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Knowledge of anaphylaxis among Emergency Department staff

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Background: Anaphylaxis is an emergency condition that requires immediate, accurate diagnosis and appropriate management. However, little is known about the level of knowledge of doctors and nurses treating these patients in the Emergency Department.

Objective: To determine the knowledge of doctors and nurses in the Emergency Department on the recent definition and treatment recommendations of anaphylaxis.

Methods: We surveyed doctors and nurses of all grades in a tertiary Hospital Emergency Department using a standardized anonymous questionnaire.

Results: We had a total of 190 respondents—47 doctors and 143 nurses. The response rate was 79.7% for doctors and 75.3% for nurses. Ninety-seven point eight percent of the doctors and 83.7% of the nurses chose the accepted definition of anaphylaxis. High proportions of doctors (89–94%) and nurses (65–72%) diagnose anaphylaxis in the three scenarios demonstrating anaphylaxis and anaphylactic shock. Forty-two point six percent of the doctors and 76.9% of the nurses incorrectly diagnosed single organ involvement without hypotension as anaphylaxis. As for treatment, 89.4% of the doctors indicated adrenaline as the drug of choice and 85.1% chose intramuscular route for adrenaline administration. Among the nurses, 40.3% indicated adrenaline as the drug of choice and 47.4% chose the intramuscular route for adrenaline.

Conclusion: High proportion of doctors and nurses are able to recognize the signs and symptoms of anaphylaxis, although there is a trend towards over diagnosis. There is good knowledge on drug of choice and the accepted route of adrenaline among the doctors. However, knowledge of treatment of anaphylaxis among nurses was moderate and can be improved.

Key words: Anaphylaxis; Health knowledge, attitudes, practice; Emergency service, hospital; Data collection

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INTRODUCTION

Anaphylaxis is a severe systemic allergic reaction that is rapid in onset and can potentially result in death [1]. It is triggered by the sudden release of chemical mediators such as histamine and leukotrienes from sensitized mast cells and basophils coated with immunoglobulin E antibodies, cumulating in a type 1 hypersensitivity reaction.

With the rise in incidence of allergies, anaphylaxis is on the rise as well, particularly in the first two decades of life [2]. The estimated prevalence of anaphylaxis was 3.3–44 million in the United States (US); the numbers also suggest that about 1.24% to 16.8% of the total US population may suffer from an anaphylactic reaction and that 0.002% may die from it [3]. In the United Kingdom, the incidence of anaphylaxis was estimated to be 8.4 per 100,000 person-years, and approximately 10% of the cases had hypotension and shock, which required urgent treatment [4]. However, locally, there were no studies on the prevalence of anaphylaxis albeit numerous studies on allergy.

In the Emergency Department (ED), the immediate identification and treatment of anaphylaxis by doctors and nurses is crucial to prevent mortality and morbidity. This requires a high index of suspicion as well as the recognition of signs and symptoms that would suggest a severe allergic reaction or impending anaphylactic shock. However, several surveys conducted among pediatricians, pediatric emergency physicians and hospital doctors revealed that the level of knowledge about recent advances in the management of anaphylaxis, were suboptimal, potentially endangering patients when urgent treatment is required [5-7]. These surveys are conducted overseas hence not local studies. Among Singaporean doctors, the subject has been covered and emphasized in their undergraduate as well as postgraduate education. Our study aims to ascertain the levels of knowledge of anaphylaxis and its treatment among doctors and nurses in a local tertiary ED. The results of this study will provide guidance if any educational intervention is required on a local scale.

MATERIALS AND METHODS

The study was conducted in the National University Hospital. This is a tertiary hospital with both adult and children's emergency and sees a total of 1,400,000 ED attendances per year, with 17–18% attendances in the children's emergency. We designed an anonymous standardized questionnaire which reflects the participant's knowledge on various aspects of anaphylaxis. We adapted the survey questions on management of anaphylaxis from a previous study [7]. The study was approved by the local Ethics Committee Doman Specific Review Board 2011/018.

We had initially intended to survey only doctors but found that ED nurses are heavily involved in triage and patient care with allergic reactions hence we surveyed the nurses at a later period. There was no change in the education program among the nurses between the survey periods and the nurses were not aware that the doctors were surveyed at the earlier period. The survey for doctors was conducted on-site at the ED between September and October 2011, comprising doctors of all ranks from medical officers and above. Survey forms were given out prior to clinical teachings, department meetings or to individual doctors between shifts. The survey for nurses was conducted during nurses' roll calls between March and April 2012, comprising nurses of all ranks. Survey forms were given out prior to each roll call. For all survey sessions, a standardized introduction was provided. Participants were not given a time limit and were not allowed to discuss the answers during and after completing the survey.

The accepted answers to the questionnaire (Table 1) is based on three guidelines on anaphylaxis namely, American Academy of Allergy, Asthma & Immunology (AAAAI), World Allergy Organisation and European Academy of Allergy and Clinical Immunology [8-11].

Data from all completed survey forms were analyzed utilizing PASW Statistics ver. 18.0 (SPSS Inc., Chicago, IL, USA). We analysed the survey answers of knowledge and management, separately, in the doctors and nurses group. We present categorical variables as percentages and all continuous variables as median (interquartile range) as the distribution was not normal.

RESULTS

A total of 190 responses were received. Forty-seven out of 59 ED doctors (79.7%) responded to the survey among whom 44.7% (21/47) were Emergency Medicine specialists (Table 2). One hundred and forty-three out of 190 nurses (75.3%) responded, where 75.2% (106/141) were staff nurses. The majority (89.4%, 169/189) has seen a case of anaphylaxis in their practice, however, a slightly lower proportion (74.3%, 136/183) are aware of the guidelines pertaining to diagnosis and management of anaphylaxis. Less than 20% (30/174) of the study population saw

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Table 1. Survey questions and answers

Question	Option*	Answer based on guideline		
		AAAAI	WAO	EAACI
Best definition of anaphylaxis	1. A severe allergic reaction 2. An allergic reaction affecting 2 or more systems 3. Severe urticarial and angioedema of lips and eyes 4. A systemic allergic reaction 5. Shock after eating a specific food	2	1, 4	1, 4
Urticaria + periorbital edema only	1. Not anaphylaxis 2. Anaphylaxis 3. Anaphylactic shock	1	1	1
Urticaria + wheeze only	1. Not anaphylaxis 2. Anaphylaxis 3. Anaphylactic shock	2	2	2
Urticaria + hypotension only	1. Not anaphylaxis 2. Anaphylaxis 3. Anaphylactic shock	3	3	3
Known allergen + hypotension	1. Not anaphylaxis 2. Anaphylaxis 3. Anaphylactic shock	3	3	3
1st Choice of drug in anaphylaxis management	1. Adrenaline 2. Antihistamines 3. Corticosteroids	1	1	1
Initial route if adrenaline is given	1. Intramuscular 2. Subcutaneous 3. Intravenous	1	1	1
Dose of adrenaline for 10 kg child (mg)	Survey responders to enter as free text	0.1 mg	0.1 mg	0.1 mg
Correct trademark of adrenaline autoinjectors†	Survey responders to enter as free text	Not mentioned	Not mentioned	Not mentioned
Amount of adrenaline in the autoinjectors designed for children	Survey responders to enter as free text	Not mentioned	Not mentioned	0.15 mg
Dose of adrenaline for an adult‡	1. <0.3 mg 2. 0.3–0.5 mg 3. 0.6–1.0 mg 4. >1.0 mg	2	2	2
When do the effects of intravenous hydrocortisone begin after injection?	1. Immediately 2. In 3–4 hr 3. In 6 hr	Not 1 'Not helpful acutely'	2 'Several hours'	Not 1 'Slow onset'
Preferred antihistamines in the treatment of anaphylaxis	1. H1 antihistamines alone 2. H2 antihistamines alone 3. H1 plus H2 antihistamines 4. The new generation antihistamines	3	3	3

AAAAI, American Academy of Allergy, Asthma & Immunology; WAO, World Allergy Organisation; EAACI, European Academy of Allergy and Clinical Immunology.

*For multiple-choice questions respondents are to circle only one answer. †Accepted answer is Epipen [7]. ‡Estimated average weight of adults in Singapore is 60 kg hence accepted answer is 2.

children in their practice. More than half (55.8%, 105/190) indicated fellow doctors as their source for anaphylaxis-related updates and information. Internet and lectures/seminars are also a large source of information for doctors. For nurses, fellow nursing colleagues form the next large source of information.

Table 3 illustrates the answers to the survey questions on knowledge and management of anaphylaxis. Ninety-seven point eight percent of the doctors (45/46) and 83.7% of the nurses

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Table 2. Characteristics of participants

Valid response	Variable	ALL (n = 190)	Nurse (n = 143)	Doctor (n = 47)
187	Median age, yr (IQR)	28 (25–32)	27 (24–30)	32 (28–36)
188	Males, n (%)	41 (21.8)	15 (10.6)	26 (55.3)
181	Median duration since graduation, yr (IQR)	6 (3–10)	5 (3–8)	7 (3–12)
185	Median time spent working in ED, mo (IQR)	36 (12–60)	36 (18–60)	24 (3–72)
189	Area of care, n (%)			
	1. Adult ED	172 (91.0)	132 (93.0)	40 (85.1)
	2. Pediatric ED	11 (5.8)	4 (2.8)	7 (14.9)
	3. Adult and pediatric ED	6 (3.2)	6 (4.2)	0 (0)
188	Employment status, n (%)			
	1. Assistant nurse/senior assistant nurse	35 (18.6)	35 (24.8)	
	2. Staff nurse/senior staff nurse	106 (56.4)	106 (75.2)	
	3. Medical officer	25 (13.3)	-	25 (53.2)
	4. Registrar	7 (3.7)	-	7 (14.9)
	5. Specialists*	15 (8.1)	-	15 (31.9)
189	Ever seen case(s) with anaphylaxis, n (%)	169 (89.4)	128 (90.1)	41 (87.2)
183	Aware of guidelines pertaining to diagnosis and management of anaphylaxis, n (%)	136 (74.3)	105 (76.1)	31 (68.9)
174	Seen children in his/her practice, n (%)	30 (17.2)	20 (15.7)	10 (21.3)
190	Acquisition of knowledge on anaphylaxis†, n (%)			
	1. From fellow nurses	50 (26.3)	49 (34.3)	1 (2.1)
	2. From fellow doctors	105 (55.8)	79 (55.2)	27 (57.4)
	3. From journals	25 (13.2)	16 (11.2)	9 (19.1)
	4. From lectures/seminars organised by ED	40 (21.1)	29 (20.3)	11 (23.4)
	5. From the internet	60 (31.6)	41 (28.7)	19 (40.4)
	6. Others	9 (4.7)	6 (4.2)	3 (6.4)

IQR, interquartile range; ED, Emergency Department.
*Specialists are associate consultants, consultants and senior consultants. †Respondents are allowed to circle more than one option.

(118/141) chose the accepted definition of anaphylaxis. Among the doctors, Forty-two point six percent (20/47) diagnosed single organ involvement without hypotension (urticaria + periorbital edema only) as anaphylaxis. However, high proportions of doctors diagnosed anaphylaxis in the three scenarios demonstrating anaphylaxis and anaphylactic shock-'urticaria + wheeze only' (93.6%, 44/7), 'urticaria + hypotension only' (89.4%, 42/47) and 'known allergen + hypotension' (89.1%, 41/46). As for treatment, 89.4% of the doctors (42/47) indicated adrenaline as their first drug of choice in anaphylaxis management. 85.1% (40/47) chose the correct route for adrenaline administration and 73.3% (33/45) chose the correct dose of adrenaline for adults with anaphylaxis. Except for one doctor, majority are aware that the effects of hydrocortisone does not occur immediately. Sixty-four point four percent (29/45) stated the correct antihistamines for subsequent treatment.

Among the nurses, a higher proportion (76.9%, 103/134) diagnosed single organ involvement without hypotension as anaphylaxis compared to the doctors. In the three scenarios demonstrating anaphylaxis and anaphylactic shock, 72% (95/132) in scenario 'urticaria + wheeze only', 68.2% (88/129) in scenario 'urticaria + hypotension only' and 64.5% (84/130) in scenario 'known allergen + hypotension' chose the accepted answers. The first drug of choice was adrenaline in 40.3% (54/134) of the nurses and less than half (47.4%, 64/135) chose the intramuscular route for adrenaline. Among the 80 responses we received for dosage of adrenaline, 50% (40/80) gave the correct dose of adrenaline for adults with anaphylaxis. High proportion of the nurses (75.6%, 90/119) had the impression that the effect of hydrocortisone was immediate.

Among the 30 respondents who sees children in their practice, 10 were doctors and 20 were nurses (Table 4). Eighty-eight point eight percent of the doctors (8/9) gave the accepted adrenaline dose for a 10 kg child, 100% (9/9) knew the trademark

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Table 3. Knowledge of participants

Valid response	Variable	ALL (n = 190)	Nurse (n = 143)	Doctor (n = 47)
187	Best definition of anaphylaxis			
	1. A severe allergic reaction	56 (29.9)	50 (35.5)	6 (13.0)
	2. An allergic reaction affecting 2 or more systems	48 (25.7)	32 (22.7)	16 (34.8)
	3. Severe urticaria and angioedema of lips and eyes	22 (11.8)	22 (15.8)	0 (0)
	4. A systemic allergic reaction	59 (31.6)	36 (25.5)	23 (50.0)
	5. Shock after eating a specific food	2 (1.1)	1 (0.7)	1 (2.2)
181	Urticaria + periorbital edema only			
	1. Not anaphylaxis	48 (26.5)	21 (15.7)	27 (57.4)
	2. Anaphylaxis	123 (68.0)	103 (76.9)	20 (42.6)
	3. Anaphylactic shock	10 (5.5)	10 (7.5)	0 (0)
179	Urticaria + wheeze only			
	1. Not anaphylaxis	20 (11.2)	17 (12.9)	3 (6.4)
	2. Anaphylaxis	139 (77.7)	95 (72.0)	44 (93.6)
	3. Anaphylactic shock	20 (11.2)	20 (15.2)	0 (0)
176	Urticaria + hypotension only			
	1. Not anaphylaxis	13 (7.4)	12 (9.3)	1 (2.1)
	2. Anaphylaxis	33 (18.8)	29 (22.5)	4 (8.5)
	3. Anaphylactic shock	130 (73.9)	88 (68.2)	42 (89.4)
176	Known allergen + hypotension			
	1. Not anaphylaxis	27 (15.3)	24 (18.5)	3 (6.5)
	2. Anaphylaxis	24 (13.6)	22 (16.9)	2 (4.3)
	3. Anaphylactic shock	125 (71.0)	84 (64.6)	41 (89.1)
181	1st Choice of drug in anaphylaxis management			
	1. Adrenaline	96 (53.0)	54 (40.3)	42 (89.4)
	2. Antihistamines	68 (37.6)	66 (49.3)	2 (4.3)
	3. Corticosteroids	17 (9.4)	14 (10.4)	3 (6.4)
182	Initial route if adrenaline is given			
	1. Intramuscular	104 (57.1)	64 (47.4)	40 (85.1)
	2. Subcutaneous	44 (24.2)	38 (28.1)	6 (12.8)
	3. Intravenous	34 (18.7)	33 (24.4)	1 (2.1)
125	Dose of adrenaline for an adult			
	1. <0.3 mg	6 (4.8)	3 (3.8)	3 (6.7)
	2. 0.3–0.5 mg	73 (58.4)	40 (50.0)	33 (73.3)
	3. 0.6–1.0 mg	27 (21.6)	19 (23.8)	8 (17.8)
	4. >1.0 mg	19 (15.2)	18 (22.5)	1 (2.2)
163	When do effects of IV hydrocortisone begin			
	1. Immediately	91 (55.8)	90 (75.6)	1 (2.3)
	2. In 3–4 hr	56 (34.4)	28 (23.5)	28 (63.6)
	4. In 6 hr	16 (9.8)	1 (0.8)	15 (34.1)
154	Preferred antihistamines anaphylaxis treatment			
	1. H1 antihistamines alone	46 (29.9)	33 (30.3)	13 (28.9)
	2. H2 antihistamines alone	9 (5.8)	8 (7.3)	1 (2.2)
	3. H1 plus H2 antihistamines	83 (53.9)	54 (49.5)	29 (64.4)
	4. The new generation antihistamines	16 (10.4)	14 (12.8)	2 (4.4)

Values are presented as number (%).

of adrenaline autoinjectors and 57.1% (4/7) gave the accepted amount of adrenaline in the pediatric autoinjectors. We had low response rates among the nurses. Thirty-five percent of the nurses (7/20) responded to the question on the correct dose of adrenaline for a 10-kg child; three nurse gave the correct answer, 10% of the nurses (2/20) responded to the question on the trademark of the autoinjectors; one nurse gave the correct answer. Forty percent of the nurses (8/20) respond to the question on the amount

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Table 4. Knowledge of participants who has seen children in their practice

Valid response	Variable	ALL (n = 30)	Nurse (n = 20)	Doctor (n = 10)
16	Dose of adrenaline for 10-kg child - Accepted answer: 0.1 mg	11/16 (68.8)	3/7 (42.9)	8/9 (88.9)
11	Correct trademark of adrenaline autoinjectors - Accepted answer: Epipen	10/11 (90.1)	1/2 (50.0)	9/9 (100)
10	Amount of adrenaline in the autoinjectors designed for children (%) - Accepted answer: 0.15 mg	4/10 (40.0)	0/3 (0)	4/7 (57.1)

Values are presented as number (%).

of adrenaline in pediatric autoinjectors; there were no correct answers.

DISCUSSION

The definition of anaphylaxis, recently revised in the 2006 guidelines by Sampson et al. [1], is widely regarded as the cornerstone for the precise recognition and timely treatment of anaphylaxis by first-responders. This states that anaphylaxis is 'a severe, potentially fatal, systemic allergic reaction that occurs suddenly after contact with an allergy-causing substance.' In addition, the AAAAI has mentioned the involvement of two organ systems as also necessary to diagnosing anaphylaxis. In describing the rationale for this universally accepted definition, it was mentioned that a thorough knowledge of the definition of anaphylaxis would reduce confusion from first-responders and aid rapid assessment and treatment of the current event. Our study showed that there was variable knowledge on anaphylaxis among ED doctors and nurses, despite these guidelines in Sampson's landmark study. High proportion of doctors chose the accepted answers on diagnosis and treatment of anaphylaxis. While these figures were higher compared to the figures from the nurses, overall for all staff, there is still room for improvement.

We evaluated the knowledge on definition of anaphylaxis using several scenarios. To our understanding there were no previous studies that had used similar method to address this knowledge. Our study revealed a trend for doctors and nurses to "over" diagnose single organ involvement without hypotension as anaphylaxis. We believe this is an acceptable approach in the ED as underdiagnosis of anaphylaxis can be detrimental if treatment is delayed. The excess "over" diagnosis among the nurses is less of a concern in our practice whereby treatment with medications cannot be instituted without prior prescription by the attending doctor. In contrast, a high proportion of doctors chose the accepted answers in the three scenarios demonstrating anaphylaxis and anaphylactic shock. It is comforting to note that even among nurses, although slightly lower than doctors, still, a large proportion recognizes the scenario of anaphylaxis and anaphylactic shock. The ED nursing staff plays an essential role in anaphylaxis management, especially in its recognition during patient triage.

As for knowledge on treatment, a high proportion of doctors (89%) chose the accepted first line drug of adrenaline. This figure is comparable to that obtained from a survey of pediatric emergency physicians at a national level in the US (94%) and pediatricians (92%) [6, 7]. We consider the comparison with the pediatric emergency physicians and pediatricians appropriate because the highest incidence of anaphylaxis occurs in children and adolescents, therefore these physicians will be the highly experienced and knowledgeable in the management of anaphylaxis in the pediatric age-group [12]. More importantly the proportion of doctors that chose intramuscular route for adrenaline administration in our study (85%) is much higher than these two studies (67% and 34%) and another study involving junior hospital doctors (58%) [5]. Additionally the latter study also reported a lower proportion of correct dose of adrenaline compared to our study (73%). The knowledge of accepted guidelines on the steroids and antihistamines in our study was also higher [7].

Among the nurses, the proportion of nurses who chose the accepted answers on first-line drug, route and dose is close to 50%. There is no previous studies that addressed pharmacology knowledge of emergency nurses in anaphylaxis hence this figure could serve as baseline for future studies. Adequate knowledge on pharmacology of drugs is pertinent to decrease the time for drug preparation before administration and during monitoring of

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patients in the ED.

To improve the knowledge among our staff, educational intervention is essential. In terms of knowledge acquisition, our survey showed that the physicians and nurses themselves served as a significant source of information for their fellow colleagues. This observation supports the literature that nurses preferred to use knowledge gained through personal experience and interactions with coworkers, however, there is very little such information among doctors available in the literature [13]. Internet is also an important source of guidelines and knowledge for all staff. We propose role-modeling and utilizing the information technology as platforms to increase knowledge of anaphylaxis. At the institution level, role modelling can be achieved through measures that promote excellence in clinical and teaching skills including teaching awards. At the departmental level, we ensure senior doctors remain up to date and consistent with the practice of anaphylaxis through continual learning e.g., departmental grand rounds and specialist updates. They will also be encouraged to continue teaching junior doctors and nurses while managing cases of anaphylaxis and allergic reactions. As for availability of knowledge, user friendly institutional guidelines will be made readily available in the intranet which also ensure that validated knowledge are disseminated to the staff. The survey can be repeated after the educational intervention.

Our study has the limitation of being a single-center study with a small sample size. However, we managed to obtain an overall response rates of 76.3% to profile the knowledge anaphylaxis. The second limitation was the use of "Internet" as the source of information in our survey which can encompass both, validated sources of knowledge: e.g., PubMed, UpToDate as well as unvalidated sources: e.g., forum or chat rooms. We had intended for the survey to be very short to increase the response rates. However, in our educational intervention, we will educate our staff that information from validated sources are preferred which can be ensured by the availability of guidelines in the intranet. Another limitation of our study is the very small numbers of staff who has seen children in the practice (total 30 doctors and nurses) and even lower response rates for survey questions on management of anaphylaxis in children (the trademark name and dose of adrenaline in autoinjectors and the dose of adrenaline in 10-kg child). It is highly possible that the nonresponse among the nurses is due to unfamiliarity with the management of anaphylaxis in children. However, the low number of responses limits generalization in this aspect of the study. Future surveys that involve multicenter ED in Singapore will be prudent to determine this knowledge.

In conclusion, high proportion of doctors and nurses are able to recognize the signs and symptoms of anaphylaxis, although there is a trend towards over diagnosis. There is good knowledge on drug of choice and the accepted route of adrenaline among the doctors. However, knowledge of treatment of anaphylaxis among nurses was moderate and can be improved. Educational intervention that focuses on role modelling and information technology, both at the institutional and departmental level are proposed strategy.

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REFERENCES

1. Sampson HA, Munoz-Furlong A, Campbell RL, Adkinson NF Jr, Bock SA, Branum A, Brown SG, Camargo CA Jr, Cydulka R, Galli SJ, Gidudu J, Gruchalla RS, Harlor AD Jr, Hepner DL, Lewis LM, Lieberman PL, Metcalfe DD, O'Connor R, Muraro A, Rudman A, Schmitt C, Scherrer D, Simons FE, Thomas S, Wood JP, Decker WW. Second symposium on the definition and management of anaphylaxis: summary report-second National Institute of Allergy and Infectious Disease/Food Allergy and Anaphylaxis Network symposium. Ann Emerg Med 2006;47:373-80.
2. Simons FE. Anaphylaxis: recent advances in assessment and treatment. J Allergy Clin Immunol 2009;124:625-36.
3. Neugut AI, Ghatak AT, Miller RL. Anaphylaxis in the United States: an investigation into its epidemiology. Arch Intern Med 2001;161:15-21.
4. Peng MM, Jick H. A population-based study of the incidence, cause, and severity of anaphylaxis in the United Kingdom. Arch Intern Med 2004;164:317-9.
5. Jose R, Clesham GJ. Survey of the use of epinephrine (adrenaline) for anaphylaxis by junior hospital doctors. Postgrad Med J 2007;83:610-1.
6. Grossman SL, Baumann BM, Garcia Pena BM, Linares MY, Greenberg B, Hernandez-Trujillo VP. Anaphylaxis knowledge and practice preferences of pediatric emergency medicine physicians: a national survey. J Pediatr 2013;163:841-6.

7. Cetinkaya F, Zubarioglu AU, Goktas S. Pediatricians' knowledge about recent advances in anaphylaxis treatment in Istanbul, Turkey. Turk J Pediatr 2009;51:19-21.
8. Anaphylaxis: Guidelines from the European Academy of Allergy and Clinical Immunology (EAACI) [Internet]. Zurich: EAACI; c2014 [cited 2014 Apr 1]. Available from: http://www.eaaci.org/attachments/Anaphylaxis%20guidelines%20Draft%204.5%202013%2006%20.pdf.
9. Lieberman P, Nicklas RA, Oppenheimer J, Kemp SF, Lang DM, Bernstein DI, Bernstein JA, Burks AW, Feldweg AM, Fink JN, Greenberger PA, Golden DB, James JM, Kemp SF, Ledford DK, Lieberman P, Sheffer AL, Bernstein DI, Blessing-Moore J, Cox L, Khan DA, Lang D, Nicklas RA, Oppenheimer J, Portnoy JM, Randolph C, Schuller DE, Spector SL, Tilles S, Wallace D. The diagnosis and management of anaphylaxis practice parameter: 2010 update. J Allergy Clin Immunol 2010;126:477-80.
10. Simons FE; World Allergy Organization. World Allergy Organization survey on global availability of essentials for the assessment and management of anaphylaxis by allergy-immunology specialists in health care settings. Ann Allergy Asthma Immunol 2010;104:405-12.
11. Simons FE, Ardusso LR, Dimov V, Ebisawa M, El-Gamal YM, Lockey RF, Sanchez-Borges M, Senna GE, Sheikh A, Thong BY, Worm M; World Allergy Organization. World Allergy Organization Anaphylaxis Guidelines: 2013 update of the evidence base. Int Arch Allergy Immunol 2013;162:193-204.
12. Lieberman P, Camargo CA Jr, Bohlke K, Jick H, Miller RL, Sheikh A, Simons FE. Epidemiology of anaphylaxis: findings of the American College of Allergy, Asthma and Immunology Epidemiology of Anaphylaxis Working Group. Ann Allergy Asthma Immunol 2006;97:596-602.
13. Estabrooks CA, Chong H, Brigidear K, Profetto-McGrath J. Profiling Canadian nurses' preferred knowledge sources for clinical practice. Can J Nurs Res 2005;37:118-40.

 http://dx.doi.org/10.5415/apallergy.2014.4.3.164