

# Validation of an ICD-9–Based Claims Algorithm for Identifying Patients With Chronic Idiopathic/Spontaneous Urticaria

Karina Raimundo,<sup>1</sup> Bruce DeCotiis,<sup>2</sup> Iftikhar Hussain,<sup>3</sup> Syed Rehman,<sup>4</sup> Stephen Tilles,<sup>5</sup> Nada Shahab,<sup>3</sup> Marianne Eagan,<sup>6</sup> Paul G. Solari,<sup>1</sup> Dasha Cherepanov,<sup>6</sup> Eunice Chang,<sup>6</sup> Michael Broder,<sup>6</sup> James Zazzali<sup>1</sup>

<sup>1</sup>Genentech, Inc., South San Francisco, CA, USA; <sup>2</sup>Ocean Allergy And Respiratory Research Center, Brick, NJ, USA; <sup>3</sup>Allergy, Asthma and Immunology Center, Vital Prospects Clinical Research Institute, P.C., Tulsa, OK, USA; <sup>4</sup>Asthma & Allergy Center-Children, Toledo, OH, USA; <sup>5</sup>ASTHMA, Inc. Clinical Research Center, Seattle, WA, USA; <sup>6</sup>Partnership for Health Analytic Research, LLC, Beverly Hills, CA, USA

## ABSTRACT

**Objectives:** Chronic idiopathic/spontaneous urticaria (CIU/CSU) is a skin condition characterized by the presence of hives and angioedema lasting  $\geq 6$  weeks with no known cause. There is no specific ICD-9 code for CIU/CSU. To validate an ICD-9–based algorithm to identify patients with CIU/CSU to allow for epidemiologic research using administrative claims databases.

**Methods:** Retrospective review of medical and billing records in 4 geographically dispersed US allergy practices. Patients were eligible for inclusion if they met the either of these criteria: (1)  $\geq 2$  outpatient visits with a diagnosis of idiopathic urticaria (ICD-9, 708.1), other specified urticaria (708.8), or unspecified urticaria (708.9)  $\geq 6$  weeks apart; OR (2)  $\geq 1$  outpatient diagnosis of 708.1, 708.8, or 708.9 and 1 diagnosis of angioedema (995.1)  $\geq 6$  weeks apart. A random sample of patients known to have CIU/CSU was also included. Chart review was performed to collect information on ICD-9 codes, prescription medications, and clinical urticarial diagnoses abstracted from records of a random sample of eligible patients. Positive predictive value (PPV) and sensitivity were calculated. The study received central IRB approval.

**Results:** There were 149 patients with a mean age of 41.1 years (SD, 20.8); 73.8% were female and 69.1% were white. For 104 “true positive” patients, the mean (median) duration of CIU/CSU was 3.1 (2.5) years. The claims algorithm had sensitivity of 71.1% and PPV of 90.4%. Using just the first algorithm reduced PPV to 90.3% and sensitivity to 67.8%. Physicians most often identified CIU/CSU using the codes for idiopathic urticaria, unspecified urticaria, and other urticaria conditions.

**Conclusion:** PPV of 90.4% suggests patients identified using the tested ICD-9 algorithm are highly likely to have CIU/CSU. Sensitivity of 71.1% suggests that some patients with CIU/CSU would not be identified. Changes to the algorithm that increase sensitivity without decreasing PPV should be explored in future studies.

## INTRODUCTION

- Chronic idiopathic/spontaneous urticaria (CIU/CSU) is a skin condition characterized by the presence of itchy hives, with or without angioedema, lasting  $\geq 6$  weeks with no known cause.
- To perform research in a CIU/CSU population using administrative claims databases, one has to identify claims of patients with the condition; however, the current International Classification of Diseases, Ninth Revision, Clinical Modification (ICD-9-CM) has no specific code for CIU/CSU.
- Previous work defined an algorithm for the identification of patients with CIU/CSU in claims databases.<sup>1</sup>
- A confirmatory analysis of both medical records and ICD-9-CM codes would be the best way to test the positive predictive value (PPV) and sensitivity of such an algorithm.

## OBJECTIVE

- The goal of this study was to validate a previously published ICD-9-CM–based algorithm<sup>1</sup> to identify patients with CIU/CSU to allow for future epidemiologic research using administrative claims databases.

## METHODS

### Study Design

- A retrospective medical and billing records review was conducted in 4 US allergy practices from different geographic locations that were identified based on enrollment rates in previous clinical trials of patients with CIU/CSU.
  - This study did not involve direct contact with human patients, an intervention, or the collection of protected health information; hence, the study was granted a waiver of informed consent and authorization by Western Institutional Review Board (protocol # 1140461).

### Patient Selection

- A patient’s records were selected if the patient met 1 of the following inclusion criteria:
  - Algorithm I:  $\geq 2$  outpatient diagnoses of idiopathic urticaria (ICD-9-CM, 708.1), other specified urticaria (708.8), or unspecified urticaria (708.9)  $\geq 6$  weeks apart;
  - Algorithm II: had 1 outpatient diagnosis of 708.1, 708.8, or 708.9, and 1 diagnosis of 995.1 (angioneurotic edema)  $\geq 6$  weeks from the 708.x diagnosis; or
  - Known to have CIU/CSU: was identified by a physician at the site as having CIU/CSU (convenience sample).
- Patients that met the requirements for algorithms I or II were included in the diagnosis-based algorithm category.
- Patients were excluded from the study if they did not have  $\geq 1$  visit to the study site between January 1, 2010 and June 1, 2013.

### Data Collection

- Chart abstraction was performed on records from between January 1, 2010 and June 1, 2013. Data collected included:
  - Medical records: demographics (age, sex, race/ethnicity), diagnoses of specific urticarial conditions (physical urticaria, contact urticaria, urticaria vasculitis, and other urticaria conditions), diagnoses of allergy-related conditions (angioedema, asthma, allergic rhinitis, atopic dermatitis, allergic purpura, and other allergy conditions), and medication use.
  - Billing records: evidence of the following ICD-9-CM codes: 708.1 (idiopathic urticaria), 708.2 (urticaria due to cold and heat), 708.3 (dermatographic urticaria), 708.4 (vibratory urticaria), 708.5 (cholinergic urticaria), 708.8 (other specified urticaria), 708.9 (urticaria, unspecified), and 995.1 (angioneurotic edema).
- All abstractors received training in correctly applying inclusion/exclusion criteria and entering data to ensure data were collected consistently across centers.
- Data quality assurance was conducted on a regular basis, which included checks for content, inconsistencies, and missing fields.
- At the end of data collection, deidentified data from each center were combined into a single analytic database.

### Statistical Analysis

- Validation statistics included PPV and sensitivity (Figure 1). The diagnosis-based algorithm was used to identify potential patients with CIU/CSU. The patients’ records were reviewed. True positives (condition present in the record) and false positives (condition not present) were identified via chart review as the gold standard.
- Exploratory analyses also were performed to test variations of the claims algorithms.
- Only sensitivity was calculated for the algorithm variations.
- Descriptive statistics, summarizing distribution of demographics, ICD-9-CM codes, duration of CIU/CSU, urticarial conditions, related conditions, and medication use also are reported.

**Figure 1. Positive Predictive Value and Sensitivity**

#### Positive Predictive Value:

$$= \frac{\sum \text{True positive (ICD-9-CM algorithm positive and had CIU/CSU)}}{\sum \text{ICD-9-CM algorithm positive}}$$

#### Sensitivity:

$$= \frac{\sum \text{True positive (ICD-9-CM algorithm positive and had CIU/CSU)}}{\sum \text{Condition present (known CIU/CSU)}}$$

CIU/CSU, chronic idiopathic/spontaneous urticaria; ICD-9-CM, International Classification of Diseases, Ninth Revision, Clinical Modification.  
\*Includes known CIU/CSU identified by physician (convenience sample) or evidence of CIU/CSU identified through medical record abstraction.

## RESULTS

- Data from records were collected from 150 patients in 4 different allergy sites across the United States.
  - 1 record was excluded after being found to neither meet the requirements for the ICD-9-CM algorithms nor belong to a patient known to have CIU/CSU.
- The final study cohort contained 149 patients.
  - 115 were identified via the diagnosis-based algorithm (113 from algorithm I and 17 from algorithm II).
  - 90 were known by their physicians to have CIU/CSU.
  - 56 were identified from both sources.
- Mean age of the entire study cohort was 41.1 years (standard deviation, 20.8), 73.8% were female, and 69.1% were white (Table).

**Table. Demographics and Patient Characteristics**

Characteristic	Diagnosis-Based Algorithm* n=115	Known CIU/CSU† n=90	All‡ N=149
Mean (SD) age, y	41.0 (21.7)	44.6 (17.6)	41.1 (20.8)
Age category, y, n (%)			
≤11	13 (11.3)	0	13 (8.7)
12–17	12 (10.4)	8 (8.9)	16 (10.7)
18–34	19 (16.5)	21 (23.3)	28 (18.8)
35–44	15 (13.0)	12 (13.3)	20 (13.4)
45–54	25 (21.7)	21 (23.3)	30 (20.1)
55–64	15 (13.0)	18 (20.0)	23 (15.4)
≥65	16 (13.9)	10 (11.1)	19 (12.8)
Female, n (%)	86 (74.8)	66 (73.3)	110 (73.8)
Race/ethnicity, n (%)			
White	81 (70.4)	55 (61.1)	103 (69.1)
Black/African American	9 (7.8)	9 (10.0)	15 (10.1)
Other/multiple	4 (3.5)	2 (2.2)	6 (4.0)
Unknown	21 (18.3)	24 (26.7)	25 (16.8)

CIU/CSU, chronic idiopathic/spontaneous urticaria; ICD-9-CM, International Classification of Diseases, Ninth Revision, Clinical Modification; SD, standard deviation.

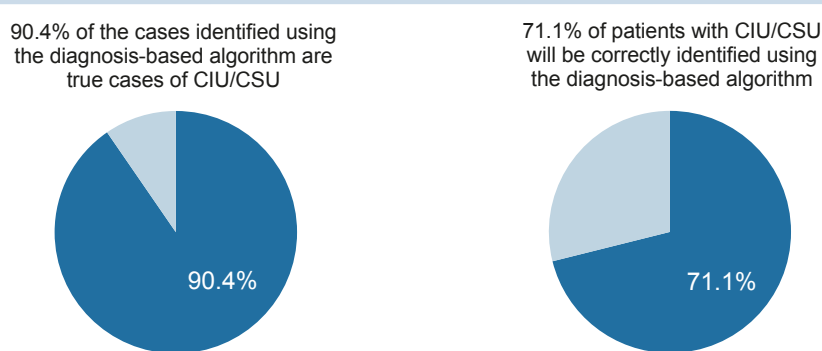
\* (I)  $\geq 2$  outpatient diagnoses of idiopathic urticaria (ICD-9-CM, 708.1), other specified urticaria (708.8), or unspecified urticaria (708.9)  $\geq 6$  weeks apart; OR (II) 1 outpatient diagnosis of 708.1, 708.8, or 708.9 and 1 diagnosis of 995.1 (angioneurotic edema)  $\geq 6$  weeks from the 708.x diagnosis.

† Known CIU/CSU (eg, identified by physician as having CIU/CSU) or evidence from medical records.

‡ Unique patients (patients may be included in >1 column).

- The diagnosis-based algorithm identified 115 patients; of those, 104 patients were true cases of CIU/CSU, ie, a 90.4% PPV of the algorithm.
- Of the patients that were known to have CIU/CSU (n=90), the diagnosis-based algorithm was able to identify 64 of them as true cases, ie, a 71.1% sensitivity of the algorithm (Figure 2).
- Using just algorithm I, a PPV of 90.3% was maintained, but sensitivity was reduced to 67.8%.

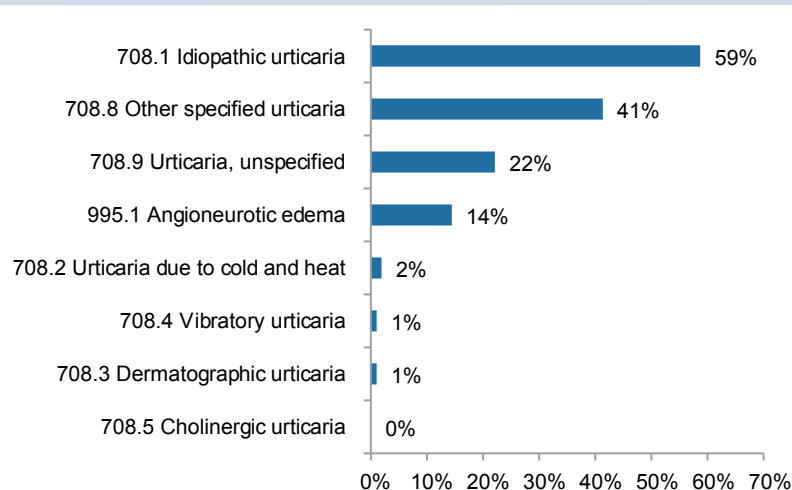
**Figure 2. Diagnosis-Based Algorithm Positive Predictive Value and Sensitivity**



CIU/CSU, chronic idiopathic/spontaneous urticaria; ICD-9-CM, International Classification of Diseases, Ninth Revision, Clinical Modification.  
Diagnosis-based algorithm: (I)  $\geq 2$  outpatient diagnoses of idiopathic urticaria (ICD-9-CM, 708.1), other specified urticaria (708.8), or unspecified urticaria (708.9)  $\geq 6$  weeks apart; OR (II) 1 outpatient diagnosis of 708.1, 708.8, or 708.9 and 1 diagnosis of 995.1 (angioneurotic edema)  $\geq 6$  weeks from the 708.x diagnosis.

- For diagnosis-based algorithm patients that were true positives (n=104), the mean (median) duration of CIU/CSU was 3.1 (2.5) years.
- For algorithm I–based patients that were true positives (n=102), the mean (median) duration of CIU/CSU was 3.1 (2.5) years.
- For algorithm II–based patients that were true positives (n=15), the mean (median) duration of CIU/CSU was 5.6 (2.8) years.
- For patients known to have CIU/CSU, the mean (median) duration of CIU/CSU was 2.9 (2.3) years.
- Among the 104 true positives, physicians most often used the codes for idiopathic urticaria (58.7%), other specified urticaria (41.3%), and urticaria, unspecified (Figure 3).

**Figure 3. ICD-9-CM Codes Used for Patients With CIU/CSU**



CIU/CSU, chronic idiopathic/spontaneous urticaria; ICD-9-CM, International Classification of Diseases, Ninth Revision, Clinical Modification.

### Exploratory Analysis

- Elimination of other specified urticaria as an eligible code decreased sensitivity to 56.7%.
- Shortening the gap required between diagnoses codes (from 6 weeks to 4 weeks) increased sensitivity to 76.7%.
- Addition of a medication component to the diagnosis-based algorithm increased sensitivity to 83.3%.
- Requirement of  $\geq 90$  days of CIU/CSU medication use (rather than any use) increased sensitivity to 74.4%.
- Given that among these variations only the diagnosis + medication algorithm showed a significant sensitivity gain compared with the original diagnosis-based algorithm, we eliminated the other 3 modifications from further testing.
  - We then used both the diagnosis and diagnosis + medication algorithms to identify groups of patients in a US insurance claims database.
    - Among a group of patients continuously enrolled for 1 year, the diagnosis-based algorithm identified 6350 patients compared with 29,913 for the diagnosis + medication algorithm.

## FUTURE RESEARCH

- Changes to the algorithm that increase sensitivity without decreasing PPV should be explored in future studies.

## CONCLUSIONS

- An algorithm requiring  $\geq 1$  urticaria code (ICD-9-CM code 708.1, 708.8, or 708.9) plus either (1) another of the same codes, or (2) a diagnosis of angioedema (995.1)  $\geq 6$  weeks from the first code had a PPV of 90.4% and a sensitivity of 71.1%.
- A PPV of 90.4% suggests that patients identified using the tested ICD-9-CM algorithm are highly likely to have CIU/CSU. Sensitivity of 71.1% suggests that most patients with CIU/CSU will be identified using the diagnosis-based algorithm.
- The most likely explanation for the identification of more than 23,000 additional patients with the revised algorithm is that it incorrectly included many non-CIU/CSU patients. Thus, the modest increase in sensitivity came at the expense of a dramatic reduction in specificity.

### REFERENCES

- Zazzali JL, et al. *Ann Allergy Asthma Immunol*. 2012;108:98–102.

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