

Anaphylaxis management before and after implementation of guidelines in the pediatric emergency department

Shilpa H. Desai, MD^{a,b}, Kwonho Jeong, PhD^c,
Jacob D. Kattan, MD^d, Rhett Lieberman, MD^e,
Stephen Wisniewski, PhD^c, and Todd D. Green, MD^f

Clinical Implications

- A hospital-wide algorithmic approach to treatment of anaphylaxis may lead to actions by clinicians that are in line with established practice guidelines and can lead to better patient quality of care.

TO THE EDITOR:

Despite availability of published anaphylaxis guidelines,^{1,2} studies demonstrate shortcomings in diagnosis and management, including a lack of epinephrine administration when indicated and failure to provide epinephrine prescriptions and emergency action plans on emergency department (ED) discharge.³⁻⁶ Use of clinical guidelines in settings such as the ED has been associated with improvement, primarily in adult populations.⁵⁻⁸ We sought to evaluate the impact of anaphylaxis guidelines in the ED of a large pediatric hospital.

METHODS

Study design

Anaphylaxis treatment guidelines at Children's Hospital of Pittsburgh of UPMC (CHP) (see [Figure E1](#) in this article's Online Repository at www.jaci-inpractice.org) were developed using criteria from published guidelines¹; implementation occurred in May 2010, with changes including availability of the guidelines on the hospital intranet, the creation of an easily accessible order set for anaphylaxis management in the electronic medical record, and physician education on these resources. A retrospective chart review was performed on children evaluated in the CHP ED from 2007 to 2013. The CHP ED sees approximately 80,000 patients per year. One author (S.H.D.) reviewed the electronic medical record of all patients under the age of 21 who presented to the ED and received either a primary or secondary ICD-9 billing designation corresponding to a diagnosis of allergic reaction or anaphylaxis (558.3, 693.1, 995.0, 995.1, 995.3, 995.60-995.69, 708.0, 708.9). In the interest of identifying records most likely to be associated with anaphylaxis, the following codes were not reviewed: 995.7 (adverse food reaction, not otherwise classified), 692.5 (contact dermatitis due to food). Patients who met National Institute of Allergy and Infectious Diseases/Food Allergy and Anaphylaxis Network diagnostic criteria¹ for anaphylaxis were included for analysis.

A 6-month wash-in/wash-out period around date of implementation was used to reduce confounding variables. The wash-in period encompassed December 2009-May 2010; the wash-out period was May-October 2010. Patients presenting in either

period were not included. The study was approved by the University of Pittsburgh Institutional Review Board.

Data collection and outcome measures

Data collected included patient demographics, personal and family allergic history, location of evaluation, interventions before arrival at CHP, symptoms and/or organ involvement, allergen exposure, pharmacotherapy administered before and at CHP, consultation with allergy/immunology, disposition, discharge medications, and allergy/immunology follow-up.

Outcome measures of interest were administration of epinephrine, disposition after evaluation, discharge with epinephrine self-injector, and allergy/immunology outpatient referral.

Statistical analysis

Descriptive statistics were reported as percentages for discrete variables and means and standard deviations for continuous variables. Comparisons of outcome were tested with a chi-square test or Fisher's exact test for proportions.

RESULTS

A total of 96 patients met the diagnostic criteria for anaphylaxis in the pre-guidelines group and 138 in the post-guidelines group. There was no statistical difference in age, race, gender, or personal history of atopy between the groups. The average age pre-guidelines was 8.54 ± 5.45 years, and post-guidelines 8.49 ± 5.39 years. Patient demographics and personal allergic history are shown in [Table E1](#) (in the Online Repository available at www.jaci-inpractice.org).

Presenting symptoms before and after guideline implementation (see [Table E2](#) in this article's Online Repository at www.jaci-inpractice.org) also did not differ, with the exception of persistent gastrointestinal (GI) symptoms (defined as nausea, abdominal pain, and/or vomiting recorded more than once over the course of the visit) reported in a higher percentage of cases postimplementation (15.6% vs 27.5%).

Administration of epinephrine before arrival was no different between the periods, but ED administration rates increased from 44.8% to 62.3% ($P = .008$) for all patients. Patients with asthma were treated with albuterol 3.8 times more often than patients without asthma (OR 3.8, $P < .001$), and administration of epinephrine among these patients increased from 37.9% pre- to 64.3% post-guidelines ($P = .008$). There was no other significant difference in management between patients who had preexisting diagnoses of allergies, asthma, or a history of anaphylaxis and patients who did not. For all patients, there was no statistically significant change in ED use of H1-blockers, H2-blockers, steroids, or albuterol. [Table I](#) shows significant improvement in the appropriate use and dosages of medications in the postimplementation period.

Hospitalization rates decreased following guideline implementation from 62.5% to 31.2% ($P < .001$). There was no significant change in either "curbside" (30.2% pre- and 24.5% post-, $P = .413$) or formal (21.9% vs 17.4%, $P = .392$) allergy/immunology consultation rates. There were significant increases in patients discharged with anaphylaxis action plans, epinephrine autoinjector prescriptions, and outpatient allergy/immunology referrals, as displayed in [Figure 1](#).

TABLE 1. Pharmacologic management

Pharmacologic management before arrival and in the pediatric ED	Pre (n = 96)	Post (n = 138)	P-value
Before arrival			
H1-blocker	61 (63.5%)	84 (60.9%)	.679
Albuterol	24 (25%)	32 (23.2%)	.749
Epinephrine	36 (37.5%)	53 (38.4%)	.888
Steroid	20 (20.8)	22 (15.9%)	.338
H2-blocker	6 (6.3%)	10 (7.3%)	.766
Emergency department			
H1-blocker	51 (53.1%)	84 (60.9%)	.238
Albuterol	39 (40.6%)	51 (36.9%)	.57
Epinephrine	43 (44.8%)	86 (62.3%)	.008
Steroid	64 (66.7%)	105 (76.1%)	.114
H2-blocker	59 (61.5%)	101 (73.2%)	.058
Saline	59 (61.5%)	59 (42.8%)	.005
Glucagon	0 (0%)	0 (0%)	N/A
Discharge medications* and disposition			
Epinephrine prescription	81 (84.4%)	137 (99.3%)	<.001
Correct dose dispensed	80/81 (98.8%)	137/137 (100%)	.372
Steroid	61 (63.5%)	112 (81.2%)	.003
Correct steroid dose and duration	55/61 (90.2%)	110/112 (98.2%)	.024
H1-blocker	50 (52.1%)	113 (81.9%)	<.001
Correct H1 dose and duration	46/50 (92.0%)	113/113 (100%)	.008
H2-blocker	26 (27.1%)	99 (71.7%)	<.001
Correct H2 dose and duration	24/26 (92.3%)	99/99 (100%)	.042
Discharge with anaphylaxis action plan	9 (9.4%)	29 (21.0%)	.018
Discharge with allergy referral	68 (70.8%)	113 (81.9%)	.047
Anaphylaxis guidelines cited in documentation		26 (19.1%)	N/A

ED, Emergency department.

*"Correct Dose and Duration" indicates that these were in accordance with the Children's Hospital of UPMC Guideline for Clinical Effectiveness (see Figure E1 in this article's Online Repository at www.jaci-inpractice.org), which adopted recommendations in the NIAID/FAAN 2006 Symposium Report.

DISCUSSION

Delays in anaphylaxis recognition and epinephrine administration are associated with increased hospitalization and fatality rates, which highlight the importance of timely recognition and appropriate treatment.³⁻⁶ Studies support outcome improvements with protocol-based management, though studies in the pediatric setting are lacking.⁵⁻⁹ We developed an anaphylaxis Guideline for Clinical Effectiveness at our hospital after anecdotal appreciation of an opportunity for improvement. Supporting an important role for its impact, we found significant improvements in rates of hospitalization and epinephrine administration as well as in patients discharged with prescriptions for epinephrine autoinjectors, written anaphylaxis action plans, and referrals for allergy/immunology evaluation. The guidelines (displayed in Figure E1 in the Online Repository available at www.jaci-inpractice.org) include guidance on all of these.

Summary of Key Patient Outcomes and Management

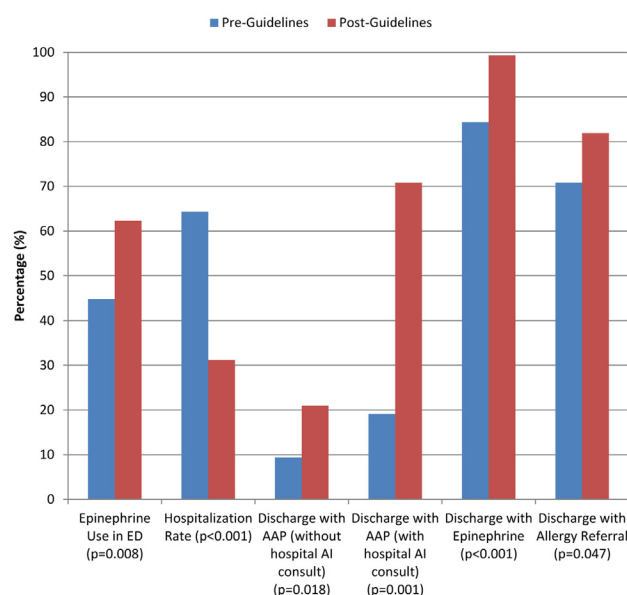


FIGURE 1. Epinephrine administration, hospitalization rate, and discharge management: a summary of key patient outcomes and management. AAP, Anaphylaxis action plan; AI, Allergy and Immunology.

We noted an apparent increase in anaphylaxis cases diagnosed between the 2 time periods; increased awareness as a result of guideline implementation may have contributed to this. The only significant difference in presenting symptoms between the 2 periods was an increase in persistent GI symptoms post-guidelines (15.6% vs 27.5%); it is possible that these symptoms caused physicians to administer epinephrine more readily, and also that the guidelines increased awareness and then documentation of these symptoms as a manifestation of anaphylaxis. Although general anaphylaxis awareness likely increased over the study time period, the fact that there was no difference in epinephrine administration by first responders and/or other ED physicians outside of CHP seems to speak in favor of a guideline effect. Finally, as nearly 40% of patients technically meeting anaphylaxis criteria were not treated with epinephrine, clearly there is still room for improvement.

Study limitations include its retrospective design, relatively small sample size, and single center aspect.

CONCLUSION

Anaphylaxis guideline implementation at a large children's hospital correlates with improved patient outcomes: statistically significant increased epinephrine administration and decreased hospitalization rates, along with an increase in management plans and epinephrine prescriptions in accordance with American Academy of Allergy, Asthma and Immunology recommendations. Additional multicenter studies would help evaluate result generalizability and identify barriers to appropriate care and follow-up.

^aDepartment of Pediatrics, Children's Hospital of Pittsburgh, Pittsburgh, Pa

^bDepartment of Allergy, Kaiser Permanente Los Angeles Medical Center, Los Angeles, Calif (Current Affiliation)

^cDepartment of Epidemiology, Graduate School of Public Health at the University of Pittsburgh, Pittsburgh, Pa

^dDepartment of Pediatric Allergy and Clinical Immunology, Icahn School of Medicine at Mount Sinai, New York, NY

^eDepartment of Emergency Medicine, Children's Hospital of Pittsburgh, Pittsburgh, Pa

^fDivision of Pulmonary Medicine, Allergy & Immunology, Children's Hospital of Pittsburgh, Pittsburgh, Pa

No funding was received for this work.

Conflicts of interest: J. D. Kattan has received research support from National Institutes of Health/National Heart, Lung, and Blood Institute (Mount Sinai K12 Research Career Development Program in Emergency Medicine 5K12 HL 109005-04). S. Wisniewski has received research support from the NIH. The rest of the authors declare that they have no relevant conflicts.

Received for publication September 8, 2014; revised January 20, 2015; accepted for publication January 26, 2015.

Available online March 7, 2015.

Corresponding author: Todd D. Green, MD, Division of Pulmonary Medicine, Allergy & Immunology, 4401 Penn Avenue, Administrative Office Building, 3rd Floor, Pittsburgh, PA 15224. E-mail: todd.green@chp.edu.

2213-2198

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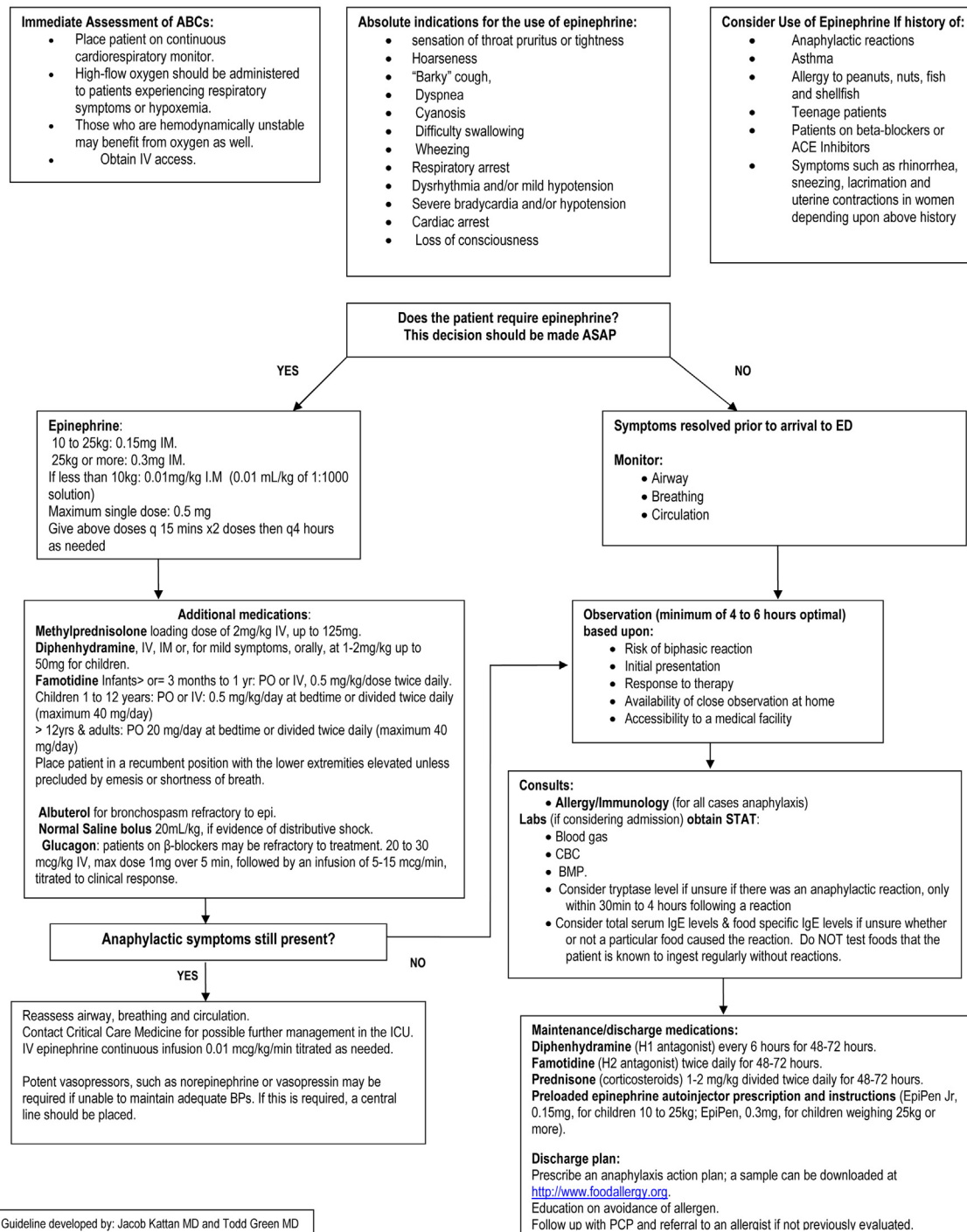
<http://dx.doi.org/10.1016/j.jaip.2015.01.021>

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Anaphylaxis Emergency Department Treatment Guidelines

Anaphylaxis is defined as a serious allergic reaction that is rapid in onset and may cause death.



Guideline developed by: Jacob Kattan MD and Todd Green MD

CE # 218.00

Origination: 5/2010

Revised/ Reviewed: 2/2012

This clinical guideline is a collaborative care plan and is not intended to construed or to serve as a standard of medical care. Rather, it is intended as a guideline to promote coordination and communication with respect to patient care and may be modified to meet individual care needs. For additional information contact the Department of Care Coordination at 412-692-7743

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FIGURE E1. © Children's Hospital of Pittsburgh of UPMC.

TABLE E1. Patient Characteristics Pre- and Post-Guideline Implementation

Patient characteristics	Pre (n = 96)	Post (n = 138)
Male	52 (54.2%)	87 (63.0%)
Age	8.54 ± 5.45	8.49 ± 5.39
Race		
White	62 (64.6%)	90 (65.2%)
Black	30 (31.3%)	34 (24.6%)
Other	4 (4.2%)	14 (10.1%)
History of asthma	29 (30.2%)	42 (30.4%)

TABLE E2. Presenting Signs/Symptoms and Suspected Etiology of Reaction

Symptom	Pre-guidelines (n = 96)	Post-guidelines (n = 138)	P-value
Skin/mucosal tissue	93 (96.9%)	138 (100%)	.068
Local cutaneous	87 (90.6%)	128 (92.8%)	.558
Diffuse cutaneous	45 (46.9%)	73 (52.9%)	.365
Upper respiratory (rhinorrhea, congestion, sneezing)	31 (32.3%)	38 (27.5%)	.433
Lower respiratory (cough, wheeze)	68 (70.8%)	84 (60.9%)	.116
BP changes/end organ	4 (4.2%)	12 (8.7%)	.2
Persistent GI	15 (15.6%)	38 (27.5%)	.032
Exposure to known allergen for patient	35 (36.5%)	51 (37%)	.938
Food	67 (69.8%)	104 (75.4%)	.345
Peanut/tree nut	50/96 (52.08%)	73/138 (52.9%)	.593

GI, Gastrointestinal.

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