



## Clinical Paper

Pre-hospital management of anaphylaxis in one Canadian Urban Centre<sup>☆</sup>

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## ABSTRACT

**Study aim:** Anaphylaxis requires prompt recognition and management to improve patient outcomes. This study examined the diagnosis and treatment of anaphylactic reactions by the Emergency Medical Services (EMS) in a Canadian urban centre.

**Methods:** Electronic patient care records (ePCRs), identifying allergy-related calls in the Edmonton-Zone for the year 2011, were retrospectively reviewed to confirm anaphylaxis diagnosis and record treatments. Data were abstracted and entered into the REDCap electronic platform. Descriptive and multivariable analyses were performed. Pre-hospital management included any care provided by paramedic personnel and/or first-aid treatment received prior to EMS arrival.

**Results:** From 481 identified allergy-related case records, 136 (28%) met guideline criteria for anaphylaxis. Seventy-six (56%) of these confirmed cases were deemed high acuity by medical dispatchers. Self-medication and bystander first-aid was recorded in 60 (44%) anaphylactic events; 34 (25%) received epinephrine. Paramedics administered epinephrine in an additional 49 cases (36%); only 7% received all three primary pre-hospital anaphylaxis treatments: epinephrine, corticosteroids, and antihistamines. Factors associated with pre-hospital epinephrine administration included: previous episode of anaphylaxis (adjusted odds ratio [aOR]=4.9, 95% confidence interval [CI]: 1.30, 19.21); administration of corticosteroids by bystanders or EMS personnel (aOR=3.8, 95% CI: 1.36, 10.65); and transport severity (aOR=3.2, 95% CI: 1.21, 8.36).

**Conclusion:** Paramedics in this region demonstrated higher use of epinephrine than reported elsewhere; however, almost half of all patients meeting anaphylaxis criteria did not receive pre-hospital epinephrine. Instead, more patients received antihistamines. Efforts to improve adherence to anaphylaxis protocols and guidelines appear warranted.

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## 1. Introduction

Anaphylaxis is a rare, but potentially fatal, hypersensitivity reaction that has a lifetime prevalence of 0.05–2%.<sup>1</sup> In North America,

anaphylaxis is reported to comprise 0.4–0.9% of all 9–1–1 calls annually to the Emergency Medical Services (EMS).<sup>2</sup> The World Allergy Organization (WAO) has labelled anaphylaxis as a “serious generalized or systemic hypersensitivity reaction to an introduced allergen that is rapid in onset and life-threatening”.<sup>3</sup>

Anaphylactic reactions generally result from exposure to an allergen, which can be inhaled, swallowed or absorbed through cutaneous contact; common allergens include food, medications, and insects. These reactions occur over minutes to hours, making immediate recognition and treatment a management imperative. Since the signs and symptoms of anaphylaxis are non-specific, it is not uncommon for health-care practitioners to overlook this

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disorder in their working differential diagnosis.<sup>4</sup> The results of a national survey showed that while almost all paramedics recognized classic signs and symptoms of anaphylaxis, less than 3% could recognize atypical presentations lacking cutaneous signs and symptoms (e.g., intra-abdominal emergencies, food poisoning, gastroenteritis and organophosphate/cholinergic poisoning).<sup>5</sup>

Anaphylaxis case descriptions and protocols vary widely from service to service depending on past traditional implementation, resources, and land demographics of the region.<sup>6,7</sup> Preliminary progress in understanding the paramedic management of anaphylaxis has been made in the United States (US)<sup>6</sup> and the United Kingdom (UK)<sup>8</sup>; however, the subject has received limited study in other settings. EMS management of anaphylaxis has only been studied in one Canadian city and the service reported 31% of anaphylactic patients received EMS epinephrine.<sup>6</sup> While this finding was thought to be related to the education and promotion of its usage in Canada<sup>9</sup>, there is no evidence regarding current practices in other regions. Finally, the few studies examining first-aid treatment before EMS activation and arrival, self-administered or bystanders, have shown no correlation between clinical severity and first-aid epinephrine use; implying that bystanders administering this medication may not be aware of the proper indications for its use.<sup>8</sup>

This study was designed to examine the diagnosis and management of anaphylactic reactions by EMS personnel in one Canadian urban centre. Special focus was given to patients' severity before ED arrival and the aggressiveness of interventions applied in the pre-hospital setting.

## 2. Methods

### 2.1. Study design

A retrospective cohort study using chart review methodology was undertaken in the city of Edmonton, Alberta, Canada from March 27th, 2011 (Date of electronic patient care report [ePCR] implementation in the EMS-Edmonton Zone) to December 31st, 2011.

### 2.2. EMS service

Edmonton EMS services attend to approximately 377,000 calls annually and transport their patients to one of 13 provincially operated EDs in the city. Since April 2009 all land ambulance services have transitioned into a unified provincial system under Alberta Health Services (AHS). The local EMS services are provided by fire first response and ALS land ambulance (tiered response). Approximately 95% of Edmonton Zone EMS ambulances are staffed with at least one advanced care paramedic. The drugs available for allergic reactions/anaphylaxis include: epinephrine, diphenhydramine (Benadryl®), systemic corticosteroids, salbutamol, ipratropium bromide, oxygen, and intravenous crystalloids. The written protocol for anaphylaxis is brief, and essentially summarized in the flow chart found in the Appendix.

### 2.3. Study cases

During each 9-1-1 call, an emergency dispatcher gathers information through an algorithm to categorize the event by patient complaint, severity, and key clinical characteristics. A Medical Priority Dispatch System (MPDS)<sup>10</sup> code is then relayed to paramedics who travel to the scene.

Since no EMS code is specific to anaphylaxis, suspected study cases were selected based on event card types suggestive of anaphylaxis as per categorized by the MPDS. All ePCRs including

**Table 1**  
Anaphylaxis diagnostic criteria.

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Anaphylaxis diagnosis is confirmed when any ONE of the following criteria are satisfied

- Criterion #1: Acute onset of an illness (minutes to hours) with involvement of the skin and/or mucosal tissue
  - Associated with at least one of the following:
    - Respiratory compromise
    - Reduced blood pressure or associated symptoms of organ dysfunction
- Criterion #2: Two or more of the following that occur rapidly after exposure to a likely allergen
  - Involvement of skin and/or mucosal tissue
  - Respiratory compromise
  - Reduced blood pressure or associated symptoms
  - Persistent gastrointestinal symptoms
- Criterion #3: Anaphylaxis should be suspected when patients are exposed to a known allergen and develop hypotension (SBP <90)

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the code for Allergy/Envenomation (MPDS-02) were selected for review. To increase sensitivity, potential mimicker cards for anaphylactic reactions including charts marked with non-allergy associated card types: MPDS-06 (breathing problem), MPDS-11 (choking), MPDS-26 (sick person), MPDS-31 (unconscious), or MPDS-32 (unknown problem), were also reviewed if they received relevant anaphylaxis treatments such as epinephrine (adrenaline) and/or diphenhydramine (Benadryl®).

### 2.4. Anaphylaxis diagnostic criteria

Diagnosis of anaphylaxis (Table 1) was based upon current clinical guidelines established conjointly by the US National Institute of Allergy and Infectious Disease (NIAID) and the Food Allergy and Anaphylaxis Network (FAAN).<sup>11</sup> Using this diagnostic tool, cases were classified into one of four categories: (1) confirmed anaphylaxis, at least one of the criteria was satisfied; (2) non-anaphylaxis allergy, when some allergic signs and symptoms were present, but no anaphylaxis criteria were met; (3) non-allergy, no allergy criteria were fulfilled and (4) unclear, insufficient evidence to make the decision (e.g., history describes an allergic reaction that resolved with no apparent signs or symptoms on EMS arrival, patient cancellation with no paramedic contact, concurrent co-morbidity with insufficient evidence indicating allergy, etc.).

### 2.5. Data collection

Data on demographics, allergy triggers, patient condition, pre-hospital management, and transport were collected by two trained research assistants and entered into REDCap<sup>®12</sup>, a secure web platform for managing online surveys and databases. Duplicate data extraction was completed on the first 20 charts in order to identify potential disagreements.

### 2.6. Statistical analysis

Descriptive data were reported using proportions, means with standard deviations (SD), or medians with interquartile range (IQR), as appropriate. Bi-variable analyses for dichotomous and continuous variables were performed by Chi-squared ( $\chi^2$ ) test and by *T*-test or Mann–Whitney tests, respectively. A logistic regression (LR), model following purposeful selection methods, was used to determine factors associated with the pre-hospital administration of epinephrine in confirmed cases of Anaphylaxis. Factors that were significant at <0.2 in the univariate LR models were selected (e.g., age, previous allergic reaction, previous episode of anaphylaxis, earliest oxygen saturation, administration of corticosteroids and transport by lights and sirens). A final model was obtained after assessing the confounding effects of variables that could be

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