

Near miss: 10 times adrenaline (epinephrine) dose error in anaphylaxis

A 13-year-old child with a history of anaphylaxis presented to an emergency department following an anaphylactic reaction. The patient had self-administered adrenaline (epinephrine) using an EpiPen® autoinjector prior to arrival, and at triage was noted to have marked work of breathing, appeared distressed and complained of feeling tight in the throat and chest. She was allocated a triage category 1.

The triage nurse attempted to call the nursing team leader who was triaging another patient at the time. Another nurse answered the call and allocated the patient to an acute bed. The medical team leader who was suturing a patient at the time was interrupted and asked to review the patient. The medical team leader attended the bedside and gave a verbal order for 'adrenaline'. Two junior nurses prepared the dose.

Just prior to administration via intramuscular injection, a senior nurse noticed 5 empty vials of adrenaline (epinephrine) 1:1000 on the IV trolley and questioned the dose with the two nurses. One of the junior nurses explained that the medical team leader had verbally ordered the adrenaline (epinephrine), however the senior nurse questioned the dose a second time. The dose was reviewed, and it was determined that a 5 mg dose of adrenaline (epinephrine) or 5 mL of 1:1000 had been prepared, rather than the intended dose of 500 microg or 0.5 mL of 1:1000 for intramuscular injection - a potential 10-fold dosing error.

A Paediatric Drug Dose Calculator was used to print out a weight-based drug information sheet, which was placed at the end of the bed. The correct order for 500 microg of intramuscular adrenaline (epinephrine) or 0.5 mL of 1:1000 was prescribed in the eMR using an existing order sentence for the treatment of anaphylaxis, and the correct dose was administered to the patient. The patient was stable throughout the near-miss and did not experience harm.

Lessons learnt

Adrenaline (epinephrine) dosing

Adrenaline (epinephrine) is a medicine used in critical and high-stress clinical events, including the treatment of anaphylaxis. Errors associated with adrenaline (epinephrine) dosing are common, due to several factors:

- calculation errors can occur when converting between dosing units i.e., microg, mg and mL, and available concentrations i.e., 1:1000 and 1:10 000
- dosage regimens differ depending on the indication for adrenaline (epinephrine) e.g., croup, anaphylaxis, cardiac arrest, vasopressor support
- dosing regimens also differ based on route of administration (i.e., intramuscular injection, intravenous injection, or nebulisation).

'Rule of 2's'

Beware of doses requiring more than 2 dosing units (e.g., vials, tablets, or syringes). Clinicians should always question any dose requiring more than 2 dosing units. In this case, 5 vials were drawn up and prepared for administration.

Communication

Lack of communication often appears in the list of contributing and causal factors in Serious Adverse Event Reviews (SAERs). Instructions that are unclear, ineffective, or lacking detail (for example this case) are prone to error. The potential for errors associated with communication is often heightened during high stress situations.

No human is infallible and as a result, error is unavoidable. Training and experience alone will not prevent mistakes. The Human Factors "Dirty Dozen" is a concept developed by Gordon DuPont that describes elements including 'lack of communication' that can act as precursors to accidents or incidents, or influence people to make mistakes. This tool helps clinicians to think about potential issues or risks ahead of time and discuss these with their team at handover and during huddles, and plan strategies to reduce, eliminate or mitigate these risks.

Recommendations

Closed loop communication

Closed loop communication may reduce errors in high-stress environments such as a resuscitation, particularly where verbal medication orders are being given. Clear communication of medication orders includes voicing the patient's identity, name of the medicine, the required dose, the route of administration and any further administration instructions including product strength (if not clear from the prescribed dose), followed by verbal confirmation of the order.

Doctor: "Administer 0.01 mL/kg of IM adrenaline (epinephrine), which for this 50 kg patient is 500 microg, or 0.5 mL of 1:1000"

Nurse: "I am giving adrenaline (epinephrine) 500 microg, or 0.5 mL of 1:1000 via intramuscular injection"

Graded Assertiveness

It is often difficult to voice specific concerns about patient care, especially during an emergency. Using a communication tool such as [CUSS](#) (Concern, Uncomfortable, unSafe, Stop) or PACE (Probe, Alert, Challenge, Emergency) can assist clinicians in raising concerns. In this case, the senior nurse was able to raise their concern and prevent the error from reaching the patient.

Timely treatment and escalation of care

The failure to allocate the patient in this case to a resuscitation bed may have contributed to the delayed recognition of a critical event by those clinicians involved. All patients with proven or suspected anaphylaxis should be treated as a medical emergency. In the emergency department setting, a child presenting with anaphylaxis should be a triage category 1 and be allocated and managed in a resuscitation bed. In the ward setting, a Rapid Response call should be activated. In some settings this may also include activating a Code Blue. This triggers a response from a team to manage the medical emergency. Allocating a team whether it be on the ward or in emergency creates clear role delineation and oversight from experienced clinicians with appropriate resources and skillset.

Teams working in this model are more likely to "automatically" defer to patterns of behaviour and communication that improve team function, and patient care. This signposts the severity of the patient's condition to the team and changes the mental model of team members. In this environment, roles are clearly defined, tasks are allocated to responsible team members and resources such as a drug dose calculator or a paediatric emergency drug handbook are readily available.

When critical events occur outside of these scenarios it can be helpful to 'signpost' them. By clearly saying "we are now in a resuscitation situation" announces to the staff assembled that they need to assume specific roles and use appropriate safety systems. An anaphylaxis order set in the Cerner eMR is available to support clinicians in prescribing and preparing the correct dose of adrenaline (epinephrine).

Paediatric Emergency Drug Calculators

Use of a drug dosing information sheet generated by a drug dose calculator should be considered for all acutely unwell patients or those patients at risk of deterioration

(including seizures). The information sheet should be based on their current weight (or if unavailable, their estimated weight based on age), printed off and placed at the end of the bed. Local endorsement of the drug dose calculator in use should occur through the Drug and Therapeutics Committee. Examples of drug dose calculators include the [NETS Clinical Calculator](#), Sydney Children's Hospital [Paediatric Emergency Drug Calculator](#) or The Children's Hospital at Westmead [Meds4Kids Dosing Guide](#). Other useful tools include the ACI Paediatric Resuscitation Lanyard Card and the Broselow Paediatric Emergency tape.

Anaphylaxis kit

Implementation of an anaphylaxis kit located on a ward-based resuscitation trolley or in the emergency department resuscitation room could be considered. The kit should contain 2 vials of adrenaline (1:1000), 1 mL syringes (only), and a dosing guide. This creates the forcing function to use the correct strength and prompts clinicians not to administer a volume more than 1 mL per dose.

Access to a personal adrenaline (epinephrine) injector in healthcare settings

The Australian Commission on Safety and Quality in Health Care Acute Anaphylaxis Clinical Care Standard highlights the importance for the patient (or their carer) to be able to immediately administer their own adrenaline (epinephrine) injector in the hospital setting. A readily accessible adrenaline (epinephrine) injector may also be used by a clinician if necessary. The adrenaline (epinephrine) autoinjector must be kept with the patient's ASCIA action plan and labelled with the patients' name. It must be kept in a safe place that allows ease of access for the patient or carer in an unlocked location while balancing the safety of others. The location and availability of a patient's own adrenaline (epinephrine) autoinjector must be communicated to all staff caring for the patient at clinical handover and during safety huddles. Local hospital may have individualised policies or procedures on the use of patient-own adrenaline (epinephrine) autoinjectors. It is important for staff to be familiar with local processes.

References

[Paediatric Watch: Kids Medication Safety involves U 2, 2016 © Clinical Excellence Commission](#)

[CUS Tool - Improving Communication and Teamwork in the Surgical Environment Module](#)

Reproduced with permission from the Acute Anaphylaxis Clinical Care Standard, developed by the Australian Commission on Safety and Quality in Health Care (ACSQHC). ACSQHC: Sydney (2021).

Paediatric Watch: Near miss: 10 times adrenaline (epinephrine) dose error in anaphylaxis 2023 © Clinical Excellence Commission SHPN (CEC) 230156.