

## BACKGROUND

Anaphylaxis is an acute life-threatening illness that is often misidentified by ICD diagnosis codes. This threatens the validity of claims-based epidemiologic studies of anaphylaxis as an adverse drug event. We conducted a population-based validation study to assess the accuracy of ICD-10 diagnosis codes for anaphylaxis in outpatient (OP), emergency department (ED), and inpatient (IP) settings.

## OBJECTIVE

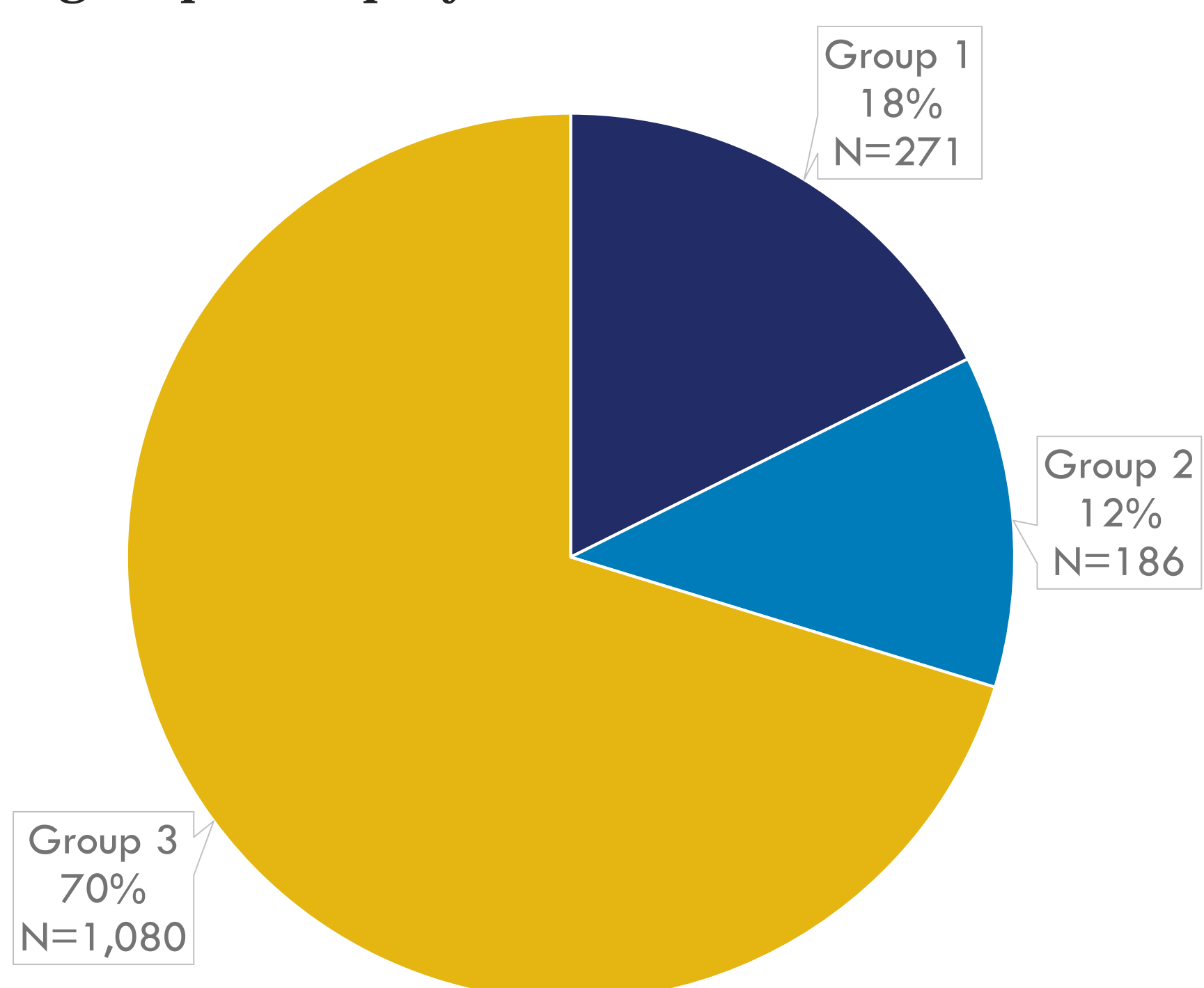
- Evaluate the accuracy of potential anaphylaxis events identified from ICD-10 diagnosis codes for physician-adjudicated events.
- Improve the accuracy of claims-based identification of anaphylaxis using natural language processing (NLP) of unstructured clinical notes and machine learning methods.

## METHODS

- We obtained medical records from IP, ED, and OP encounters with anaphylaxis ICD-10 codes in an integrated healthcare system in Washington State from October 2015 to December 2018. Both children and adults were included.
- Individuals with a diagnosis code for anaphylaxis in the year prior to the qualifying potential event were excluded.
- Eligible OP events were also required to have diagnosis or procedure codes suggesting the presence of an acute condition.
- Two physicians performed adjudication using established events criteria; disagreements were resolved by discussion.
- We also reviewed IP and ED encounters with diagnosis codes for allergic reactions and adverse drug reactions to identify additional genuine anaphylaxis cases.

## RESULTS

- Three groups of potential events were identified: individuals with anaphylaxis diagnosis codes from IP or ED encounters (Group 1), individuals with anaphylaxis diagnosis codes from OP encounters (Group 2), and individuals with diagnosis codes for allergic reactions or adverse drug reactions (Group 3). The number of potential events in each group is displayed below.



- In Groups 1 and 2, out of 246 potential events sampled for adjudication for which medical records were obtained, 239 (93%) had records adequate for adjudication. Among the 193 potential events that were adjudicated independently, agreement was 80% on initial review.

**Table 1.** Positive Predictive Value (PPV) of Anaphylaxis ICD-10 Codes for Validated Events

	Sampled for adjudication	Validated events	PPV (95% CI)	P value for interaction
<b>Overall</b>	239	154	64% (58-70%)	
<b>Site</b>				0.51
ED or IP (Group 1)	161	106	66% (59-73%)	
OP (Group 2)	78	48	62% (51-72%)	
<b>Sex</b>				0.33
Female	139	86	62% (54-70%)	
Male	100	68	68% (59-77%)	
<b>Age (years)</b>				0.04
0 to <20	64	50	78% (66-87%)	
20 to <40	51	33	65% (51-77%)	
40 to <60	71	41	58% (46-69%)	
60+	53	30	57% (43-69%)	
<b>Diagnosis code</b>				0.78
Drug or vaccine	39	24	62% (45-76%)	
Food	65	44	68% (55-78%)	
Unspecified	135	86	64% (55-71%)	

- The PPV for anaphylaxis ICD-10 codes was higher among younger patients.
- Common reasons for false positives included lack of multiple organ system involvement, presence of competing diagnoses, and timing of symptoms onset that was inconsistent with anaphylaxis.
- Out of 85 potential events that did not meet validation criteria, 80 (94%) were considered by at least one adjudicator to be a serious allergic reaction.
- Out of 76 Group 3 potential events that underwent adjudication, only 1 met criteria for a validated event (PPV 1.3%; 95% CI 0.2-9.0%).
- Assuming that all validated events were identified by Group 1, 2, and 3 algorithms, and accounting for sampling weights, the sensitivity of ED and IP anaphylaxis diagnosis codes was 58% (95% CI, 51-65%), but increased to 95% (95% CI, 74-99%) when OP events were included.

**Table 2.** Characteristics of Patients with Validated Anaphylaxis Events

<b>Total</b>	155
<b>Age in years (range)</b>	1-92
<b>Age in years, median (IQR)</b>	36 (17-57)
<b>Female</b>	87 (56%)
<b>Race</b>	
White	95 (61%)
Asian	21 (14%)
Black/African American	10 (6%)
Multiple	10 (6%)
Other	8 (5%)
Unknown	11 (7%)
<b>Ethnicity</b>	
Hispanic	9 (6%)
Non-Hispanic	135 (87%)
Unknown	11 (7%)
<b>History of anaphylaxis</b>	50 (32%)
<b>Epinephrine administered</b>	150 (97%)
<b>Encounter type</b>	
Inpatient	32 (21%)
Emergency department	74 (48%)
Outpatient	48 (31%)

**Table 3.** Cause of Validated Anaphylaxis Events by Age Group

	All ages	0 to <20 years	20 to <40 years	40 to <60 years	60+ years
<b>Food</b>	61 (39%)	33 (66%)	19 (56%)	8 (20%)	1 (3%)
<b>Drug</b>	54 (35%)	10 (20%)	10 (29%)	23 (56%)	11 (37%)
<b>Insect</b>	19 (12%)	3 (6%)	0 (0%)	8 (20%)	8 (27%)
<b>Idiopathic</b>	18 (12%)	4 (8%)	5 (15%)	2 (5%)	7 (23%)
<b>Other</b>	3 (2%)	0 (0%)	0 (0%)	0 (0%)	3 (10%)
<b>Total</b>	155	50	34	41	30

## CONCLUSION

- In this population-based setting, ICD-10 diagnosis codes for anaphylaxis from ED and IP settings had moderate PPV and sensitivity for validated events. Sensitivity was substantially improved by including OP-identified events.
- Many of the misclassified events were serious allergic reactions.
- These findings have implications for pharmacoepidemiologic studies that seek to estimate treatment-related risks of anaphylaxis using electronic health record.
- Using this set of adjudicated cases, analyses are in progress to use structured and unstructured electronic health data together with machine learning methods to further improve the identification of validated anaphylaxis events from electronic health data.

## ACKNOWLEDGEMENTS/DISCLOSURES

- The Sentinel Coordinating Center is funded by the FDA through the Department of Health and Human Services (HHS) Contract number HHSF223201400030I.
- JSF has consulted for Shionogi Inc.
- Robert Ball is an author on US Patent 9,075,796, "Text mining for large medical text datasets and corresponding medical text classification using informative feature selection."
- Many thanks to Kaiser Permanente Washington Health Research Institute, that provided data for this analysis.
- The views expressed in this poster represent those of the author(s) and do not necessarily represent the official views of FDA, or any of its affiliated entities.