Understanding administrative coding of emergency department visits for unspecified acute allergic reactions

Colleen McMilin, Carlos Camargo Jr, Susan Morton, Cameron Grant

ABSTRACT

AIM: Emergency department (ED) visits for food-related acute allergic reactions enable estimation of temporal trends in food allergy prevalence. To use this approach in New Zealand requires an understanding of the proportion of ED visits coded as ‘anaphylaxis, unspecified’ or ‘allergy, unspecified’ that are food-related allergic reactions.

METHOD: We reviewed all ED presentations of children, coded as ‘anaphylaxis, unspecified’ or ‘allergy, unspecified’, from 1988–2011 to the Auckland City Hospital ED. Charts were reviewed independently by two investigators to determine agreement on categorisation of presentations as being food-related acute allergic reactions. We compared ED presentation rates in different time intervals using rate ratios (RR) and 95% confidence intervals (CI).

RESULTS: Sixty-five (29%) of the 221 ED presentations given a discharge code of ‘anaphylaxis, unspecified’ or ‘allergy, unspecified’, were a food-related allergic reaction. Inter-observer agreement was very good (kappa >0.80). The ED presentation rate with food-related allergic reactions in 2004–2011 was 98% higher than in 1988–1995 (RR=1.98, 95%CI 1.10–3.72). By contrast, ED presentation rates for non-food-related allergic reactions did not change over these years.

CONCLUSION: ED presentations for food-related allergic reactions are identifiable from within ED presentations coded as ‘anaphylaxis, unspecified’ or ‘allergy, unspecified’. ED presentations for food-related allergic reactions have increased over time in Auckland.

Worldwide, food allergies have been the subject of much debate in recent decades due to what many observe as a dramatic increase in childhood food allergy prevalence, incidence, and severity.1-5 Despite New Zealand having one of the highest prevalences of asthma worldwide, the epidemiology of other atopic diseases, including food allergy, has been poorly characterised.6-8

Due to difficulties inherent with the establishment of stable and repeatable measures of food allergy prevalence in the community or in primary care settings, hospital emergency department (ED) presentations for food-related acute allergic reactions have been used in other countries to estimate temporal trends.9-12 Such an approach would seem particularly appropriate in New Zealand given that acute hospital-based secondary care services are free, the hospital presentation data is stored and accessible at both a national and regional level, and each person having contact with health services in New Zealand is assigned a unique identifier: the national health index (NHI) number.

While hospital event data only describes food-related allergic reactions at the severe end of the clinical spectrum, these data do allow for a measure of disease burden that is less subject to bias than those based upon self-report, or in the case of children, parental report. Rates of IgE-mediated food allergy can easily be overestimated as people confuse IgE-mediated food allergy...
with other, non-IgE-mediated, food intolerances. Rate estimates based on studies that use self-reported data are often based on broad questions, for example “do you (or your child) have a food allergy?” A systematic review of studies published from 1988 to 2009 showed that the prevalence of food allergy estimated from self-report data is much higher than that estimated when diagnosis is based upon skin prick testing, food specific IgE determinations or food challenges. For example, based on the inclusion of 51 relevant studies, the pooled estimate for cow's milk allergy prevalence from self-report was 3.5%, and from the other three methods was between 0.6% and 0.9%. Population estimates of food allergy prevalence based upon self-reported data also vary widely between studies, ranging from 1.2% to 17% for milk, 0.2% to 7% for egg, 0% to 2% for peanuts and fish, 0% to 10% for shellfish, and 3% to 35% for any food.

Episodes of acute allergic reactions that result in ED presentations are identified by administrative codes based on the International Classification of Diseases (ICD) system. These codes include both those specific to food-related allergic reactions (eg, contact dermatitis due to food in contact with skin, dermatitis due to food taken internally, anaphylactic shock due to peanuts) and those that are more generic (eg, anaphylaxis unspecified, allergy unspecified).

Inconsistent code assignment and lack of a universally-accepted clinical definition for anaphylaxis have required that investigation of ED presentations for food-related allergic reaction presentations consider both visits coded as being food-related and visits coded as being due to an anaphylactic or allergic reaction not further specified. In a study conducted across multiple US EDs, relying solely on food specific ICD-9-CM codes resulted in identification of only 53% of patients presenting to the ED with a food-related allergic reaction, whereas 87% of patients presenting with insect sting-related allergic reactions were identified by the codes specific to insect sting-related reactions. In another multi-site ED study from the US—specifically of ED visits for food-related allergic reactions—57% of patients were identified by using food-related allergic reaction codes and an additional 43% were identified from within less specific ICD-9 codes. Hence, the inclusion of only patients who are identified by ICD codes specific to food-related allergic reactions results in an underestimation of the true frequency of ED presentations.

To describe temporal trends in food-related allergic reactions in New Zealand requires a more comprehensive understanding of the application of the commonly used administrative codes (ie, ICD-9-CM-II and ICD-10-AM). Specifically, it is necessary to determine for what proportion of ED visits coded as ICD-9 codes 995.0 (ICD-10 T78.2) (anaphylaxis, unspecified) and 995.3 (ICD-10 T78.4) (allergy, unspecified) is the ED presentation due to a food-related allergic reaction?

Our objective was to complete a review of the ED presentations of children who presented to a public hospital ED between 1988 and 2011 with allergic reactions that were coded as either ‘anaphylaxis, unspecified’ and/or ‘allergy, unspecified’. From this review we sought to establish the proportion of children with an ED presentation, identified by the aforementioned ICD-9 and ICD-10 codes, in whom the presentation was caused by a food-related allergic reaction. Knowledge of this proportion is necessary before being able to utilise national ED presentation data to determine if there have been increases in food-related allergic reaction hospital presentations in New Zealand in recent decades.

**Method**

We completed a chart review of all presentations from 1988 to 2011 of children (0–14 years old) to the public hospital ED in the Auckland District Health Board (ADHB) region, for which the ICD codes for ‘anaphylaxis, unspecified’ or ‘allergy, unspecified’, were assigned. Although these codes only capture a subset of acute allergic reaction presentations, it is important to focus on these unspecified codes as they account for the majority of ED presentations that are not identified by food specific ICD codes. We chose this time period because it is the same as that for which data are available nationally. The ADHB operates New Zealand's largest public hospital, with almost two million patient contacts.
annually, serving more than 30% of the Auckland population. The demographics of the ADHB population are broadly generalisable to the national population. Population estimates were based upon the national five-yearly census and intercensal estimates.

Ethical and institutional approval for the project was granted by the ADHB Research Review Committee (Approval number A+ 6133). Patient record data at ADHB is predominantly electronic. Once identified, patient charts were obtained from the ADHB. We reviewed these charts and extracted data to describe demographics and determine whether the hospital presentation was due to a food-related allergic reaction. Presentations were categorised as food-related, not food-related or due to an unknown cause (Table 1).

To ensure that data extraction was complete and allergic reaction categorisation was consistent, the two reviewers (CM and CCG) independently reviewed all of the patient charts and assigned each ED presentation as being due to a food-related allergic reaction, non-food-related allergic reaction or due to a reaction for which the cause was unknown. We then determined inter-observer agreement for this categorisation.

**Statistical analyses**

Agreement between investigators was calculated using a Kappa (κ) statistic. Kappa scores and 95%CI were calculated using SAS SAS-PC version 9.3 software. Kappa scores were defined as showing poor (κ ≤0.2), fair (κ >0.2 to ≤0.4), moderate (κ >0.4 to ≤0.6), good (κ >0.6 to ≤0.8) or very good (κ >0.8 to ≤1.0) agreement.

We compared the age of those for whom the ED presentation was or was not a food-related allergic reaction using the Wilcoxon Rank-Sum test. We described the number of individuals in each year with an ED presentation that was food-related, not food-related or of unknown cause and determined whether the annual number of presentations in each of these three categories changed over time. We assumed that, in addition to being infrequent, presentations to the ED in each of these categories occurred independently of each other and at a constant rate.

In view of the small number of ED presentations per year in each of the three categories (food-related, not food-related or unknown cause) and large year-to-year variability we grouped cases into eight-year intervals (ie, 1988–1995, 1996–2003, and 2004–2011), and described the number of presentations per person-year in each interval. Using the first time interval as the reference period, we then determined if ED presentation rate in the other two subsequent eight-year time intervals differed from this baseline interval, using rate ratios (RR) and 95% CIs. Because anaphylaxis is only identified in a proportion of patients

<p>| Table 1: Definitions used to categorise hospital presentations identified by ICD codes ‘anaphylaxis, unspecified’* and ‘allergy, unspecified’† in children (0–14 years). |</p>
<table>
<thead>
<tr>
<th>Food-related allergic reaction category</th>
<th>Features used to assign hospital emergency department visits to each category</th>
</tr>
</thead>
</table>
| **Food-related** | • History of atopic disease and generalised reaction shortly after consuming specified food  
Or  
• A previous episode of food-related allergic reaction with the reaction occurring in a location where food supervision was potentially not stringent and the history indicated timing in association with food consumption  
Or  
• A generalised reaction in association with food without documentation that exposure to a new food had occurred |
| **Not food-related** | • Non-food allergen identified  
• Localised reaction eg, digit or eye |
| **Unknown cause** | • Generalised reaction not related to meal  
• No known allergen exposure or no allergen exposure documented  
• No past history of food-related allergic reaction |

* Anaphylaxis, unspecified = ICD-9 code 995.0 or ICD-10 code T78.2  
† Allergy, unspecified = ICD-9 code 995.3 or ICD-10 code T78.4
Table 2: Categorisation of children aged 0 to 14 years presenting to the hospital emergency department with ‘anaphylaxis, unspecified’* and ‘allergy, unspecified’† from 1988 to 2011.

<table>
<thead>
<tr>
<th>Categorisation by investigator one n(%)</th>
<th>Food-related allergic reaction category</th>
<th>Food-related</th>
<th>Not food-related</th>
<th>Reaction to unknown cause</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Food-related</td>
<td>58 (26)</td>
<td>2 (1)</td>
<td>3 (1)</td>
<td>63 (29)</td>
<td></td>
</tr>
<tr>
<td>Not food-related</td>
<td>5 (2)</td>
<td>125 (57)</td>
<td>13 (6)</td>
<td>143 (65)</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>65 (29)</td>
<td>130 (59)</td>
<td>26 (12)</td>
<td>221 (100)</td>
<td></td>
</tr>
</tbody>
</table>

Table 3: Agreement between researchers in categorising of hospital presentations

<table>
<thead>
<tr>
<th>Categories</th>
<th>Kappa score* (κ)</th>
<th>95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Food-related vs. not food-related or unknown</td>
<td>0.87‡</td>
<td>0.80-0.94</td>
</tr>
<tr>
<td>Food-related vs. not food-related</td>
<td>0.92‡</td>
<td>0.85-0.98</td>
</tr>
</tbody>
</table>

* Inter-observer agreement classification: Poor (κ ≤ 0.2), fair (κ >0.2 to ≤0.4), moderate (κ >0.4 to ≤0.6), good (κ >0.6 to ≤0.8) or very good (κ >0.8 to ≤1.0) agreement.
† Simple kappa

Table 4: Comparison of rate of hospital presentations due to acute allergic reactions in Auckland that were coded as ‘anaphylaxis, unspecified’* and ‘allergy unspecified’†: 1996–2003 and 2004–2011 versus 1988 to 1995.

<table>
<thead>
<tr>
<th>Time interval</th>
<th>Average population per year</th>
<th>Number of ED presentations</th>
<th>Rate ratio vs. 1988–95 (95% CI)†</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Food-related</td>
<td>1988–95</td>
<td>249,270</td>
<td>17</td>
<td>1.00</td>
</tr>
<tr>
<td></td>
<td>1996–03</td>
<td>289,047</td>
<td>8</td>
<td>0.41 (0.15–0.99)</td>
</tr>
<tr>
<td></td>
<td>2004–11</td>
<td>296,841</td>
<td>40</td>
<td>1.98 (1.10–3.72)</td>
</tr>
<tr>
<td>Not food-related</td>
<td>1988–95</td>
<td>249,270</td>
<td>38</td>
<td>1.00</td>
</tr>
<tr>
<td></td>
<td>1996–03</td>
<td>289,047</td>
<td>35</td>
<td>0.79 (0.49–1.29)</td>
</tr>
<tr>
<td></td>
<td>2004–11</td>
<td>296,841</td>
<td>57</td>
<td>1.26 (0.82–1.95)</td>
</tr>
<tr>
<td>Unknown</td>
<td>1988–95</td>
<td>249,270</td>
<td>5</td>
<td>1.00</td>
</tr>
<tr>
<td></td>
<td>1996–03</td>
<td>289,047</td>
<td>6</td>
<td>1.03 (0.26–4.29)</td>
</tr>
<tr>
<td></td>
<td>2004–11</td>
<td>296,841</td>
<td>15</td>
<td>2.52 (0.87–8.86)</td>
</tr>
</tbody>
</table>

Abbreviation: ED, emergency department.
* Anaphylaxis, unspecified = ICD-9 code 995.0 or ICD-10 code T78.2
† Allergy, unspecified = ICD-9 code 995.3 or ICD-10 code T78.4
† CI = confidence interval
making an ED presentation with anaphylaxis we combined ED presentations for which the code identified or did not identify the presence of anaphylaxis.18

Results

Of the 248 records that met the inclusion criteria, 226 were reviewed by both reviewers. We included 221 (89%) in the analysis, with the five excluded being duplicate presentations; we only counted the first event for the individuals who presented twice. None of the five presentations excluded were food-related acute allergic reactions. Of these 221 presentations, 120 (54%) were coded as ‘anaphylaxis, unspecified’, and 101 (46%) as ‘allergy, unspecified’. Records reviewed by both investigators were categorised with respect to the probability of the allergic reaction being due to a food allergen (Table 2).

Inter-observer agreement was very good for categorisation into a food-related allergic reaction versus all other visits (κ=0.87) or only an allergic reaction not due to food (κ=0.92) (Table 3).

Sixty-five (29%, 95%CI 24–36%) of the 221 hospital presentations with a discharge code of ‘anaphylaxis, unspecified’ or ‘allergy, unspecified’, were identified as food-related allergic reactions. Of these 65 presentations, 43 (19%) were coded as ‘anaphylaxis, unspecified’, and 22 (10%) as ‘allergy, unspecified’. Of the remaining presentations, 130 (59%, 95%CI 52–65%) were not due to a food-related allergen, and 26 (12%, 95%CI 8–17%) were due to an unknown allergen. Median age at presentation of those with a food-related allergic reaction (2.0 years) was less than those for whom the allergic reaction was not food-related (7.0 years, p<0.001) or was due to an unknown allergen (8.5 years, p=0.02).

Change over time was evident for the rate of hospital presentations for food-related allergic reactions, but not for reactions that were non-food-related or for which the allergen was unknown (Figure 1). In comparison to the 1988–1995 time interval (average annual rate 0.85/100,000), the rate of presentation with food-related allergic reactions was lower from 1996–2003 (0.35/100,000, RR=0.41) and higher from 2004–2011 (1.68/100,000, RR=1.98) (Table 4).

The proportion of presentations that were due to a food-related allergic reaction varies slightly between the three time intervals (p=0.04), however not in any directional way. Upon further investigation in which the proportions were grouped into six four-yearly time intervals, random variance is present, as there is no statistically significant directional trend (p=0.07). The distribution of food-related allergic reactions and their proportion of all presentations across the four-year period was 7 (29%) in 1988–1991, 10 (28%) in 1992–1995, 1 (6%) in 1996–1999, 7 (21%) in 2000–2003, 9 (23%) in 2004–2007 and 31 (42%) in 2008–2011.

Discussion

Food-related acute allergic reactions account for 29% of hospital presentations that were assigned a discharge code for ‘anaphylaxis, unspecified’ or ‘allergy, unspecified’. Identification of these cases permitted us to have a more complete picture of ED visits for unspecified acute allergic reactions. In comparison with

![Figure 1: Trends in hospital presentations due to acute allergic reactions that were coded as ‘anaphylaxis, unspecified’* and ‘allergy, unspecified’†](image-url)
1988–95, the ED presentation rate for food-related allergic reactions decreased during 1996–03 and then increased during 2004–11, with the average annual rate from 2004–11 being almost twice as high as it had been from 1988–95. In contrast, there was no significant change over time in the hospital presentation rates for ‘anaphylaxis, unspecified’ or ‘allergy, unspecified’ ED presentations that were not food-related or for which the allergen was unknown.

An unanticipated finding from this study was the decrease in food-related allergic reaction presentations during the time period 1996–03. A similar, but non-significant, reduction was also seen during this time interval in hospital presentation rates for acute allergic reactions that were not food-related. In July of 1995 (the start of the 1995/96 New Zealand financial year), New Zealand changed from using ICD-9-CM to ICD-9-CM-A discharge coding systems. As part of this change the National Coding Standards were introduced, including a coding standard for allergic reactions. These standards were introduced to improve consistency in applying the classifications across the hospital and health services of New Zealand. This change may have resulted in a more strict application of the ICD codes investigated in this study, potentially leading to a decrease in the number of ED presentations assigned these codes. Another factor that may potentially explain the decrease in ED presentations during this time period is that it was a period when the New Zealand health care system experienced some major structural changes which included the temporary introduction of part charges for public hospital presentations.23

Based on the data obtained from the ADHB, the code ‘anaphylaxis, unspecified’ (19%) was used for a larger proportion of the hospital presentations than was reported from a large US study of ED presentations for acute allergic reactions where <1% of all ED visits were coded as anaphylaxis.18 Based on other work by the authors of this US study,16,24 which shows that approximately 51% of food-related allergic reactions and 31% of venom-related allergic reactions result in anaphylaxis, this very low proportion of ED presentations that were coded as anaphylaxis implies these codes cannot be used to reliably identify all ED presentations where anaphylaxis has occurred. Due to the variable documentation of presenting symptoms and signs in the Auckland records, we cannot determine from our study if the rate of hospital presentation with true anaphylaxis differs in New Zealand from that reported in the US.

Our study represents the first attempt to estimate the frequency of hospital ED presentations of food-related allergic reactions in New Zealand. We have validated the methodology for identifying, at a national level, the food-related proportion of hospital presentations assigned a discharge code for ‘anaphylaxis, unspecified’ or ‘allergy, unspecified’. Our data suggest that, consistent with observations reported from Australia and the US, the rate of such presentations has increased in New Zealand in recent years.11,12

In comparison with other causes of ED presentations, food-related acute allergic reactions are relatively rare events. Our study only included a subset of these food-related allergic reactions, as we were only investigating those ED presentations that were coded as ‘anaphylaxis, unspecified’ and ‘allergy, unspecified’. Because of these small numbers it was necessary to combine years to allow for temporal trends to be determined. As a result it was difficult to identify the true impact of events such as the 1995 change from using ICD-9-CM to ICD-9-CM-A codes. Nor were we able to determine if there has been a plateauing in the rate of hospital presentations for food-related allergic reactions as has been reported recently from the US.9 A subsequent larger national study is likely to overcome the issues described, as it will allow for the inclusion of the unspecified and specific food-related allergic reaction codes.

We showed very good inter-observer reliability in our assignment of ED presentations to the different food-related categories and to the food versus not-food related categories. No trend over time was observed in our estimate of the food-related proportion of hospital presentations coded as ‘anaphylaxis, unspecified’ or ‘allergy, unspecified’. Thus it appears reasonable to infer that these observations are likely to apply to national data over the same time interval. It
is important though to remain aware of the potential for the quality of such clinical data to change over time. For example, in 1992 the number of diagnosis codes for an event that were included in National Minimum Dataset reporting expanded from 4 to 25. Since this time they have been expanded even further to 99 codes which could lead to an increase in the number of codes used per event, and thus potentially inflate the overall total number of presentations for which a food-related code was included.

Our study provides insight into the use of two unspecified ICD codes in one large New Zealand hospital ED and sets the foundation for future work on the epidemiology of food allergy and food allergy-related allergic reactions in New Zealand. We can now justify including a proportion of presentations from both ICD codes ‘allergy, unspecified’ and ‘anaphylaxis, unspecified’ in a national study of ED presentations of food-related allergic reactions. This will enable us to describe this aspect of food allergy epidemiology in a manner that will enable comparison with other countries.

Competing interests: Nil
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