

Doctor – How do I use my EpiPen?

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Parents and children who have been prescribed an EpiPen are often unable to demonstrate its correct administration. One contributory factor may be that doctors are unfamiliar with the EpiPen and are unable to demonstrate the correct administration of the pen to the family. The aim of this study was to determine the rate of correct EpiPen demonstration by junior and Senior Medical Staff at a major tertiary paediatric Hospital. Junior and Senior medical staff were scored on their ability to correctly use the EpiPen trainer. A 6 step scoring system was used. One-hundred doctors were recruited (Residents $n = 31$, Senior Residents $n = 39$, Fellow/Consultants $n = 30$). Junior and Senior Medical staff had similar scores for EpiPen demonstration, the number that needed to read the EpiPen instructions prior to use and the frequency of accidental self-injection into the thumb. Only two doctors (2%) demonstrated all 6 administration steps correctly. The most frequent errors made were not holding the pen in place for > 5 seconds (57%), failure to apply pressure to activate (21%), and self-injection into the thumb (16%). Ninety five doctors needed to read the instructions, and of these, only 39 (41%) then proceeded to correctly demonstrate the remaining 5 steps. Forty-five doctors had previously dispensed an EpiPen, but only three demonstrated its use to parents/children with a trainer. The majority of doctors do not know how to use an EpiPen and are unable to provide appropriate education to parents/children. In 37% of cases, the demonstration would not have delivered adrenaline to a patient.

Key words: EpiPen; anaphylaxis; doctor

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EpiPen is prescribed to children at risk of anaphylaxis for the first-line management of an anaphylactic episode occurring in the community setting. In Australia, self-injectable adrenaline is available in the form of EpiPen Junior®/EpiPen® (CSL Ltd, Parkville, Australia), and may be prescribed by paediatricians, emergency physicians or allergists on subsidized prescription. It is estimated that one in 544 Australian children under the age of 10 yr are prescribed an EpiPen (1). National guidelines devised by the Australian Society of Clinical Immunology and Allergy (2) suggest that EpiPens may be prescribed to patients who have experienced an anaphylactic reaction and are believed to be at continued risk, and to patients with milder allergic reactions who have associated risk factors, such as age over 5 yr, nut or insect venom sensitization, concurrent or a past history of asthma, history of ischaemic heart disease and those living far from

medical services (2). Many parents and children who possess an EpiPen, however, are unable to demonstrate its correct use (3, 4). Furthermore, less than one-third of patients who have been prescribed an EpiPen use it during an anaphylactic episode (4). A number of factors are thought to be contributory. Repeat anaphylactic attacks are relatively infrequent in food allergic children (5), the EpiPen is often considered an invasive intervention by parents, with many fearful to administer the pen even during anaphylaxis (6) and most parents/children receive infrequent training regarding the EpiPen, usually seeing their physician once every 1–2 yr for a review of their food allergies (6). Finally, doctors themselves may be unfamiliar with the EpiPen's correct administration (3), so that parents/children receive little or incorrect advice on its use, leading to parental discomfort in using the EpiPen (6).

The aim of this study was to determine the rate of correct EpiPen trainer demonstration by Junior medical staff (Residents and Registrars) and Senior medical staff (Fellows and consultants) at a major tertiary paediatric hospital, who are not specializing in the field of Allergy and/or Immunology but who are able and likely to prescribe an EpiPen.

Methods

Junior medical staff were general paediatric trainees. In Australia, a paediatric resident has at least 1 yr of General Paediatrics experience, whilst a paediatric registrar has at least 3 yr of General Paediatrics experience. Fellows and Consultants included in the study were from General Paediatrics, Emergency and Respiratory Medicine. Fellows and Consultants from other subspecialties were not included in the study, as they would not prescribe an EpiPen in their day-to-day practise. Allergists, allergy Fellows and allergy nurse specialists were excluded as they would be expected to be familiar with the use of an EpiPen.

Doctors were scored and timed on their ability to correctly use the EpiPen trainer using a scoring system devised by Sicherer et al. (3). A total of six points was possible, with one point being ascribed to – recognition of the pen (i.e. not requiring to read the instructions prior to use), removal of the grey cap, selection of the outer mid-thigh, selection of black end to inject into the thigh, pressure to activate and holding the EpiPen in place for at least 5 s.

The study was approved by the Hospital Ethics Committee as an Audit Project. Each participant gave verbal consent. Data were analysed using MINITAB (Minitab, State College, Pennsylvania, USA) for Windows. Continuous data were described as either the mean (s.d.) or median [interquartile range (IQR)] if not normally distributed. Differences between groups for categorical variables were determined using either the chi-squared analysis or Fisher's exact test. The Student's *t*-test and the Mann–Whitney *U*-test were used for comparisons between parametric and non-parametric continuous variables respectively. $p < 0.05$ were considered statistically significant.

Results

Demographic characteristics

One hundred doctors were recruited, with similar numbers of Residents, Registrars and Fellow/Consultants. There were a total of 37 male and

63 female doctors, with a median length of clinical experience of 5 yr (IQR 3–11). Residents and Registrars had less years of overall clinical experience as doctors and were more likely to be female than their Fellow/Consultant counterparts (Table 1).

Prior familiarity experience with the EpiPen

There was no difference in the rate of familiarity with the EpiPen trainer between groups (Table 2). Doctors stated that they had seen an EpiPen or EpiPen trainer more often than they had prescribed one ($p = 0.007$).

EpiPen scoring

The overall mean EpiPen score was 4 (SD 1), with a median time to the administration of 38 s (IQR 30–45). There was no significant difference between groups with respect to the total EpiPen trainer score, the number that needed to read the pen instructions, the correct demonstration of each of the separate administration steps, and the frequency of accidental self-injection into the thumb ($p > 0.05$) (Table 2). Senior medical staff completed the EpiPen demonstration faster than their junior counterparts ($p < 0.05$) (Table 2).

Only two doctors (2%) correctly demonstrated all six steps (Table 3). The most frequent errors made were not holding the pen in place for > 5 s (57%) and failure to apply pressure to activate (21%) (Table 2). A total of 16% of doctors injected the EpiPen trainer into their thumbs (Table 2). Of the 95 doctors who needed to read the EpiPen instructions before demonstrating its use, only 39 (41%) then proceeded to correctly demonstrate the remaining five steps for EpiPen administration (Tables 2 and 3).

Prescribers vs. non-prescribers

There were 45 doctors who had previously prescribed an EpiPen. Residents were significantly less likely to have prescribed an EpiPen

Table 1. Demographic characteristics of the doctors recruited

Demographics	Resident	Registrar	Fellow/Consultant	Total
Number (%)	31 (31)	39 (39)	30 (30)	100 (100)
Female (%)*	22 (71)	32 (82)	9 (30)	63 (63)
Median years experience as a doctor (IQR)†	3 (2–3)	5 (4–8)	16 (11–20)	5 (3–11)

*Resident vs. Fellow/Consultant ($p = 0.001$), Registrar vs. Fellow/Consultant ($p = 0.0001$).

†Resident vs. Registrar ($p = 0.00001$), Resident or Registrar vs. Fellow/Consultant (both evaluations, $p = 0.00001$).

Table 2. EpiPen education and administration by medical staff (n = 100)

EpiPen information	Resident (n = 31)	Registrar (n = 39)	Fellow/Consultant (n = 30)	Total (n = 100)
Own an EpiPen (%)	0 (0)	0 (0)	1 (1)	1 (1)
Seen an EpiPen/EpiPen trainer (%)	21 (68)	22 (56)	21 (70)	64 (64)
Prescribed an EpiPen (%)*	7 (23)	18 (46)	20 (66)	45 (45)
Education on EpiPen use (%)				
None	5 (71)	9 (50)	8 (40)	22 (49)
Anaphylaxis plan	0 (0)	2 (11)	5 (25)	7 (16)
Relied on pharmacist	1 (14)	3 (17)	3 (15)	7 (16)
Referred to nurse educator	1 (14)	3 (17)	2 (10)	6 (13)
Demonstrated use with an EpiPen trainer	0 (0)	1 (1)	2 (10)	3 (7)
Score for use of EpiPen				
Mean total score (s.d.)	4 (1)	4 (1)	4 (1)	4 (1)
Median time (s) to administer (IQR)†	40 (30–50)	40 (30–50)	30 (20–45)	38 (40–45)
Read instructions/recognized EpiPen (%)	31 (100)	37 (95)	27 (90)	95 (95)
Removed grey cap (%)	30 (97)	38 (97)	28 (93)	96 (96)
Select outer thigh as body part (%)	30 (97)	39 (100)	30 (100)	99 (99)
Pressed black end into outer thigh (%)	25 (81)	33 (85)	26 (87)	84 (84)
Pressed to activate (%)	24 (77)	32 (82)	23 (77)	79 (79)
Held pen for >5 s (%)	12 (39)	17 (44)	14 (47)	43 (43)
Self-injection into the thumb (%)	6 (19)	6 (15)	4 (13)	16 (16)

*Resident vs. Registrar (p = 0.04), Resident vs. Consultant (p = 0.001).

†Resident or Registrar vs. Consultant (p = 0.01 for both analysis).

than more senior members of staff (p < 0.05) (Table 2). Seventy-one per cent of prescribers had dispensed one to five EpiPens during their years of clinical practise, whilst only 29% had prescribed less than five EpiPens.

EpiPen prescribers and non-prescribers did not differ significantly with respect to gender, total EpiPen trainer score, number needing to read the pen instructions, or the rate of accidental thumb self-injection (data not shown).

Of the 45 doctors who previously dispensed an EpiPen, 49% stated that they had not given any form of education to parents/children, and only 7% had demonstrated the use of the device with an actual trainer (Table 2). There was no significant difference between staff members with respect to the type of education provided once an EpiPen was prescribed.

EpiPen recognition

Doctors who did not need to read instructions on the EpiPen trainer had more years of

Table 3. EpiPen score

EpiPen score (of 6)	Total (n = 100)
0–1	0 (0%)
2	17 (17%)
3	3 (3%)
4	37 (37%)
5	41 (41%)
6	2 (2%)

training (p = 0.03), had a higher total EpiPen trainer score (p = 0.02), administered the pen faster (p = 0.002) and never self-injected their thumbs (p = 0.4) compared with doctors who needed to read the instructions prior to use (Table 4).

Discussion

This is the largest study examining the demonstration of EpiPen administration by medical staff. A surprising number of doctors were unfamiliar with the device, despite almost half having previously prescribed an EpiPen. The majority failed to administer the device correctly, with only 2% of doctors showing all six steps for correct EpiPen administration. In this study,

Table 4. Comparison between those who read the EpiPen instructions prior to use vs. those who did not

Variable	Not read instructions (n = 5)	Read instructions (n = 95)
Resident (%)†	0 (0)	31 (100)
Registrar (%)†	2 (5)	37 (95)
Consultant (%)†	3 (10)	27 (90)
Female (%)	2 (40)	61 (64)
Median years of training (IQR)*	15 (8–20)	5 (3–10)
Previously prescribed an EpiPen (%)	4 (80)	41 (43)
Mean total EpiPen score (s.d.)**	5 (0.8)	4 (1)
Median time to administration (IQR)***	10 (8–23)	40 (30–45)
Self-injection into the thumb (%)	0 (0)	16 (17)

†n = 31 (Resident), 39 (Registrar) and 30 (Consultant).

*p = 0.03; **p = 0.02; ***p = 0.002.

there was no significant difference between Residents, Registrars or Fellow/Consultants with respect to their ability to correctly demonstrate EpiPen administration. The major factor associated with a better EpiPen score and faster time to administration was recognition of the pen prior to use.

In 37% of cases, the demonstration would have failed to deliver adrenaline to a patient. The commonest mistakes, in this study and that of Sicherer et al. (3), were not exerting enough pressure to activate, and quickly punching and removing the EpiPen instead of holding it in place for at least 5 s. This may result in delivery of an insufficient intramuscular dose. Of particular concern, is that 16% of doctors would have taught parents/children to self-inject into their thumbs. Sicherer et al. (3) similarly reported that approximately 10% of American Paediatricians and parents evaluated in their study would have injected the trainer into their thumbs. Accidental injection has led to digital ischaemia (7), and failure to administer adrenaline to the child in need of it. Furthermore, our study was performed in a relaxed environment, in which no patient was having an anaphylactic attack. It is possible that more frequent errors would have occurred in the pressured environment of acute anaphylaxis where rapid administration of adrenaline is required.

Overall education of parents/children in the use of an EpiPen when prescribed was poor. The vast majority of doctors (93%) provided no education or relied upon the written anaphylaxis plan, nurses or pharmacists to provide the education, rather than demonstrating correct administration with a trainer. This poor provision of education is not unique to our study population. Only 17% of prescribers in the study of Sicherer et al. (3) had demonstrated the use of EpiPen to parents/children with a trainer, and only 24% had provided an anaphylaxis plan. Nursing staff were not included in this study, as the primary aim of the study was to determine the rates of correct EpiPen demonstration by potential and previous prescribers of EpiPens, and currently, nurses are not able to prescribe the EpiPen in Australia. Development of 'anaphylaxis nurse educators' would be one approach to optimizing delivery of Anaphylaxis Education to patients (and their carers) where an EpiPen is prescribed. Currently, the Australian Pharmaceutical Benefits Scheme guidelines stipulate that an anaphylaxis management plan must be provided on prescription of an EpiPen. There is no requirement that the prescriber needs to demonstrate the use of the pen with a trainer. Correct

administration of the EpiPen by parents/children has not been associated with doctors demonstrating the device (3), and instead has been correlated with factors related to review of medication use and food allergies (3). Nevertheless, Kim et al. (6) demonstrated that training parents on the use of the EpiPen was a significant factor in improving parental comfort with future EpiPen use, and recommended physicians should use the EpiPen trainer to demonstrate correct administration. If parents/children receive no or incorrect information regarding the pen's administration and there is no opportunity for repeated review of their technique, then they will continue to be inadequately prepared to manage any subsequent anaphylactic reactions.

The poor knowledge of EpiPen administration by doctors, in this study, reflects the lack of specific, regular training sessions aimed at medical staff. Our findings emphasize that poor demonstration of EpiPen technique is not just confined to the USA; and disappointingly, despite the report by Sicherer et al. (3) more than 5 yr ago identifying significant deficits in the ability of paediatric specialists to deliver EpiPen training, incorrect EpiPen demonstration by medical staff in a major tertiary paediatric institution continues to be a problem. Training of healthcare professionals involved in the delivery of anaphylaxis education to patients and their carers must be seen as a priority when food allergy is common and EpiPen prescription is ever increasing. In addition, the consistent demonstration of poor technique by parents and doctors alike (3), even after reading instructions on the EpiPen device, suggests that the design of the device may be suboptimal. Despite 95% of doctors reading the instruction on the EpiPen trainer, only 41% proceeded to demonstrate the remaining steps required for proper administration. Furthermore, almost one in every five doctors self-injected the trainer into their thumbs. Improved packaging of the EpiPen, such as having clearer instructions and encasing the needle in clear tubing with the needle clearly visible, may help doctors and patients correctly orientate the pen prior to injection.

In conclusion, this study revealed an alarmingly poor rate of familiarity with the EpiPen amongst doctors who are able to prescribe one. The overwhelming majority of doctors who had prescribed an EpiPen had failed to demonstrate its use with a trainer to parents and children. Improved education of doctors is required to ensure that correct education regarding EpiPen administration can be provided to parents and

children. Furthermore, any life-saving device should be able to be reliably and correctly administered to a patient after minimal training as it may need to be administered by an untrained person in an emergency setting. Liaison between Professional Allergy groups and companies that currently make the EpiPen injectors should be encouraged, with the aim of improving the EpiPen device such that there are clearer instructions for doctors, parents and patients.

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