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Community presentations of anaphylaxis in Tasmania: Who is administering the adrenaline?

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Research

Community presentations of anaphylaxis in Tasmania: Who is administering the adrenaline?

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Abstract

Introduction
Anaphylaxis is a significant health concern within the community. The early administration of adrenaline to patients experiencing anaphylaxis has long been recognised as the cornerstone of treatment. Health care providers, including general practitioners, nurses and paramedics, are well equipped to manage anaphylaxis through the administration of adrenaline. Patients themselves also often have adrenaline auto-injectors, allowing early self-management. The objective of this study was to determine the rates of adrenaline administration and identify the administering persons for all anaphylaxis patients presenting to ambulance services in Tasmania over a four-year period by using a retrospective chart review.

Methods
Ambulance Tasmania electronic case reports (n=226,421) from the period 1 January 2008 to 31 December 2011 were searched for all cases fitting the parameters of anaphylaxis, allergy or allergic reaction. Of these cases, 373 were given a final paramedic diagnosis of anaphylaxis and constituted the primary data for this report.

Results
During the study period, Ambulance Tasmania attended 373 patients that were given a final primary diagnosis of anaphylaxis. Of these, 59 (15.8%) were excluded, leaving 314 electronic records for analysis. Of the cases identified, 71.7% (n=225) were administered adrenaline according to paramedic records. Adrenaline was administered by a range of health professionals, including general practitioners (n=27), paramedics (n=159), ambulance volunteers (n=4), nurses (n=1) and other health professionals (n=3). Adrenaline was self-administered by 12.4% (n=28) of patients, with an additional 11.6% (n=26) receiving adrenaline from a non-health care worker (layperson). In 10.2% of cases (n=23) adrenaline was administered by more than one provider. Administration of adrenaline prior to paramedic arrival was evident in fewer than 10% of cases treated with adrenaline (n=22).

Conclusion
The early administration of adrenaline in anaphylaxis is often vital for patient recovery. This study shows that adrenaline is administered by a number of different providers, with early administration accounting for only 9.8% of presentations treated with adrenaline. These findings raise the question, is adrenaline being administered early enough and often enough to improve health outcomes?

Keywords
adrenaline; anaphylaxis; drug administration; paramedic; Epipen

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Introduction

Allergy is estimated to affect over 4 million Australians, with current trends predicting that 7.7 million Australians will suffer from some form of allergic disease by 2050 (1). The high incidence of allergy in Australia creates a significant financial burden to the community, along with the associated social burdens and human impact. Anaphylaxis involves the cardiovascular and/or respiratory systems, and is the most severe form of systemic allergic reactions (2). It is a life-threatening condition that can result from exposure to any one of a range of potential triggers, commonly including foods, insect stings, insect bites and medications, along with a range of less common triggers (2).

The administration of intramuscular or intravenous adrenaline is widely recognised as the most effective first line treatment for acute anaphylaxis, and is considered crucial for successful treatment (2-4). Evidence also indicates that early treatment can significantly reduce the impact of disease, with research demonstrating that administration of adrenaline via an adrenaline auto-injector (AAI) shortly after reaction onset reduces the likelihood of admission to hospital (5). Given the importance of adrenaline to the management of anaphylaxis, limited research exists regarding its administration in cases occurring outside the hospital setting, particularly in relation to who is actually administering the drug.

Although the benefits of early treatment are recognised by health care professionals, the incidence of early adrenaline administration in anaphylaxis cases outside the hospital environment remains low. In a study of anaphylaxis fatalities in the United Kingdom, Pumphrey found that while 62% of patients were treated with adrenaline, only 14% received adrenaline prior to cardiac arrest (4). This is supported by a number of studies internationally that have reported low rates of self-administration (5-7).

There are a number of potential barriers to the early administration of adrenaline in the out-of-hospital environment. Decision making regarding if and when to administer adrenaline has been identified as one of the most common barriers to early administration (2,7,8). Several investigators have highlighted the diversity in and ambiguous nature of some definitions of anaphylaxis (2-4,9,10), which may be a complicating factor. Within Australia, the Australasian Society of Clinical Immunology and Allergy (ASCIA) provides a definition of anaphylaxis (Box 1).

Confusion regarding the appropriate time to administer adrenaline may contribute to the low rates of administration prior to hospital management as revealed in some studies (7,12). To address this uncertainty, some authors have attempted to clarify the defining criteria and the threshold for when to administer adrenaline by creating a severity grading system (9), while others have suggested the use of key symptoms as an indicator for when adrenaline should be administered (7,13).

> Any **acute onset illness** with **typical skin features** (urticarial rash or erythema/flushing, and/or angioedema), **PLUS** involvement of **respiratory** and/or **cardiovascular** and/or persistent severe **gastrointestinal** symptoms
> OR
> Any **acute onset** of **hypotension** or **bronchospasm** or **upper airway obstruction** where anaphylaxis is considered possible, even if typical skin features are not present.

Box 1. ASCIA definition of anaphylaxis for the purpose of emergency treatment (11)

Inadequate education and training has also been identified as a barrier to the early administration of adrenaline. Insufficient training in the appropriate use of AAIs has been associated with a reluctance to use and a failure to effectively administer the devices (4,14). Mullins found that the likelihood of Australian patients to self-administer AAIs was inversely related to the time passed since their initial assessment and diagnosis of anaphylaxis (6). Simons reported that 40% of patients studied tried alternative treatments such as antihistamines or an asthma inhaler prior to AAIs (7). These two examples suggest a need for ongoing patient education to maintain competence.

In addition to insufficiencies in self-administration, inadequate education in regard to the recognition of anaphylaxis by health care professionals has also been shown to result in delays in the administration of adrenaline. A study concerning anaphylaxis fatalities in the United Kingdom reported that paramedics experienced difficulty deciding whether to follow an asthma or anaphylaxis treatment pathway, leading to delayed or inappropriate treatment (4). Improvements in the early treatment of anaphylaxis require a greater understanding of where and with whom the educational gaps lay.

The objective of this study was to determine the rates of adrenaline administration and identify the administering persons for all anaphylaxis patients presenting to ambulance services in Tasmania from 1 January 2008 to 31 December 2011 by using a retrospective chart review.

Methods

Study Design

This retrospective chart review included all patients requiring emergency assistance in Tasmania (Australia) between 1 January 2008 and 31 December 2011 who were given a final paramedic diagnosis of anaphylaxis. Patients were identified from the Victorian Ambulance Clinical Information System (VACIS), an electronic database used by paramedics to record patient information.

Setting

In Tasmania, all air and ground ambulance services are provided by a single service regulated by Ambulance Tasmania, a branch of the Department of Health and Human Services. Ambulance Tasmania has an operational workforce that includes employed paramedics (comprising paramedic interns, paramedics and intensive care paramedics) and volunteer ambulance officers. Operations are divided into three regions (North, North West and South), servicing a total population of over 510,000 people. In the study period, the Ambulance Tasmania paramedic workforce included 230 paramedics and 488 volunteer ambulance officers (15) who attended 226,421 cases, 1539 of which were categorised as allergic reaction by the dispatcher.

Inclusion and exclusion criteria

The database was queried for all cases fitting the search parameters 'anaphylaxis', 'allergy' or 'allergic reaction'. From these results, all cases with a final paramedic diagnosis of anaphylaxis were included (n=373). Cases with insufficient documentation or no electronic clinical record associated with them were excluded (n=59) to prevent inaccurate identification of treatment provided or diagnosis.

Methods of measurements

The VACIS identified cases with a final paramedic diagnosis of anaphylaxis. Data abstraction from the 314 cases meeting the inclusion criteria encompassed: the date of the emergency call; demographic information (gender, age); details regarding whether adrenaline was administered, by whom (self-administration, non-health professional, nurse, general practitioner, paramedic, or other health professional), and if administration occurred prior to or following paramedic arrival.

Data analysis

Data obtained was entered into Microsoft Excel 2010 (Microsoft, USA) for descriptive analysis.

Ethics

Ethics approval was sought from the University of Tasmania's Higher Education Research Council. As the data provided by Ambulance Tasmania were de-identified the research was determined to be of no significant risk and hence exempt from formal ethics approval process in accordance with paragraph 5.1.22 of the National Statement on Ethical Conduct in Human Research (2007 – updated 2013) (16).

Results

During the 5-year study period ambulance services attended 226,421 cases, with 1539 having a case description of allergic reaction. A final paramedic diagnosis of anaphylaxis was assigned in 373 of the cases, 314 of which were included in the final data analysis. This study reports electronic case records only – the electronic patient record system was being introduced during 2006 to 2008, which may have reduced the number of case records for the first year.

Of the case records available for review, 12.1% (n=38) were in 2008, 30.3% (n=95) were in 2009, 26.7% (n=84) were in 2010 and 30.9% (n=97) were in 2011 (Table 1). Due to the period when electronic case records were being introduced, there was insufficient data to demonstrate any change in the frequency of presentation or frequency of administration of adrenaline.

Year	Adrenaline	No adrenaline	Total presentations
2008	20	18	38
2009	66	29	95
2010	64	20	84
2011	75	22	97

Table 1. Presentations of anaphylaxis per year by adrenaline administration

In the time from onset of clinical symptoms through to completion of the ambulance report, 71.7% (n=225) of cases were administered adrenaline, while 28.3% (n=89) were not (Figure 1). The ambulance report was considered complete when the patient was handed over to a receiving care service (eg. hospital) or when the paramedics discontinued care in the field. Data were analysed for distribution of presentation and adrenaline administration on the basis of gender: Female patients accounted for 57.3% (n=180) of the patients and male presentations accounted for 42.7% (n=134). Within the sample population, 76.1% (n=102) of male patients and 70% (n=126) of female patients were administered adrenaline (Figure 2).

Administration was performed by paramedics in 70.7% of cases treated with adrenaline, with GPs (n=27), ambulance volunteers (n=4), other health professionals (n=3) and nurses (n=1) administering adrenaline in 15.6% of cases (Table 2). It was also revealed that adrenaline was self-administered by 12.4% of patients (n=28), while non-health professionals administered adrenaline to 11.6% of patients (n=26). In total, 248 separate administrations were recorded, resulting in 10.2% (n=23) of subjects being administered adrenaline by more than one provider.

Figure 3 demonstrates the low rates of adrenaline administration prior to paramedic arrival (deemed early administration for the purposes of this study), evident in fewer than 10% of cases. Early administration rates by health professionals and non-health professionals (including self-administration) were comparable, with rates of 25.7% and 24.1%, respectively. Early self-administration was more likely to occur than early administration by a GP (35.7% compared with 29.6%, respectively).

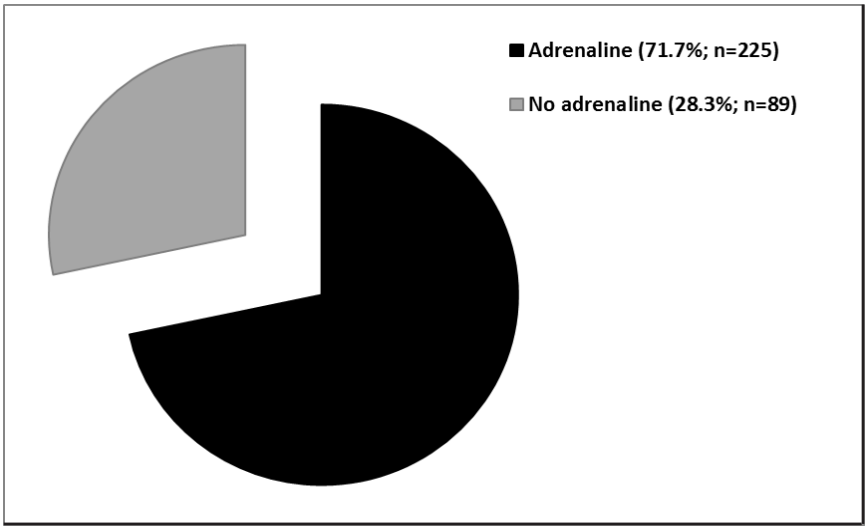

Figure 1. Proportion of anaphylaxis cases receiving adrenaline prior to hospital care

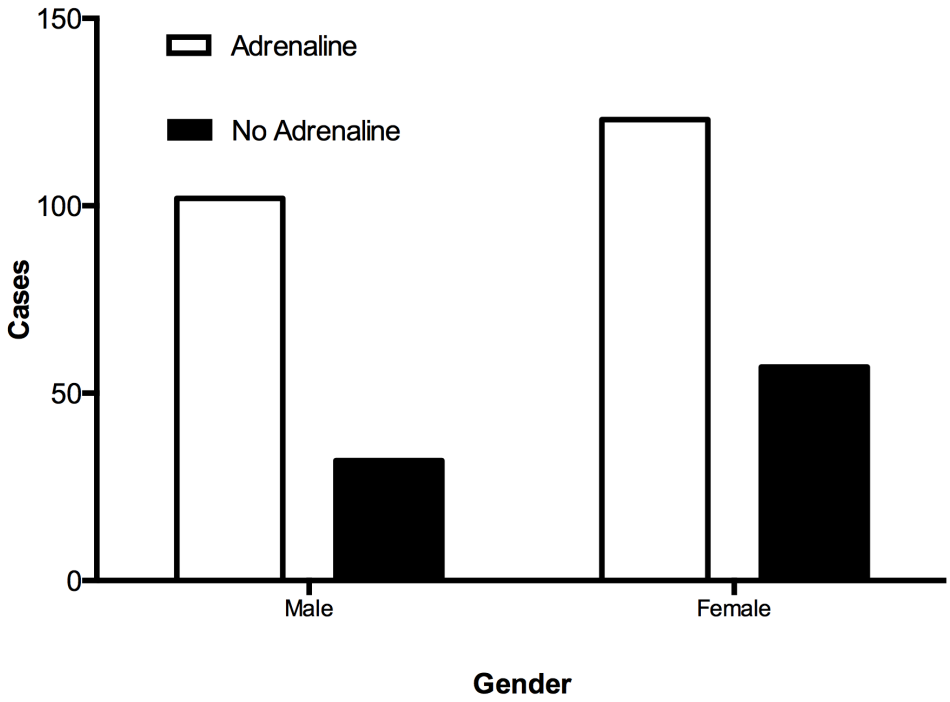

Figure 2. Proportion of male and female anaphylaxis cases receiving adrenaline prior to hospital care

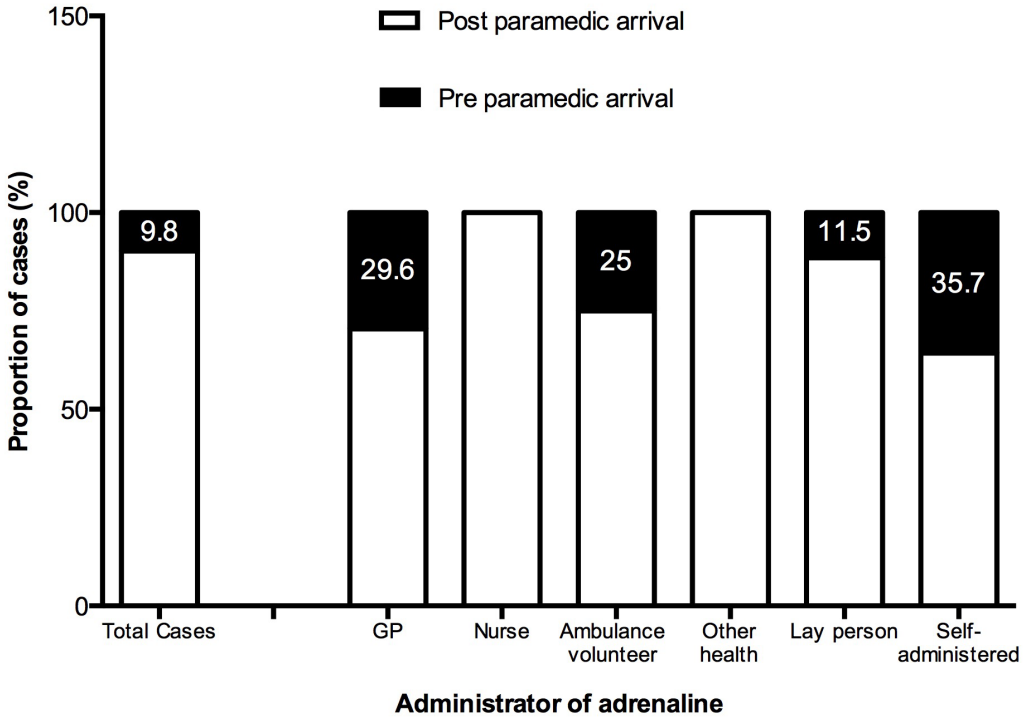

Figure 3. Source of non-paramedic administration of adrenaline prior to and following paramedic arrival

Layperson - refers to any non-health care professional, other than the patient, who was involved in the administration of adrenaline, including members of the family or others present at the time of the case
Numbers indicate percentage of cases

Adrenaline administrator	Number of cases[1] (n=248)	Proportion of anaphylaxis cases (n=314)	Proportion of cases treated with adrenaline (n=225)
GP	27	8.6%	12%
Paramedic	159	50.6%	70.7%
Nurse	1	0.3%	0.4%
Other health professional	3	0.9%	1.3%
Ambulance volunteer	4	1.3%	1.8%
Layperson[2,3]	26	8.3%	11.6%
Self-administered[3]	28	8.9%	12.4%

Table 2. Adrenaline administration by source

[1]This number reflects the number of cases where the source provider administered adrenaline, some cases received adrenaline from more than one provider
[2]Layperson refers to any non-health care professional, other than the patient, involved in the administration of adrenaline, including members of the family or others present at the time of the case
[3]Adrenaline administered using an AAI in these cases

Discussion

The main finding of this study was that a number of people are involved in the administration of adrenaline to patients experiencing anaphylaxis in the Tasmanian community, and the majority of anaphylaxis presentations were administered adrenaline. The secondary finding was that AAI products (such as EpiPen™) were used in a relatively small proportion of presentations of anaphylaxis (24%), and administration of adrenaline prior to paramedic arrival was evident in very few cases.

There is an overall lack of evidence in the literature regarding the breakdown of who administers adrenaline to patients presenting with anaphylaxis out of the hospital environment. Of the available evidence, an Australian study conducted in Queensland reported adrenaline administration in 142 presentations of anaphylaxis (12). The study identified that only 18% of patients received adrenaline prior to hospital care, with paramedics administering the drug to 11 patients, GPs to nine patients and only six patients self-administering adrenaline. This supports the current investigation concerning the people involved in the administration of adrenaline, as well as supporting the finding that self-administration occurs in a relatively small proportion of presentations. However, the Queensland study was limited in that it investigated only those patients presenting to a single emergency department over a period of 1 year.

A previous Tasmanian study, aimed at providing a grading system for anaphylaxis presentations, investigated 1149 patients presenting to the Royal Hobart Hospital over a period of more than 8 years from 1990 to 1999 (9). Brown et al found that 32% of presentations were administered adrenaline, with 169 receiving adrenaline only pre-hospital, 156 only in hospital and 47 both pre-hospital and in hospital. This rate of adrenaline administration for anaphylaxis is considerably lower than the current results indicate. The variation in paramedic administration of adrenaline might be accounted for by a change in the scope of practice of ambulance paramedics (the base level paramedic in Tasmania) in 2007, when they were first given authority to administer adrenaline for anaphylaxis. Prior to this time, only intensive care paramedics were authorised to administer adrenaline. The progressive implementation of this change may also contribute to the low results for the administration of adrenaline in 2008.

Two other Australian studies looked at the rate of adrenaline usage prior to hospital care. A study in Canberra investigating 432 presentations of anaphylaxis identified only 8% of participants as having used their own AAI (6). This study did not explore the administration of adrenaline from other potential pre-hospital sources. The second study, by Gold and Sainsbury in South Australia, also showed a relatively low rate of self-administration using an AAI at 29% (5). It was also revealed that when an AAI was not used, 47% of patients were admitted to hospital compared to only 15% where an AAI was used (5). The Gold study was limited however in its sample size, with only 45 presentations of anaphylaxis.

The low rates of adrenaline administration prior to paramedic arrival identified in this study indicate a need for improvements in anaphylaxis education for both health professionals and non-health professionals. The hesitance to administer adrenaline may in part be due to a lack of understanding in regards to discerning the symptoms of anaphylaxis, which has been identified in previous studies (4,7,12). Fear of the consequences of administering adrenaline to non-anaphylactic patients may also contribute to delayed administration rates. However, intramuscular adrenaline (diluted 1 in 1000) in doses between 0.01 and 0.4 mg/kg is not associated with significant cardiotoxicity, even in the absence of anaphylaxis (17). As such, recent guidelines suggest that adrenaline should be administered intramuscularly immediately following suspicion of acute anaphylaxis, as the consequences of delayed treatment in genuine cases far outweigh the side effects of adrenaline treatment in non-anaphylactic cases (18,19). Additionally, treatment with adrenaline can prevent the progression from mild symptoms to a severe, life-threatening form, which can occur rapidly and is often unpredictable (20).

The potential for adverse consequences of delayed treatment is amplified in paediatric populations, and venom reactions often result in the shortest time to cardia arrest (4,21). As the demographic profile of the study population, described in a previous investigation by this group, indicates that paediatric cases account for over 20% of anaphylactic cases in Tasmania, and the most common aetiology is envenomation, early administration is of particular importance (22).

Limitations of this study

This study used the electronic case records from a single Australian ambulance service as its data sample. This presents a selection bias in that only cases of anaphylaxis in which an ambulance was dispatched were captured; those cases where a patient was transported by a means other than ambulance were not identified. While these unidentified patients would not have received adrenaline from paramedics, they may have self-administered or have been given adrenaline by others, including family and other non-clinical people present. This model of data sampling also presents limitations in that it only captured Tasmanian presentations, potentially impacting the pertinence of these results to other populations.

Furthermore, the electronic patient care record was in the final process of introduction for the first year of our data collection period. During this time case records may have been documented as hand-written records. Hand-written records were not available for data analysis during this study, and thereby may prevent a complete picture being drawn for the first year.

Conclusions

This study has revealed that adrenaline is administered by a number of different providers, with early administration accounting for only 9.8% of cases treated with adrenaline. As the early administration of adrenaline in anaphylaxis is often vital for patient recovery, questions are raised regarding the outcomes for the patients in whom treatment with adrenaline was delayed. Further research is required to identify if improved health outcomes are associated with early administration of adrenaline in the pre-hospital setting. Results from this and future studies may help to direct the implementation of improved education in regards to the recognition and first-line treatment of anaphylaxis, for both health and non-health professionals.

Conflict of interest

The authors declare they have no competing interests. Each author of this paper has completed the ICMJE conflict of interest statement.

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