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Validation of international classification of disease ninth revision codes for atopic dermatitis

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Abstract

Background—Evaluation of large-scale data sets is needed to better understand the epidemiology, cost and burden of atopic dermatitis (AD). We sought to validate the use of ICD-9-CM codes for identifying AD.

Methods—Patients from a large metropolitan quaternary care medical center with a diagnostic code of either 691.8 (AD) or 692.9 (eczema and contact dermatitis) were queried. Medical records were reviewed for demographics, Hanifin & Rajka (H&R) and United Kingdom Working Party

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(UKWP) criteria. Sensitivity, specificity and positive predictive values (PPV) of the codes were calculated.

Results—Of 43,278 patients identified with associated ICD-9 codes of 691.8 or 692.9, 519 and 253 with 691.8 and 692.9 were randomly selected for chart review. There was extensive overlap: 34.3% had 1 occurrence of 691.8 and 692.9; 25.6% had multiple occurrences of both codes. Among patients with 1 occurrence of 691.8, 29.9% and 30.8% met the H&R and UKWP criteria, respectively. Similarly, among patients with 1 occurrence of 692.9, 33.7% and 32.2% met the H&R and UKWP criteria. Increased PPV was associated with concomitant diagnoses of asthma, hay fever and food allergy, and increased disease severity.

Conclusions—In the outpatient setting, the ICD-9-CM codes 691.8 and 692.9 alone have poor PPV. Incorporation of diagnoses of asthma, hay fever and food allergy improves PPV and specificity. In the inpatient setting, a primary discharge diagnosis of 691.8 had excellent PPV. Although ICD-10 has been adopted in Europe and more recently the US, the same systematic errors would likely occur unless providers standardize their coding.

Keywords

atopic dermatitis; eczema; coding

Introduction

Atopic dermatitis (AD) is a chronic eczematous disorder that is a significant cause of morbidity, quality-of-life impairment and health care costs (1–3). In order to better understand the epidemiology, comorbidities, and burden of AD, evaluation of large-scale data sets that are representative of the broader population is needed. However, no studies to date have established the best methods for identifying patients with AD from such data sets. *International Classification of Diseases, Ninth Revision, Clinical Modification (ICD-9-CM)* diagnostic codes are a potential way of screening for AD, though their validity has yet to be established. Validation studies for large-scale studies have been successfully performed for other dermatologic diseases, such as pemphigus(4). In the present study, we sought to validate the use of ICD-9-CM codes for identifying in the epidemiological study of AD.

Methods

Data source

The study protocol was approved by the Northwestern University Institutional Review Board. Electronic medical record (EMR) data mining was conducted through the Northwestern Medicine Electronic Data Warehouse, which includes an EMR repository for >2.5 million individuals from multiple affiliated Chicago metropolitan area sites with representation of all races, ethnicities, ages and socio-economic status. Cases with an associated diagnostic code of either 691.8 or 692.9 between January 2001 and November 2014 were queried. An *ICD-9-CM* code of 691.8 corresponds to AD, while an *ICD-9-CM* code of 692.9 corresponds to eczema and contact dermatitis.

Data extraction

Medical records were reviewed in the entirety from first encounter through all subsequent outpatient and inpatient records. Chart review was performed by four separate and independent reviewers (DYH, PD, NV and KAS). The collected data included age, sex, and race; presence of each of the Hanifin & Rajka (H&R) major and minor criteria (5) and United Kingdom Working Party criteria (6), highest body surface area reported, severity of disease based on presence of physician-reported severity descriptors in chart review (mild, moderate, severe), type of treatment for AD, physician type, physician's final working diagnosis, inpatient hospitalization including primary or secondary diagnosis, and number of 691.8 and 692.9 codes assigned.

Diagnosis of AD

The diagnosis of atopic dermatitis was confirmed by both the H&R(5) and UKWP Diagnostic Criteria for AD (6). Patients having at least 3 major *and* at least 3 minor H&R criteria were considered to have definite AD (5). Patients were considered to have probable AD when meeting 2 major *and* 2 minor H&R criteria. In addition, patients with pruritus as well as 3 of the minor UKWP criteria were considered to have AD (6). Whereas, those with pruritus *and only* two minor UKWP criteria were considered to have probable AD. All data analyses, including sensitivity, specificity, positive and negative predictive values, were calculated through SAS version 9.4 (SAS Institute, Cary, NC, USA).

Results

Search results

Overall, 41,162 patients with eczema or contact dermatitis (692.9) and 2,106 patients with AD (691.8) were identified. Of these, 519 with an associated diagnostic code of 691.8 and 253 with an associated code of 692.9 were randomly selected for medical record review.

There was extensive overlap between the usage of the ICD-9 codes 691.8 and 692.9; 198 patients (34.3%) had occurrences of at least one ICD-9 code of 691.8 and 692.9 (Table 1). One hundred and forty-eight patients (25.6%) had multiple codes of both 691.8 and 692.9.

In patients who had 1 ICD code of 691.8 or 692.9, AD and eczema were the most common final clinical working diagnoses, followed by non-specific dermatitis, and contact dermatitis (Table 2). Of patients who had at least 1 code of 691.8, 71.5% were coded by a dermatologist, 5.7% by an allergist/immunologist, 10.3% by an internist, and 12.5% by another specialist. Of patients who had at least 1 code of 692.9, 83.2% were coded by a dermatologist, 6.0% by an allergist/immunologist, 6.4% by general internal medicine, and 4.4% by other.

Confirmation of diagnosis

To validate the diagnostic codes 691.8 and 692.9, we performed a complete review of the EMR. There were relatively similar proportions of H&R and UKWP criterion present in those with the ICD-9 codes of 691.8 and 692.9, e.g. pruritus, flexural dermatitis, and personal or family history of atopic disease (Supplemental Table 1). Among patients with 1

ICD-9 code of 691.8, 29.9% and 30.8% met the H&R and UKWP criteria, respectively. Similarly, among patients with 1 ICD-9 code of 692.9, 33.7% and 32.2% met the H&R and UKWP criteria, respectively.

The PPV of a single ICD-9 code of 691.8 was 31.3% compared to those with a definite diagnosis of AD (Supplemental Table 2). The PPV did not improve when limiting analyses to those patients with multiple occurrences of 691.8. However, limiting analyses to patients who also had a diagnosis of asthma or hay fever improved the PPV to 46.6% and 47.1% per H&R and UKWP criteria. Requiring an additional diagnosis of food allergy raised PPV to 76.3% and 65.8%, respectively.

The PPV of a single ICD-9 code of 692.9 was 31.0% AD and the PPV improved slightly when limiting analyses to those patients with multiple occurrences of 692.9. However, limiting analyses to patients who also had a diagnosis of asthma or hay fever improved the PPV to 59.8% and 54.9% per H&R and UKWP criteria. Requiring an additional diagnosis of food allergy raised PPV to 81.0% and 66.7% per H&R and UKWP criteria, respectively.

Confirmation of codes by, medication history, physician coder, and disease severity

In patients who had at least a single ICD-9 code of 691.8 as well as a history of systemic treatments, 67.9% and 62.3% met H&R and UKWP criteria, respectively (Supplemental Table 3). In patients who had at least a single ICD-9 code of 692.9 as well as a history of systemic treatments, 65.4% and 61.5% met H&R and UKWP criteria, respectively.

In patients who had at least a single ICD-9 code of 691.8 which was coded by a dermatologist or allergist, 39.7% and 39.5% met H&R and UKWP criteria, respectively. In patients who had at least a single ICD-9 code of 692.9 which was coded by a dermatologist or allergist, 36.9% and 35.9% met H&R and UKWP criteria, respectively. An increasing severity of AD tended to predict for a higher sensitivity, specificity, and PPV of the diagnostic codes 691.8 or 692.9 (Supplemental Table 4)

Confirmation of ICD-9 codes used in the inpatient setting

Ten patients had a primary inpatient discharge diagnosis of 691.8, of which 9 (90%) and 10 (100%) met H&R and UKWP criteria, respectively (Table 3). Only 1 patient had a primary inpatient diagnosis of 692.9 and did not have definite or probable AD as per H&R or UKWP criteria.

For patients with a secondary inpatient diagnosis of 691.8, the PPV of AD was only 62.1% and 55.2% as per H&R and UKWP criteria, respectively. Limiting analyses to those with who also had a discharge diagnosis of asthma or hay fever improved the PPV of AD to 73.7% as per H&R and UKWP criteria. For patients with a secondary inpatient diagnosis of 692.9, the PPV of AD was only 66.7% and 60.0% as per H&R and UKWP criteria, respectively. Limiting analyses to those with who also had a discharge diagnosis of asthma or hay fever improved the PPV of AD to 88.9% and 100% as per H&R and UKWP criteria.

Discussion

The present findings demonstrate that the *ICD-9-CM* codes 691.8 and 692.9 alone have a poor predictive value of a definite or probable diagnosis of AD in the outpatient setting. To address this, we stratified patients by having a single vs. multiple occurrences of the respective *ICD-9-CM* code and found that patients with multiple occurrences of 691.8 or 692.9 had no to minimal increased predictive values of the diagnostic codes. However, 691.8 or 692.9 with a concomitant diagnosis of asthma or hay fever, as well as food allergy, demonstrated excellent PPV and specificity. However, the sensitivity of this algorithm is low and likely excluded many cases of AD. Nevertheless, this algorithm represents a potential approach for epidemiological studies of AD using *ICD-9* codes.

In the inpatient setting, patients who were primarily admitted with a diagnosis of 691.8 had excellent PPV. Patients admitted primarily for AD were admitted by a dermatologist or had an inpatient dermatology consultation that confirmed the diagnosis. Thus, a single occurrence of the *ICD-9-CM* code 691.8 as a primary inpatient diagnosis may serve as a way of identifying patients with AD. For secondary diagnoses of 691.8 or 692.9, a concomitant diagnosis of asthma or hay fever increased specificity and PPV. The sensitivity and PPV of a primary inpatient diagnosis of 692.9 was not estimated owing to too few cases.

Many patients with unconfirmed diagnoses of AD were likely due to inadequate documentation rather than misdiagnosis. Indeed, AD and eczema were the most common clinical diagnoses in patients with either 691.8 or 692.9 who did not meet H&R or UKWP criteria. This may stem from a lack of formal criteria used to diagnose AD in clinical practice or lack of documentation of some findings present in the history and/or physical exam. On the other hand, 22.7% and 38.1% of patients with *ICD* codes 691.8 and 692.9 had final clinical diagnoses other than AD, indicating that some were initially misdiagnosed as AD. Non-dermatologists might confuse other eczematous disorders as AD. When AD was coded by dermatologists or allergists, the PPV of the diagnostic codes increased, but were still low.

A substantial proportion of patients with AD were assigned an *ICD* code of 692.9 but not 691.8. Moreover, many patients with an *ICD-9* code of 691.8 also had an *ICD-9* code of 692.9. This resulted from the entry of “eczema” into the electronic medical record and represents a systematic error in the *ICD-9* coding for AD. Moreover, this systematic error coding raises major challenges for the epidemiological study of AD. A substantial proportion of AD patients were coded with 692.9 and not 691.8. However, it is likely a considerable proportion of patients with 692.9 indeed have atopic dermatitis. For instance, a study of the national Ambulatory Medical Care Survey was queried for top diagnoses at the dermatologist from 1993–2010; among patients aged 0 to 4, 18.4% had 691.8 (AD) and 16.1% had 692.9 (contact dermatitis or eczema) (7). These trends of similar percentages remained steady for many of the age groups, with 692.9 overtaking 691.8 in frequency in older age groups. It is unlikely that these cases, especially in children, all represent contact dermatitis.

Defining AD by 691.8 would underestimate disease prevalence, whereas 691.8 and 692.9 would overestimate disease prevalence. Thus, epidemiological studies using ICD-9 codes to define AD should be interpreted with caution. It is therefore imperative that the more precise ICD coding of AD be used in practice going forward. 692.9 is the ICD-9 code for unspecified contact dermatitis, but is also linked to the term “eczema”. Thus, entry of the lay term “eczema” in many electronic health records will assign incorrect ICD codes, which may have ramifications for reimbursement and patients’ access to medications for their AD.

It is noteworthy that the transition to ICD-10 occurred in Europe over a decade ago and has been adopted in the United States since 2013. The ICD-9 and ICD-10 codes for AD (691.8 and L20.x) are distinct from those of eczema (692.9 and L30.9). Nevertheless, in ICD-10, contact dermatitis (L23-L24) has now been separated from eczema (L30.9). Furthermore, there are more sub-diagnoses within atopic dermatitis now, such as flexural eczema (L20.82) and atopic dermatitis, unspecified (L20.9). Although the new ICD-10 system is more nuanced, the same systematic error would likely occur since ICD-10 codes for AD are distinct from those of eczema. Further studies are needed to address miscoding in ICD-10 and to develop potential solutions, such as consensus guidelines regarding nomenclature for atopic dermatitis (8).

Strengths of this study include a structured data abstraction to confirm the diagnosis of atopic dermatitis using 2 validated diagnostic instruments. Another strength is that both outpatient and inpatient records were reviewed at a large quaternary care hospital and outpatient practice network in a major metropolitan city. A limitation of this study is that it was performed in an urban hospital and practice network that may not necessarily be generalizable to all medical centers. On the other hand, if selection of atopic dermatitis based on a single ICD-9-CM diagnosis code in the outpatient setting is not reliable in the present study, it is likely not reliable in many other settings. Another limitation may be the smaller proportion of inpatients studied. Further validation studies are warranted for both ICD-9-CM codes in the inpatient setting.

In conclusion, the results of this study demonstrate that ICD-9 codes alone are insufficient for identifying patients with AD from healthcare databases. In the outpatient setting, limitation to multiple occurrences of the ICD codes 691.8 or 692.9, presence of asthma or hay fever, as well as a food allergy dramatically increased PPV at the expense of much lower sensitivity. In the inpatient setting, a primary diagnosis of 691.8 appears valid. A secondary inpatient diagnosis of 691.8 or 692.9 combined with the presence of asthma or hay fever has reasonable sensitivity and PPV. Given the uncertainty of these ICD-9 codes, epidemiological studies using ICD-9 to identify cases of AD should be interpreted with caution.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Abbreviations used

ICD-9-CM	International Classification of Disease 9 th edition Clinical Modification
AD	atopic dermatitis
PPV	positive predictive value

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Table 1

Co-occurrence of ICD-9 codes 691.8 and 692.9 (n=577).

Occurrence of ICD-9 code 692.9	Occurrence of ICD-9 code 691.8		
	None	Single	Multiple
None	-	45 (7.8%)	276 (47.8%)
Single	11 (1.9%)	3 (0.5%)	28 (4.9%)
Multiple	44 (7.6%)	19 (3.3%)	148 (25.6%)

Table 2

Most common final diagnoses of subjects coded with 691.8 or 692.9

Final diagnosis	691.8		692.9	
	Freq	Rank	Freq	Rank
Atopic dermatitis	265 (51.1%)	1	106 (41.9%)	1
Eczema	56 (10.8%)	2	31 (12.3%)	2
Unspecified dermatitis	47 (9.1%)	3	29 (11.5%)	3
Contact dermatitis	27 (5.2%)	4	24 (9.5%)	4
Atopic/Contact dermatitis	14 (2.7%)	5	7 (2.8%)	7
Seborrheic dermatitis	8 (1.5%)	6	-	-
Hand dermatitis	7 (1.4%)	7	7 (2.8%)	7
Nummular eczema	7 (1.4%)	7	-	-
Asteatotic eczema	4 (0.8%)	9	4 (1.6%)	9
Dyshidrotic eczema	3 (0.6%)	10	12 (4.7%)	5
Rash, not specified	-	-	10 (4.0%)	6
Acute urticaria	-	-	3 (1.2%)	10

Diagnoses represent physician's final working diagnosis of the patient who had previously been associated with the ICD code 691.8 or 692.9.

Table 3

Sensitivity, specificity, positive and negative predictive values of ICD-9 code 692.9 in the inpatient setting (n=29).

Variable	691.8				692.9			
	Primary diagnosis	Secondary diagnosis	Secondary diagnosis with history of asthma or hay fever	Primary diagnosis	Secondary diagnosis	Secondary diagnosis with history of asthma or hay fever		
Hanifin & Rajka (Definite)	Sensitivity	9 (100%)	94.7%	14 (73.7%)	-	52.6%	8 (42.1%)	
	Specificity	0 (0%)	15.4%	8 (61.5%)	-	61.5%	12 (92.3%)	
	PPV	9 (90%)	62.1%	14 (73.7%)	-	66.7%	8 (88.9%)	
	NPV	0 (0%)	66.7%	12 (52.2%)	-	47.1%	8 (61.5%)	
Hanifin & Rajka (Probable) *	Sensitivity	10 (100%)	95.7%	16 (69.6%)	-	52.2%	9 (39.1%)	
	Specificity	0 (0%)	22.2%	6 (66.7%)	-	66.7%	9 (100%)	
	PPV	10 (100%)	76.9%	16 (84.2%)	-	80.0%	9 (100%)	
	NPV	0 (0%)	66.7%	9 (39.1%)	-	35.3%	6 (46.2%)	
U.K. Working Party (Definite)	Sensitivity	10 (100%)	100.0%	14 (82.4%)	-	56.3%	7 (41.2%)	
	Specificity	0 (0%)	18.8%	10 (66.7%)	-	62.5%	13 (86.7%)	
	PPV	10 (100%)	55.2%	14 (73.7%)	-	60.0%	7 (77.8%)	
	NPV	0 (0%)	100.0%	13 (56.5%)	-	58.8%	10 (76.9%)	
U.K. Working Party (Probable) **	Sensitivity	10 (100%)	95.2%	15 (71.4%)	-	57.1%	9 (42.9%)	
	Specificity	0 (0%)	18.2%	7 (63.7%)	-	72.7%	11 (100%)	
	PPV	10 (100%)	69.0%	15 (79.0%)	-	80.0%	9 (100%)	
	NPV	0 (0%)	66.7%	11 (47.8%)	-	47.1%	6 (46.2%)	

* Probable based on meeting 2 major and 2 minor criteria for H&R

** Probable based on meeting pruritus and 2 minor criteria for UKWP