

## Online Repository

### Trends in emergency department visits and hospitalizations for anaphylaxis among US older adults: 2006-2014

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**Table E1. ICD-9-CM diagnostic codes used for acute allergic reactions**

Acute Allergic Reactions	ICD-9-CM Code	
Drug Allergy	693.0	Dermatitis due to drug
	995.2	Unspecified adverse effect due to unspecified drug
	995.1	Angioneurotic edema
	995.4	Shock due to Anesthesia
Venom Allergy	989.5	Toxic effect of venom
Food Allergy	693.1	Dermatitis due to food
	995.60	Anaphylactic shock due to unspecified food
	995.61	Anaphylactic shock due to peanuts
	995.62	Anaphylactic shock due to crustaceans
	995.63	Anaphylactic shock due to fruits & vegetables
	995.64	Anaphylactic shock due to tree nuts & seeds
	995.65	Anaphylactic shock due to fish
	995.66	Anaphylactic shock due to food additives
	995.67	Anaphylactic shock due to milk products
	995.68	Anaphylactic shock due to eggs
	995.69	Anaphylactic shock due to other specified food
	995.70	Adverse food reaction, not classified elsewhere
	Other Allergy	995.0
995.3		Allergy, unspecified
708.0		Allergic urticaria
999.4		Anaphylactic reaction to serum
999.41		Anaphylactic reaction due to administration of blood and blood products
999.42		Anaphylactic reaction due to vaccination
999.49		Anaphylactic reaction due to other serum

**Table E2. ICD-9-CM diagnostic codes and algorithm used for anaphylaxis**

<b>Anaphylaxis Method I</b>	995.60	Anaphylactic shock due to unspecified food
	995.61	Anaphylactic shock due to peanuts
	995.62	Anaphylactic shock due to crustaceans
	995.63	Anaphylactic shock due to fruits & vegetables
	995.64	Anaphylactic shock due to tree nuts & seeds
	995.65	Anaphylactic shock due to fish
	995.66	Anaphylactic shock due to food additives
	995.67	Anaphylactic shock due to milk products
	995.68	Anaphylactic shock due to eggs
	995.69	Anaphylactic shock due to other specified food
	995.0	Other anaphylactic shock
<b>Anaphylaxis Method II<sup>14</sup></b>		
Symptoms		
Skin-mucosal tissue involvement		Conjunctival edema (372.73), Edema of eyelid (374.82), Edema of larynx (478.6), Edema of pharynx or nasopharynx (478.25), Flushing (782.62), Urticaria (708), Allergic urticaria (708.0), Idiopathic urticaria (708.1), Urticaria due to cold and heat (708.2), Dermatographic urticaria (708.3), Vibratory urticaria (708.4), Cholinergic urticaria (708.5), Other specified urticaria (708.8), Urticaria, unspecified (708.9), Pruritus and related conditions (698), Pruritus of genital organs (698.1), Other specified pruritic conditions (698.8), Unspecified pruritic disorder (698.9)
Respiratory compromise		Acute respiratory failure (518.81), acute respiratory distress (518.82), dyspnea/respiratory distress (786, 786.00–786.09), stridor (786.1), extrinsic asthma (493.0) or unspecified asthma (493.9)
Reduced blood pressure		Hypotension (458, 458.0, 458.2, 458.8, 458.9), or syncope/collapse (780.2)
Gastrointestinal symptoms		Allergic gastroenteritis/colitis (558.3), nausea/vomiting (787.0), nausea with vomiting (787.01), vomiting alone (787.03), or abdominal pain (789.0).
Algorithm		Skin-mucosal tissue involvement was found in conjunction with shock caused by anesthesia (995.4)
		Respiratory compromise was found in conjunction with shock caused by anesthesia (995.4) or angioneurotic edema (995.1)
		Reduced blood pressure was found in conjunction with skin-mucosal involvement, angioneurotic edema (995.1), the toxic effect of venom (989.5), or an Ecode indicating the cause of poisoning was a venomous animal/plant (E905, E905.3, E905.5, E905.8, E905.9)

	Reduced blood pressure and gastrointestinal symptoms were found in conjunction with an unspecified adverse effect caused by the correct administration of a drug, medicinal, and biologic substance (995.2) or an unspecified allergic reaction (995.3)
	Reduced blood pressure and skin-mucosal tissue involvement were found in conjunction with an unspecified adverse effect caused by the correct administration of a drug, medicinal, and biologic substance (995.2) or an unspecified allergic reaction (995.3)
	Respiratory compromise and reduced blood pressure were found in conjunction with an unspecified adverse effect caused by the correct administration of a drug, medicinal, and biologic substance (995.2) or an unspecified allergic reaction (995.3)
	Respiratory compromise and gastrointestinal symptoms were found in conjunction with an unspecified adverse effect caused by the correct administration of a drug, medicinal, and biologic substance (995.2); an unspecified allergic reaction (995.3); skin-mucosal involvement; the toxic effect of venom (989.5); or an Ecode indicating the cause of poisoning was a venomous animal/plant (E905, E905.3, E905.5, E905.8, E905.9)
	Respiratory compromise and skin-mucosal tissue involvement were found in conjunction with an unspecified adverse effect caused by the correct administration of a drug, medicinal, and biologic substance (995.2); an unspecified allergic reaction (995.3); the toxic effect of venom (989.5); or an Ecode indicating the cause of poisoning was a venomous animal/plant (E905, E905.3, E905.5, E905.8, E905.9)
	Gastrointestinal symptoms and skin-mucosal tissue involvement were found in conjunction with an unspecified adverse effect caused by the correct administration of a drug, medicinal, and biologic substance (995.2); an unspecified allergic reaction (995.3); the toxic effect of venom (989.5); or an Ecode indicating the cause of poisoning was a venomous animal/plant (E905, E905.3, E905.5, E905.8, E905.9)

**Table E3. Characteristics of anaphylaxis-related ED visits among younger adults (18-64 years) and older adults (≥65 years) in the US, 2006-2014 National Emergency Department Sample**

Characteristics	Adults (18-64 years)				Older Adults (≥65 years)			
	Unweighted Frequency	Weighted Frequency			Unweighted Frequency	Weighted Frequency		
		Frequency	%	95% CI		Frequency	%	95% CI
Overall number	81,169	365,509	100		20,989	93,795	100	
Sex								
Male	32,676	147,311	40	40-41	8,200	36,801	39	39-40
Female	48,479	218,130	60	59-60	12,786	56,973	61	60-61
Missing	14				<10			
Epinephrine Use	5,354	24,100	7	6-7	418	1,933	2	1.8-2.3
Number of ED procedures								
0	74,311	333,408	91	90-92	19,757	88,143	94	93-95
1	2,668	12,224	2	3-4	493	2,203	2	2-3
2 or more	4,190	19,878	5	4-6	739	3,415	4	3-4
Any chronic condition	43,933	196,606	54	53-55	18,194	81,230	87	86-87
Type of Trigger								
Drug	14,968	67,158	18	18-19	7,428	33,013	35	34-36
Venom	5,647	25,142	7	6-7	1,267	5,711	6	5.7-6.5
Food	14,900	68,103	19	18-19	1,304	5,920	6	6.0-6.7
Other/multiple	45,654	205,107	56	56-57	10,990	49,152	52	52-53

Abbreviations: US, United States; CI, confidence interval; ED, emergency department.

**Table E4. Clinical risk factors for severe anaphylaxis (hospitalization, cardiac arrest/intubation, or death) among US older adults – Method I only, 2006-2014 National Emergency Department Sample**

Risk Factors	Hospitalization		Cardiac arrest/Intubation		Death	
	OR	95% CI	OR	95% CI	OR	95% CI
Year	0.92	0.89-0.94	0.99	0.96-1.02	1.03	0.97-1.09
Age						
65-74 years	1.00 (referent)		1.00 (referent)		1.00 (referent)	
75-84 years	1.43	1.27-1.62	1.34	1.16-1.55	1.29	0.96-1.75
≥85 years	2.12	1.72-2.62	1.46	1.18-1.80	2.81	1.97-4.01
Sex						
Male	1.00 (referent)		1.00 (referent)		1.00 (referent)	
Female	0.83	0.75-0.93	0.83	0.72-0.96	0.98	0.74-1.31
Primary Health Insurance						
Private	1.00 (referent)		1.00 (referent)		1.00 (referent)	
Public	1.37	1.15-1.62	1.27	0.99-1.63	1.22	0.65-2.27
Self-pay	1.39	0.74-2.64	1.32	0.58-3.03	<i>Not calculated</i>	
Other	1.13	0.61-2.10	1.10	0.41-2.94	1.77	0.36-8.61
Median household income quartile						
1 (lowest)	1.38	1.14-1.66	1.59	1.28-1.98	1.18	0.77-1.80
2	1.18	0.99-1.40	1.40	1.14-1.72	1.38	0.94-2.02
3	1.16	0.98-1.37	1.24	1.00-1.52	1.17	0.78-1.75
4 (highest)	1.00 (referent)		1.00 (referent)		1.00 (referent)	
Season of Discharge						
First quarter (Jan - Mar)	1.00 (referent)		1.00 (referent)		1.00 (referent)	
Second quarter (Apr - Jun)	1.00	0.86-1.17	0.83	0.68-1.01	0.77	0.52-1.15
Third quarter (Jul - Sep)	0.93	0.80-1.07	0.80	0.67-0.96	0.86	0.59-1.27
Fourth quarter (Oct - Dec)	1.06	0.90-1.25	0.99	0.82-1.19	0.96	0.66-1.41
Hospital Region						
Northeast	1.00 (referent)		1.00 (referent)		1.00 (referent)	
Midwest	0.61	0.49-0.77	0.77	0.61-0.97	0.55	0.35-0.87
South	0.52	0.41-0.64	0.85	0.69-1.05	0.56	0.38-0.84
West	0.64	0.51-0.81	1.06	0.84-1.35	0.67	0.42-1.08
Hospital Status						
Non-Metropolitan	1.00 (referent)		1.00 (referent)		1.00 (referent)	
Metropolitan, Non-teaching	1.77	1.48-2.12	1.68	1.30-2.18	1.79	0.98-3.28
Metropolitan Teaching	1.98	1.65-2.37	2.15	1.68-2.75	2.42	1.34-4.40
Weekend presentation						

No	1.00 (referent)		1.00 (referent)		1.00 (referent)	
Yes	0.94	0.83-1.07	0.96	0.80-1.14	1.02	0.72-1.43
Type of Trigger						
Food	1.00 (referent)		1.00 (referent)		1.00 (referent)	
Drug	3.75	3.10-4.54	2.39	1.80-3.18	5.60	2.47-12.70
Venom	0.52	0.29-0.94	1.60	0.70-3.65	<i>Not calculated</i>	
Other	1.95	1.68-2.28	2.09	1.62-2.69	5.23	2.37-11.54
Epinephrine use in ED						
Yes	1.00 (referent)		1.00 (referent)		1.00 (referent)	
No	11.59	7.12-18.88	5.21	2.08-13.10	2.07	0.50-8.68
Any chronic condition						
No	1.00 (referent)		1.00 (referent)		1.00 (referent)	
Yes	15.77	12.70-19.58	19.96	10.69-37.26	17.96	4.13-78.13

Note: Number of chronic conditions had to be collapsed due to unstable estimates for the 2 or more group  
 Survey weights were used to construct this model. Unweighted n = 8,273 (due to missing data); weighted n = 37,092.

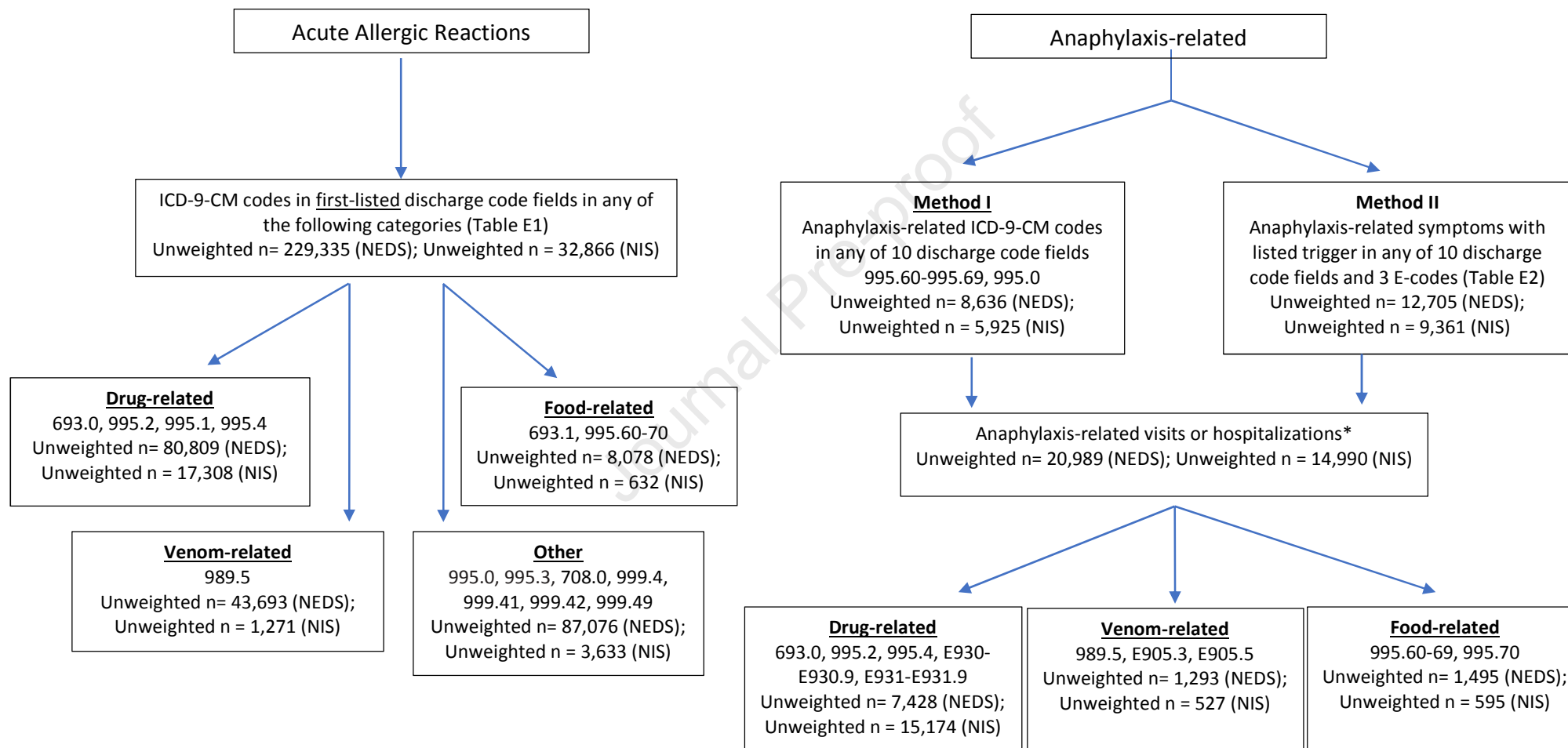
**Table E5. Clinical risk factors for severe anaphylaxis (cardiac arrest/intubation or death) among US older adults – Method I only, 2006-2014 National Inpatient Sample**

Risk Factors	Cardiac arrest/Intubation		Death	
	OR	95% CI	OR	95% CI
Year	1.00	0.97-1.02	0.98	0.93-1.04
Age				
65-74 years	1.00 (referent)		1.00 (referent)	
75-84 years	1.12	0.96-1.30	1.30	0.95-1.77
≥85 years	0.89	0.70-1.12	2.13	1.47-3.09
Sex				
Male	1.00 (referent)		1.00 (referent)	
Female	0.90	0.79-1.03	0.93	0.71-1.22
Race/Ethnicity				
White	1.00 (referent)		1.00 (referent)	
Black	1.50	1.17-1.92	1.21	0.76-1.95
Hispanic	1.11	0.84-1.45	0.86	0.49-1.52
Asian	1.03	0.70-1.51	0.96	0.45-2.06
Other	1.24	0.84-1.82	2.01	1.09-3.71
Primary Health Insurance				
Private	1.00 (referent)		1.00 (referent)	
Public	0.86	0.68-1.07	1.40	0.80-2.45
Self-pay	0.78	0.32-1.89	1.78	0.29-10.92
Other	1.30	0.61-2.79	3.11	0.97-9.97
Median household income quartile				
1 (lowest)	1.13	0.92-1.39	1.07	0.71-1.61
2	1.04	0.85-1.26	1.05	0.71-1.55
3	0.98	0.81-1.18	1.02	0.70-1.51
4 (highest)	1.00 (referent)		1.00 (referent)	
Season of Discharge				
First quarter (Jan - Mar)	1.00 (referent)		1.00 (referent)	
Second quarter (Apr - Jun)	1.10	0.91-1.33	1.16	0.79-1.71
Third quarter (Jul - Sep)	0.97	0.80-1.16	0.89	0.60-1.31
Fourth quarter (Oct - Dec)	1.00	0.83-1.21	1.10	0.75-1.61
Hospital Region				
Northeast	1.00 (referent)		1.00 (referent)	



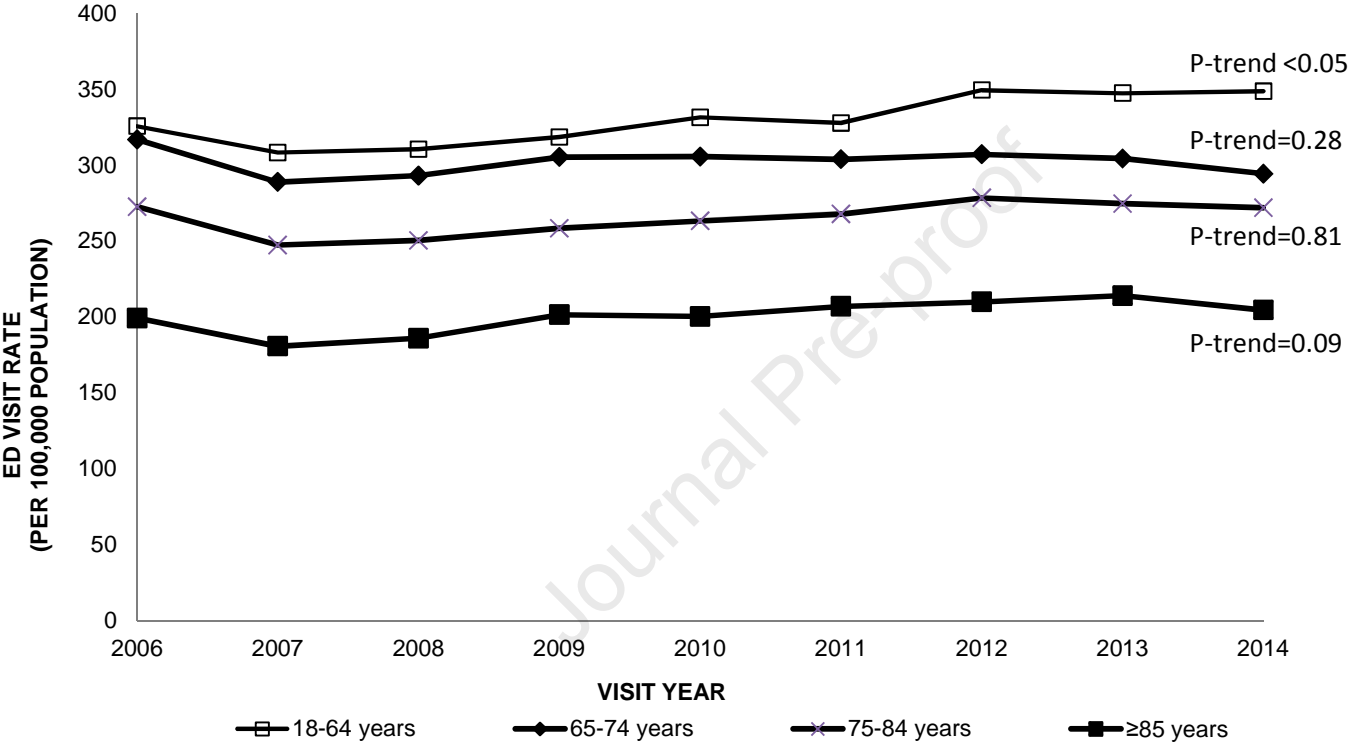
Midwest	1.03	0.84-1.28	0.76	0.49-1.19
South	0.98	0.82-1.18	0.93	0.64-1.36
West	1.14	0.93-1.40	1.08	0.72-1.63
Hospital Status				
Non-Metropolitan	1.00 (referent)		1.00 (referent)	
Metropolitan, Non-teaching	1.10	0.87-1.41	1.03	0.59-1.80
Metropolitan Teaching	1.40	1.10-1.78	1.05	0.61-1.82
Weekend presentation				
No	1.00 (referent)		1.00 (referent)	
Yes	0.99	0.83-1.17	1.17	0.83-1.65
Type of Trigger				
Food	1.00 (referent)		1.00 (referent)	
Drug	0.90	0.69-1.19	1.56	0.69-3.50
Venom	1.51	0.35-6.45	<i>Not calculated</i>	
Other	1.15	0.90-1.47	2.88	1.38-6.05
Elixhauser Index Score	1.06	1.05-1.07	1.08	1.06-1.10
Any chronic condition				
No	1.00 (referent)		1.00 (referent)	
Yes	1.17	1.03-1.32	1.11	0.85-1.45
Comorbidities* (referent: no for each condition)				
Alcohol	2.64	1.65-4.22	1.81	0.78-4.24
Congestive Heart Failure	0.81	0.66-0.99	0.73	0.50-1.06
Chronic Pulmonary Disease	1.21	1.05-1.40	0.91	0.68-1.22
Diabetes	1.11	0.95-1.29	1.15	0.84-1.56
Hypertension	1.03	0.88-1.19	0.84	0.63-1.11
Liver Disease	0.45	0.24-0.86	0.79	0.28-2.21
Obesity	1.58	1.26-1.97	1.57	1.01-2.46
Oncologic	0.62	0.49-0.78	0.64	0.42-0.98
Renal Failure	0.76	0.63-0.93	0.92	0.64-1.32
Rheumatoid arthritis/collagen vascular diseases	0.94	0.67-1.32	1.36	0.74-2.50

**Figure E1. Flow diagram for acute allergic reactions and anaphylaxis-related ED visits and hospitalizations in the U.S. from 2006-2014, National Emergency Department Sample (NEDS) and National Inpatient Sample (NIS)**

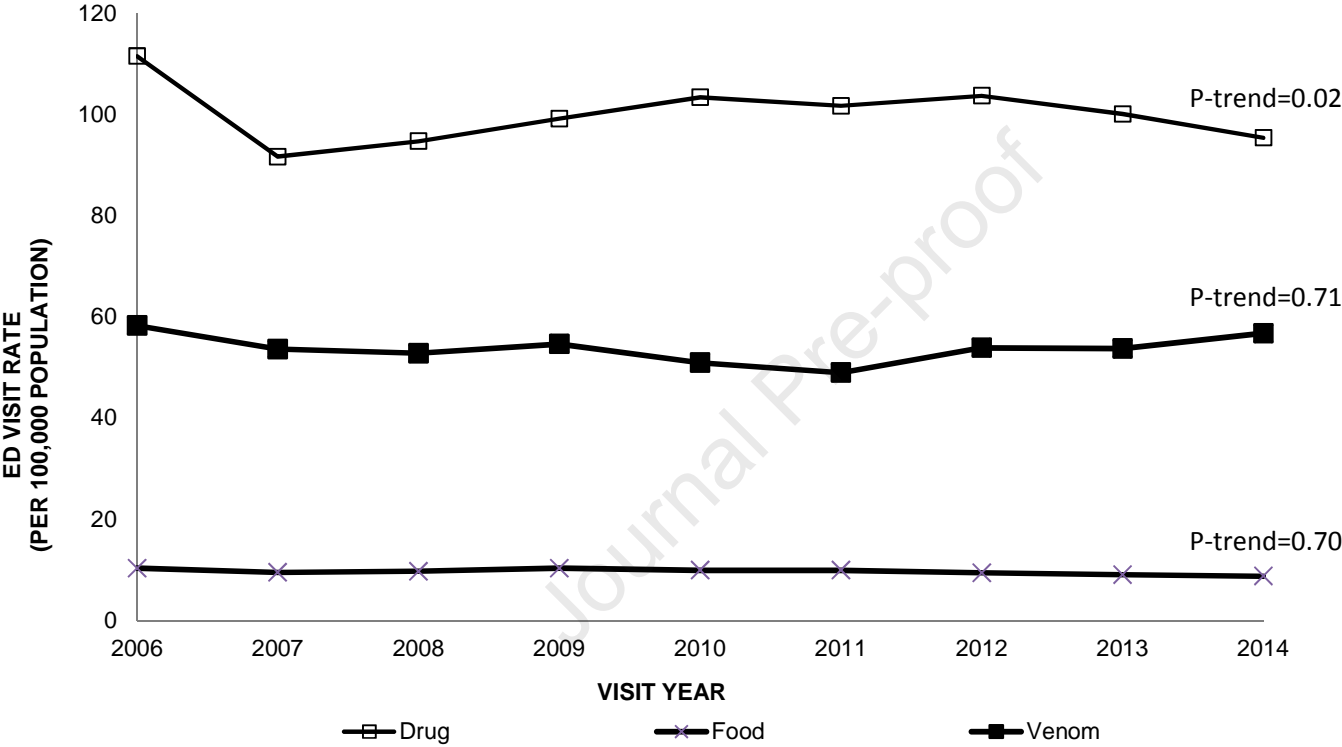


\*We also included an “other” category for anaphylaxis-related visits which included visits with multiple triggers or those visits that were not included in the above categories.

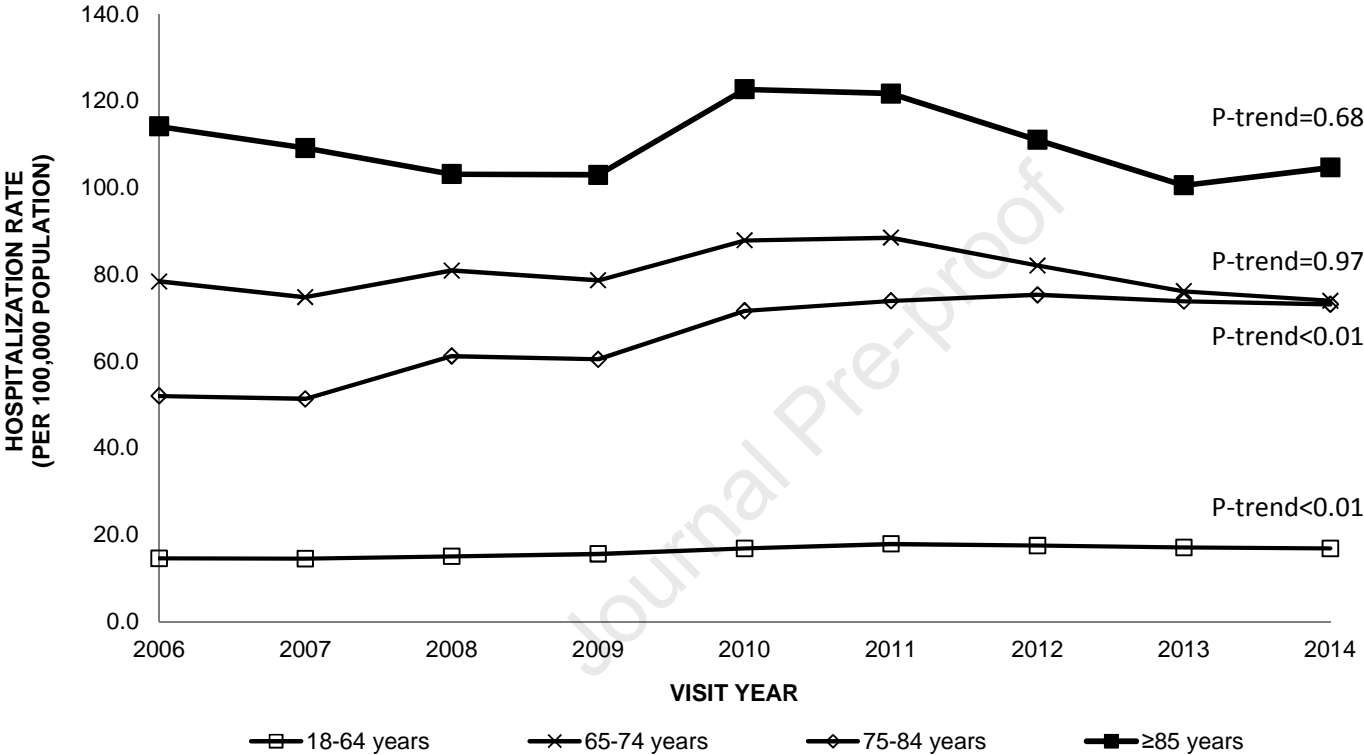
**Figure E2. Rate of emergency department visits for acute allergic reactions per 100,000 population among all adults ( $\geq 18$  years) in the US, 2006-2014 National Emergency Department Sample**



**Figure E3. Rate of emergency department visits for acute allergic reactions per 100,000 population among older adults ( $\geq 65$  years) in the US, 2006-2014 National Emergency Department Sample**



**Figure E4. Rate of hospitalizations per 100,000 population for acute allergic reactions among all adults ( $\geq 18$  years) in the US, 2006-2014 National Inpatient Sample**



**Figure E5. Rate of hospitalizations per 100,000 population for acute allergic reactions among older adults ( $\geq 65$  years) in the US, 2006-2014 National Inpatient Sample**

