

Sean Duke, MSc, MD, Victoria E. Cook, MD, FRCPC

# In situ simulation training for in-office anaphylaxis preparedness

Mobile or virtual in-office anaphylaxis simulation programs can offer clinic staff practical, cost-effective opportunities to practise anaphylaxis management within their own work environment, and ultimately improve patient safety.

**ABSTRACT:** For medical professionals and administrative staff, the prospect of managing a medical emergency in the office can generate a great deal of unease, particularly when such events are infrequent and challenging to prepare for. Given the rapidly evolving, life-threatening nature of anaphylaxis, successful management relies on prompt recognition and treatment. To ensure swift management of anaphylaxis, medical clinic personnel, particularly those in practices that administer immunotherapy, must make a concerted effort to prepare for these events. Although international guidelines for anaphylaxis management are widely available, a considerable discrepancy exists between those recommendations and their implementation in practice, thus necessitating a revised approach to medical training for anaphylaxis. Simulation training facilitates the development of emergency management skills in a controlled setting, thereby providing opportunities to gain valuable experience prior to actual events. Given

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*Dr Duke is a pediatric resident doctor in the Faculty of Medicine, University of British Columbia. Dr Cook is a pediatric allergist and clinical immunologist in the Faculty of Medicine, Department of Pediatrics, Division of Allergy and Immunology, University of British Columbia.*

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the challenges associated with the COVID-19 pandemic, mobile or virtual simulation programs could offer logistically feasible, accessible, and cost-effective opportunities to enhance preparedness for in-office anaphylaxis at the point of care.

**T**he prospect of encountering a medical emergency in the office is a considerable source of concern for health care providers and administrative staff, particularly when such events are infrequent and challenging to prepare for.<sup>1</sup> Anaphylaxis, a severe, life-threatening systemic hypersensitivity reaction,<sup>2</sup> results from the rapid systemic release of mediators from mast cells and basophils.<sup>3</sup> Although anaphylaxis can occur in any setting where medications or biologic agents are administered,<sup>3</sup> the most common cause of anaphylaxis in the medical office is subcutaneous immunotherapy.<sup>4</sup> Systemic reactions occurred in 80%

to 85% of allergy practices in the United States between 2008 and 2016, which corresponds to 0.1% of injection visits, while fatal anaphylaxis occurred in 1 per 9.1 million injection visits.<sup>5</sup>

Medical clinic preparedness, prompt recognition, and rapid treatment are essential for the

successful management of in-office anaphylaxis, as even a short delay can lead to death by means of respiratory or cardiovascular collapse.<sup>3,6</sup> Initial signs and symptoms, however mild, are important to recognize because patients can quickly deteriorate.<sup>3</sup> Recognition of anaphylaxis can be difficult due to the abundance of nonspecific signs and symptoms across multiple systems, including the skin and mucosa, respiratory, cardiovascular, gastrointestinal, and central nervous systems [Table 1].<sup>7-9</sup> Moreover, the presentation of anaphylaxis can vary between patients, and between anaphylactic episodes in the same patient.<sup>7</sup>

**As soon as anaphylaxis is recognized...initial management involves rapid assessment of the patient's airway, breathing, circulation...[and] swift administration of intramuscular epinephrine.**

Current guidelines developed by the World Allergy Organization emphasize the use of a printed, regularly rehearsed anaphylaxis management protocol that involves rapid patient assessment, prompt intramuscular epinephrine administration, appropriate patient positioning, and manage-

ment of respiratory distress, hypotension/shock, and cardiorespiratory arrest when indicated.<sup>7,10</sup> Despite the widespread availability of global guidelines, a discrepancy exists between their recommendations and their implementation in practice, indicating the need for revised medical

education and practical training in the management of anaphylaxis.<sup>11,12</sup>

Simulation training is an effective method of medical education where participants can practise emergency management skills in a controlled setting without risking harm to patients.<sup>13,14</sup> Its utility has been demonstrated in the context of anaphylaxis management across multiple settings.<sup>1,13,15-17</sup> Mobile or videoconferenced in situ simulations are cost-effective alternatives to traditional lab-based simulations and provide the additional benefits of identifying office-specific technical gaps and familiarizing medical office personnel with procedures at the point of care.<sup>18</sup> Given physical distancing measures compelled by the COVID-19 pandemic, employing a virtual platform, where external reviewers facilitate scenarios remotely, eliminates unnecessary crowding, and improves the accessibility of simulation training to underserved communities.

### Preparing for anaphylaxis management

Although anaphylaxis management recommendations depend on practice resources and proximity to emergency services, key components for medical clinics include a highly visible anaphylaxis protocol, regular rehearsals, appropriately maintained supplies, and a treatment log to record events.<sup>3,19</sup>

Clinic staff should be familiar with an anaphylaxis management protocol that is tailored to their office and incorporates input from staff members across multiple disciplines.<sup>20</sup> This protocol should feature flow charts for initial management of respiratory distress and hypotension/shock, and should include drug dos-

**Medical clinic preparedness, prompt recognition, and rapid treatment [with intramuscular epinephrine] are essential for the successful management of in-office anaphylaxis.**

ages, supplemental oxygen and intravenous fluid recommendations, and contact information for emergency medical services.<sup>7</sup> The importance of a protocolized approach to anaphylaxis care cannot be overstated because the rapidly evolving nature of anaphylaxis does not afford the time to look up information or recall memorized algorithms.<sup>6</sup> In one pediatric emergency department, implementing an anaphylaxis protocol enhanced anaphylaxis management by

improving the rates of epinephrine administration and appropriate observation, and by reducing the rate of corticosteroid monotherapy.<sup>21</sup>

Guidelines strongly recommend regular anaphylaxis rehearsals; however, they do not specify the content or frequency of those events, but rather defer this to the discretion of the attending physician.<sup>3,7,19</sup> At the least, medical professionals should be able to quickly locate and assemble necessary supplies for administration, and roles for calling emergency services and treatment logging should be established.<sup>3,19</sup> Readily available supplies should be maintained, and their contents and expiry dates should be regularly documented.<sup>3</sup> Recommended anaphylaxis supplies are provided in the **Box**. Treatment logs should be readily accessible for documenting clinical events, vital signs, and medications/treatments administered.<sup>7</sup>

### Managing anaphylaxis

According to international guidelines, as soon as anaphylaxis is recognized or strongly suspected, appropriate initial management involves rapid assessment of the patient's airway, breathing, circulation, mental status, and estimated body mass; swift administration of intramuscular epinephrine; appropriate positioning; and calling for assistance (e.g., emergency medical services) where appropriate.<sup>6,10</sup> Vital signs and patient condition should be monitored frequently or

**TABLE 1.** Signs and symptoms of anaphylaxis.

System	Signs and symptoms
Cutaneous/mucosal	Urticaria, pruritus, angioedema, conjunctival erythema
Upper respiratory	Rhinorrhea, sneezing, throat itching and tightness, tongue swelling, stridor, obstruction
Lower respiratory	Coughing, dyspnea, tachypnea, decreased peak expiratory flow, wheezing/bronchospasm, respiratory arrest
Cardiovascular	Tachycardia, pallor, syncope, hypotension, arrhythmias, cyanosis, cardiac arrest
Gastrointestinal	Abdominal pain, nausea/vomiting, diarrhea, dysphagia
Central nervous	Headache, altered mental status, sense of impending doom
Other	Uterine cramps and bleeding, metallic taste in mouth

Adapted from "World Allergy Organization guidelines for the assessment and management of anaphylaxis"<sup>7</sup> and "Position statement: Emergency treatment of anaphylaxis in infants and children."<sup>9</sup>

### BOX. Anaphylaxis supplies checklist

**Essential:**

- Injectable aqueous epinephrine (1:1000 solution) with needles and syringes, or epinephrine auto-injector (preferred)

**Consider:**

- Personal protective equipment
- Stethoscope
- Blood pressure cuffs (pediatric and adult sizes)
- Pulse oximeter
- Oral second-generation antihistamine
- Salbutamol metered-dose inhaler with spacer
- Airway adjuncts (e.g., oral or laryngeal mask airway)
- Oxygen and equipment for administration
- One-way valve face mask with oxygen inlet port
- Intravenous fluids and equipment for administration
- Automatic electric defibrillator

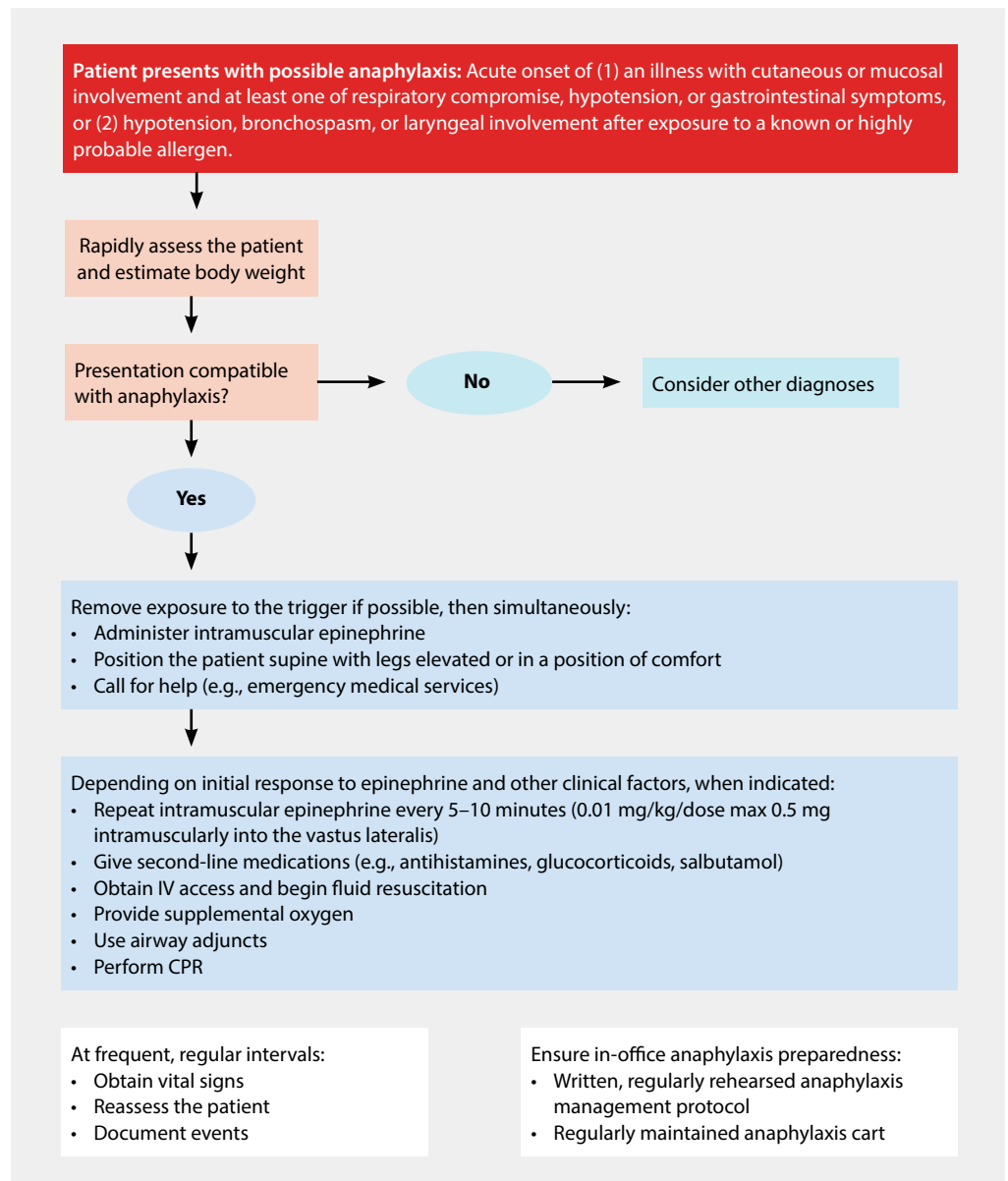
Adapted from "The diagnosis and management of anaphylaxis practice parameter: 2010 update."<sup>19</sup>

continuously; the airway should be maintained; and the administration of supplemental oxygen, intravenous fluids, and second-line medications should be considered depending on the response to epinephrine and other clinical contextual factors.<sup>3,6</sup> These steps are outlined in the **Figure**. Guidelines are subject to physician discretion; variations in management and transfer of care depend on clinical judgment, resource availability, and proximity to emergency assistance.<sup>3,19</sup> The utility of second-line medications in the initial management of anaphylaxis is outlined in **Table 2**.<sup>22-25</sup>

### Challenges in preparing for and managing anaphylaxis

There is significant inconsistency between the recommendations outlined in current guidelines and the preparative measures and treatments used to manage anaphylaxis in practice.<sup>8</sup> Despite guidelines emphasizing the maintenance of a regularly rehearsed, highly visible anaphylaxis management protocol,<sup>7</sup> an evaluation of 500 allergists' self-reported adherence to anaphylaxis practice parameters revealed that 57% of allergists had not conducted office-based anaphylaxis management rehearsals.<sup>26</sup> More fundamentally, in-office preparedness for anaphylactic events was revealed to be an area for improvement in general, with 34% of allergists not having ensured that their staff certifications (e.g., basic life support, advanced cardiovascular life support, pediatric advanced life support) were up to date, and 44% not having assigned a staff member to be responsible for calling emergency medical services.<sup>26</sup> Currently, there are no published reports that reveal the rates of office-based anaphylaxis management rehearsals for primary care practices, which comprise a substantial proportion of subcutaneous immunotherapy administration.

A 2010 systematic review identified common gaps in anaphylaxis management across community and hospital settings.<sup>8</sup> Prominent themes for primary care providers included insufficient knowledge about the signs and symptoms of anaphylaxis; lack of understanding about how to use, and thereby how to instruct a patient to use, an epinephrine autoinjector; infrequent and delayed administration of epinephrine; and first-line use of subcutaneous



**FIGURE.** Steps in anaphylaxis management.

Adapted from “The diagnosis and management of anaphylaxis: An updated practice parameter”<sup>23</sup> and “World Allergy Organization guidelines for the assessment and management of anaphylaxis.”<sup>7</sup>

**TABLE 2.** Second-line medications in anaphylaxis management.

Medication	Comments
Antihistamines and glucocorticoids	Although routinely used in anaphylaxis management, Cochrane reviews have demonstrated an overall scarcity of data to support their use in initial anaphylaxis management. <sup>22,23</sup> Further, a recent Canadian study demonstrated an association between prehospital glucocorticoid administration and ICU/hospital ward admission after adjusting for severity, age, sex, and presence of asthma. <sup>24</sup>
Inhaled beta-2 agonists	Although occasionally used in anaphylaxis to alleviate lower airway symptoms refractory to epinephrine, <sup>7</sup> they do not address the life-threatening complications of upper airway obstruction and shock. <sup>7,24</sup>

or intravenous epinephrine rather than the recommended intramuscular route.<sup>8</sup> Perhaps the most striking of these pitfalls is the underuse of epinephrine, which is corroborated in Canadian studies.<sup>12, 24, 25</sup> In analyzing 3498 cases of anaphylaxis presenting to emergency departments across Canada, Gabrielli and colleagues found that only 31% of cases received prehospital epinephrine, while the same proportion received prehospital antihistamine monotherapy.<sup>24</sup> Strikingly, more than 25% of cases did not receive epinephrine in either the community or emergency department.<sup>24</sup> This is in keeping with a prospective study that revealed primary care paramedics in Quebec did not administer prehospital epinephrine in 35.6% of anaphylaxis cases.<sup>27</sup> Nguyen-Luu and colleagues found that only 21% of children with confirmed peanut allergy were treated with epinephrine when presenting to community and emergency department settings with moderate or severe anaphylaxis.<sup>12</sup>

### Simulation training

International guidelines recommend the regular rehearsal of anaphylaxis management protocols,<sup>3, 7, 19</sup> which may range from independently organized events to formal clinical simulation training with external reviewers. Clinical simulation training, which has demonstrated utility in in-office anaphylaxis preparedness,<sup>1</sup> provides valuable opportunities to develop team-based skills, improve procedural and intellectual knowledge, and gain confidence in the care of uncommon events without risking harm to patients.<sup>13, 14</sup> This method typically involves independent external reviewers who can identify gaps in knowledge, procedures, and equipment through direct observation within a simulation suite or at the point of care.

In situ simulation training, where participants engage in clinical scenarios within their natural workplace, offers a low-cost, highly accessible alternative to traditional, academic centre-based simulation training. Additional benefits include environmental fidelity, the ability for the participants—who normally constitute the clinical team—to develop familiarity with procedures at the point of care, and the opportunity to uncover issues specific to the workplace (e.g., office procedures, availability

and proximity of supplies and equipment) that would not have arisen in a foreign space such as a simulation suite. Weinstock and colleagues developed a cost-effective simulation program that used a mobile cart to facilitate point-of-care simulations throughout five departments in a pediatric tertiary care centre.<sup>18</sup> The program delivered experiences that were similar to those

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taking place in the hospital's dedicated simulation suite—featuring high-fidelity scenarios and video-based debriefing—with the benefit of reaching a broader range of interdisciplinary teams that would not otherwise participate in simulations due to logistical reasons, such as clinical obligations for staff to remain at their respective sites.<sup>18</sup>

There is a lack of evidence to support a specific frequency at which anaphylaxis management should be rehearsed. In the author's clinic, in addition to debriefing after actual in-office emergencies, team members find that rehearsals occurring twice yearly are helpful for revisiting procedures and ensuring equipment/medications are up to date. Involving external reviewers at the point of care (e.g., mobile or virtual simulations) should be strongly considered.

### Future directions

Considering the infection precaution measures related to the COVID-19 pandemic, alternative methods of simulation training are required

to improve the accessibility and feasibility of simulation programs. One low-cost alternative is the use of teleconferencing, where external reviewers are able to facilitate and observe scenarios remotely, and consequently expand the accessibility of simulation training programs beyond academic centres to rural and remote areas. This method has been used previously; ICU and emergency specialists at urban centres have remotely facilitated scenarios in rural emergency departments.<sup>28</sup> With the need for a renewed approach to in-office anaphylaxis training, in concert with the logistical challenges the COVID-19 pandemic presents, the development of an accredited in-office anaphylaxis simulation program, where external reviewers facilitate in situ scenarios via a virtual platform, is highly warranted.

The development of simulation guidelines for in-office anaphylaxis will empower physicians to independently facilitate scenarios that involve their clinical teams within their workspace. A recent example of a similar initiative is the BC Simulation Network's COVID-19 Simulation Guide, which equips clinicians with tools to facilitate simulations for COVID-19 management.<sup>29</sup>

### Summary

Anaphylaxis is a medical emergency that can be encountered in the medical office, particularly where immunotherapy is practised. In-office preparedness for these rapidly evolving events is critical because prompt recognition and management can be lifesaving. Despite the availability of current anaphylaxis management guidelines, the discrepancy between the recommendations and their implementation, particularly regarding the use of epinephrine, has resulted in a call for a revision in medical education and practical training among health care providers. Clinical simulation training has proven to be an effective educational method for the management of anaphylaxis. By implementing mobile or virtual in-office anaphylaxis simulation programs, clinic staff can access practical, cost-effective opportunities to practise anaphylaxis management within their own work environment and, in doing so, learn from errors, identify limitations, build confidence, and ultimately improve patient safety. ■

## Resources

Examples of tools to facilitate optimal anaphylaxis management are available with the online version of this article at [bcmj.org](http://bcmj.org):

- 911 telephone script for in-office emergencies
- Anaphylaxis flow sheet
- Immunotherapy reaction flow sheet
- In-office emergency debrief summary
- Resuscitation equipment checklist

## Competing interests

Dr Cook has received speaker honoraria from CSL Behring, ALK, and Aralez Pharmaceuticals; consultancy fees from Bausch and ALK; and fees from UBC CPD for organizing education. She is also the CPD vice chair for the Canadian Society of Allergy and Clinical Immunology.

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