occurrences of anaphylactic shock? (<i>n</i> = 129)								
Yes	113	88	83	64	78	61		
Slightly	13	10	38	29	42	33		
Don't feel one way or another	3	2	6	5	5	4	<0.001	a<bc
Not much	0	0	1	1	4	3		
Not at all	0	0	1	1	0	0		
Do you feel any resistance to using EpiPen [®] ? (<i>n</i> = 129)								
Yes	92	71	32	25	36	28		
Slightly	26	20	54	42	65	51		
Don't feel one way or another	10	8	19	15	8	6	<0.001	a<bc
Not much	0	0	16	12	16	12		
Not at all	1	1	8	6	4	3		
Do you have any anxiety about responding to emergencies (at the occurrences of anaphylactic shock) ? (<i>n</i> = 129)								
Yes	112	87	55	43	55	43		
Slightly	14	11	57	44	53	41		
Don't feel one way or another	2	2	12	9	11	8	<0.001	a<bc
Not much	1	0	5	4	9	7		
Not at all	0	0	0	0	1	1		
Do you feel any burden when accepting children who carry EpiPen [®] ? (<i>n</i> = 128)								
Yes	59	46	32	25	29	22		
Slightly	39	30	39	30	57	44		
Don't feel one way or another	25	20	34	26	27	21	<0.001	a<bc
Not much	4	3	15	12	15	12		
Not at all	1	1	9	7	1	1		
Knowledge verification (<i>n</i> = 131)								
Respondents who correctly identified the 13 symptoms for which EpiPen [®] is indicated for treatment								
							<i>p</i> -value [‡]	
Repeated vomiting	56	43	121	92	116	89	<0.001	a<bc
Unbearable abdominal pain	30	23	128	98	101	77	<0.001	a<c<b
Tightening in the throat or chest	82	63	122	93	115	88	<0.001	a<bc
Hoarseness	33	25	107	82	88	67	<0.001	a<c<b
Barking cough	48	37	125	95	107	82	<0.001	a<bc
Persistent severe coughing	56	43	123	94	110	84	<0.001	a<bc
Breathing with wheeze	71	54	122	93	121	92	<0.001	a<bc
Difficulty in breathing	114	87	124	95	120	92	0.197	
Pale lips or nails	64	49	127	97	101	77	<0.001	a<c<b
Hardly palpable pulse	78	60	121	92	106	81	<0.001	a<bc
Light headedness	113	86	129	98	121	92	<0.001	a<b
Fatigue	104	79	126	96	113	86	<0.001	ac<b
Urinary or fecal incontinence	55	42	126	96	101	77	<0.001	a<c<b
	M (Q1, Q3)		M (Q1, Q3)		M (Q1, Q3)		<i>p</i> -value*	
Subtotal, timing of EpiPen use	8 (6, 11)		14 (13, 15)		13 (11, 14)		<0.001	a<c<b
Subtotal, EpiPen [®] management	5 (4, 5)		5 (4, 5)		5 (4, 5)		<0.001	a<b
Total, knowledge	12 (11, 15)		19 (18, 20)		17 (15, 18)		<0.001	a<c<b

M/Q1/Q3 : Median/25percentile/75percentile

*Friedman-test, ‡ Cochran's Q test

Multiple comparisons : Bonferroni correction : significance level<0.05

†Coding, Yes = 1~Not at all = 5

Table 6 Procedures for using EpiPen® and participants who successfully performed the procedures after receiving corresponding training

STEP	Specifics of Training	Successful performance*	
		<i>n</i>	%
1. Preparation	Firmly hold EpiPen® at its mid-point with the orange needle cover pointing downward : remove the blue safety cap with the other hand	144	99
2. Injection	Push EpiPen® against the anterolateral thigh in a perpendicular manner	135	93
	Push firmly until the tip of the orange needle cover “clicks”	142	98
	Hold against the thigh for several seconds (count to five)	139	96
3. Confirmation	After injection, confirm that orange needle cover has extended	127	88

*Those who successfully performed the procedures in a performance test (*n* = 145)

Table 7 Areas of improvement in emergency action plan

n = 271

Category (Number of Record Units : %)	Subcategory (Number of Record Units)
Improving knowledge, techniques, and awareness in all employees on action to anaphylactic emergencies (85 : 31.4%)	Acquiring sound knowledge and techniques for action to anaphylaxis (41)
	Implementing trainings that allow acquisition of knowledge and techniques for action to anaphylaxis (34)
	Raising crisis management awareness (10)
Generating the facility’s own action plan (63 : 23.2%)	Drawing up an individual support plan for each child with allergies (24)
	Drawing up manuals that meet each nursing school’s specific needs (23)
	Assessing the handling of extraordinary format of nursery care (16)
Reviewing and revising contents of manuals (59 : 21.8%)	Reviewing contents of manuals (30)
	Reviewing and assessing instruction, command, and communication systems (29)
Setting up equipment/system in the nursery school (46 : 17.0%)	Setting up a system that allows employees to work together and cooperate with each other (26)
	Developing a physical environment within the nursery school (18)
	Improving organization within the nursery school (2)
Giving consideration to children while dealing with anaphylaxis (18 : 6.6%)	Giving consideration to children while dealing with anaphylaxis and other children (18)

ing five categories : improving knowledge, techniques, and awareness in all employees on responding to anaphylactic emergencies ; generating the facility’s own action plan ; reviewing and revising contents of manuals ; setting up equipment/system in the nursery school ; and giving considerations to children while dealing with anaphylaxis.

4) Level 4 (result) : improvements in the emergency action plan at 6 months post-training

Free comments on improvements in emergency action plan (physical, personnel, fiscal, and organizational aspects) at 6 months post-training provided by 94 respondents were considered valid responses. An analysis of 151 recording units (Table 8) identified 22 codes and 7 sub-categories, which were organized into the following four cate-

Table 8 Improvements to emergency action plan*n* = 151

Category (Number of Record Units : %)	Subcategory (Number of Record Units)
Undertaking efforts to develop the facility's own manual (71 : 47.0%)	Have continued to hold simulation training and EpiPen [®] exercise periodically (28)
	Have re-examined the contents of in-house manuals (25)
	Have assessed and switched to an environment and methods that allow rapid actions (18)
Strengthening accident preventive measures (41 : 27.2%)	Have strengthened measures to prevent accidental ingestion and mistakes in meal provision (41)
Strengthening intra- and extra-school cooperation and coordination (30 : 19.9%)	Better information sharing among employees (16)
	Have worked with physicians and guardians to assess methods of caring for children with allergies (14)
Becoming more sensitive to protect the human rights and other rights of children with food allergies (9 : 5.9%)	Have made arrangements so that children with allergies can carry out activities just like the other children (9)

gories: "undertaking efforts to develop the facility's own manual," "strengthening accident preventive measures," "strengthening intra- and extra-school cooperation and coordination," and "becoming more sensitive to protect the human rights and other rights of children with food allergies."

DISCUSSION

1. Changes in knowledge and awareness in nursery school employees about responding to anaphylaxis

The number of correct answers on knowledge required in responding to anaphylaxis increased significantly after the training. A by-symptom examination of the numbers of respondents who correctly identified each of the 13 symptoms listed in the "Indications for over-the-counter EpiPen[®]" showed that with respect to the four symptoms of "unbearable abdominal pain," "hoarseness," "pale lips or nails," and "urinary and fecal incontinence," the number of respondents who gave the correct answer at 6 months post-training was higher than at pre-training but significantly lower than at post-training. Furthermore, the percentage of

those who recognized "difficulty breathing" as one of the symptoms was high at pre-training and remained high at post-training and 6 months post-training. These findings show that among the "symptoms that you believe to warrant EpiPen[®] use", the proportion of participants who recognized respiratory symptoms were high, but those who recognized "unbearable abdominal pain", "urinary or fecal incontinence," and other abdominal symptoms were low, which were consistent with the results of our previous study. Patel et al. followed up on nursery school employees who participated in an anaphylaxis seminar concerning knowledge about recognizing, evaluating, and treating anaphylactic symptoms at 6 and 12 months after the seminar¹⁰. They showed that with time, there was a significant decline in correctly recognizing typical anaphylaxis symptoms, including abdominal cramping, chest tightness, low blood pressure, and diarrhea, whereas symptoms such as hives, swelling, and wheezing continued to be identified correctly¹⁰.

Given that the symptoms evaluated were described differently in the present study, direct comparison was not possible. Nonetheless, the two

studies shared the result that gastrointestinal symptoms tended to be less recognizable than respiratory symptoms. Moreover, there were increased numbers of symptoms for which the number of respondents who gave the correct answer decreased from post-training to 6 months post-training, indicating a need to review the timing of follow-up trainings and to hold repeated trainings. To maintain the level of understanding about the 13 symptoms listed in the "Indications for over-the-counter EpiPen[®]" over time, it is necessary to consider the use of visual teaching materials and lectures that include the basis on which one can identify symptom onset. Furthermore, in an emergency, nursery school employees may panic and become unable to determine whether the observed symptoms warrant EpiPen[®] use. There is thus a need to provide information through a simple tool that allows anyone to make appropriate judgments during an emergency, such as a checklist of symptoms included in the Tokyo Metropolitan Food Allergy Emergency Manual¹¹⁾.

In a survey of teachers, Nakano et al.¹²⁾ reported that post-lecture "confidence in EpiPen[®] use" and "understanding of when to use an EpiPen[®]" increased significantly, but there was still "anxiety and fear despite deepened understanding" and "lack of confidence on whether one will be able to respond to an actual emergency." They suggested that it is necessary to find ways to build the confidence of survey respondents through activities such as role playing. In the present study, subjects received training on knowledge and techniques, including simulation training. Participation in the training significantly reduced the four psychological difficulties in nursery school employees identified in our previous study³⁾, with the reductions maintained even after 6 months post-training. Furthermore, each participant also received practical skill training using an EpiPen[®] Trainer, and approximately 90% of participants demonstrated the acquisition of five techniques required in the three steps of EpiPen[®] use in a post-training performance test. Nevertheless, approximately 90%

still responded that they had fear or slight fear of occurrences of anaphylactic shock and anxiety in responding to emergencies (at the occurrences of anaphylactic shock), after the training showing that practical experience under simulated conditions in the simulation training provided no substantial reductions in hesitancy such as fear and anxiety. These findings indicate a need to periodically provide repeated trainings on initial action to anaphylaxis.

2. Changes in nursery school employee behaviors and institutional awareness

Simulation in education is a continuous process that transforms acquired knowledge into experience, thereby building new knowledge; it bridges the gap between knowledge and practice¹³⁾¹⁴⁾. The training program we evaluated included simulation training. In the debriefing session held after the simulation training, participants were asked to list areas for improvement that they noticed in their own nursery school's emergency action plan. What they pointed out included "a need to improve knowledge, techniques, and awareness in all employees on responding to anaphylactic emergencies," "reviewing and revising manuals and generating the facility's own action plan," and "setting a system of collaboration among employees and developing an emergency action plan." Simulation training raised the awareness of crisis management in each individual employee and helped to reveal specific actions needed to develop each school's own emergency action plan. The participants reported in the 6 months post-training survey that actions were taken to re-examine manuals to meet each school's specific needs, to repeat simulation training sessions under various scenarios and circumstances, and to overhaul ways of collaboration among employees to allow close sharing of information. They also reported the "strengthening of measures to prevent accidental ingestion or mistakes in meal provision" using plates of different colors and having multiple employees on different lines of work double-check foods served, among other efforts. Murai et al.¹⁵⁾

conducted a survey on changes in awareness in teachers before and after a lecture on the EpiPen[®]. They reported that a low percentage of teachers recognized the conditions that warrant immediate action against anaphylaxis before the lecture, but there was a change in that percentage after the lecture. The present study showed that the nursery school employees who participated in the training took notice of areas for improvement or problems in their own nursery school's emergency action plan and made improvements to the plan gradually starting from what were practicable, indicating changes in individual employees' behaviors and institutional awareness. When surveyed for the degree of satisfaction with the training program on initial action to anaphylaxis, more than 90% of the nursery school employees gave a positive response to the question on each of the 10 items. Moreover, the improved levels of knowledge and techniques and awareness of crisis management in the nursery school employees also led to improvements in existing emergency action plans or the development of an emergency action plan. Nevertheless, the training program failed to provide any substantial relief from hesitancy about responding to anaphylactic emergencies. The challenge going forward is thus to build a system that allows nursery school employees to attend continued training periodically.

3. Significance of the training program on initial actions against anaphylaxis

In 2012, an elementary school student in Chofu City died from anaphylactic shock due to accidental ingestion¹⁶⁾. Since that accident, many training sessions regarding anaphylaxis have been held for school employees, and the effects of such trainings have been reported^{2)12)15)17)~19)}. In recent years, schools have held school nurse (*Yogo* teacher)-led training sessions for staff to improve the ability of their entire staff to respond to anaphylaxis²⁰⁾. In Japan, however, only about 20–30% of nursery schools have a nurse on site²¹⁾. The current situation is thus such that the key person who deals with anaphylaxis is absent from most nursery

schools. The present study included a training program for employees of nursery schools that have yet to establish a system to provide continuous and periodic training. The program is highly significant in that it strengthened the readiness of individual nursery school employees to respond to anaphylaxis and brought about organizational and environmental changes. In addition, Kirkpatrick's Four Levels of Training Evaluation Model used in the present study is a model for evaluating changes in trainee knowledge and skill levels as well as long-term and final outcomes in the form of organizational changes⁵⁾. Likewise in Japan, several papers on studies using Kirkpatrick's Four Levels of Training Evaluation Model have been published, but none included evaluations up to level 4 (results), as confirmation of organizational changes requires long-term studies. The present study evaluated changes in the knowledge and skill levels of nursery school employees using Kirkpatrick's Four Levels of Training Evaluation Model. Furthermore, the study also evaluated long-term and final outcomes in the form of level-4 organizational changes. The results showed that the program strengthened the readiness of individual nursery school employees in responding to anaphylaxis and brought about organizational and environmental changes within the nursery schools, indicating that the program is highly significant.

STUDY LIMITATIONS AND FUTURE DIRECTIONS

The first limitation to this study was the fact that the level-3 evaluations (behavior) of Kirkpatrick's Four Levels of Training Evaluation Model were originally aimed at evaluating whether nursery school employees are able to deal with anaphylactic shock. In reality, however, waiting until a child develops anaphylactic shock to evaluate such readiness is not feasible. Thus, "areas for improvement in the emergency action plan as noted by individual nursery school employees" were evaluated instead, after the employees had undergone

simulation training and participated in a debriefing session. Second, the presence of bias cannot be ruled out, as subjects in the present study were a highly motivated population who requested to attend the training program and who voluntarily participated in the study. Moreover, employees of nursery schools that have children who carry an EpiPen® or have a nurse on site likely had high levels of awareness and knowledge of crisis management even before the training, which can be expected to impact the results considerably.

In the future, we would like to further analyze whether any differences in the results for “changes in awareness” or “verification of knowledge” are attributable to special facility characteristics such as the presence of children carrying EpiPen® or an on-site nurse, or differences in training experiences or job description.

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There are no conflicts of interest to disclose.

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保育所における食物アレルギー児の アナフィラキシー初期対応研修プログラムの評価

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抄録:

【目的】保育所職員が感じているアナフィラキシーショックの対応に対する知識不足や不安感・自信のなさを軽減し、アナフィラキシー対応の救急処置体制を整備することを目的としたアナフィラキシー初期対応研修プログラムを実施し、その効果を検証する。

【方法】研修を受講した保育所職員を対象に、Kirkpatrickの4段階評価測定モデルを用いて研修前・研修後・研修6か月後にアンケート調査を実施した。

【結果】155名から回答を得た。保育所職員のアナフィラキシー対応に関するネガティブな意識は、研修前と比較して研修後、研修6か月後に有意に軽減されていた。「一般向けエピペン[®] 適応」の13の症状について研修前後、6か月後に、「息がしにくい」以外のすべての症状において有意な差が認められた。シミュレーション訓練後、保育所の救急処置体制の改善点が具体的に抽出され、研修6か月後は具体的な改善が行われていた。

【結論】シミュレーション訓練を組み込んだ研修プログラムは、保育所職員の知識・技術の向上と維持、救急処置体制の改善を促進した。

キーワード：アドレナリン自己注射薬（エピペン[®]）、アナフィラキシーショック、食物アレルギー、保育所（園）、プログラム評価

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