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In-Office Anaphylaxis Management

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Disclosures

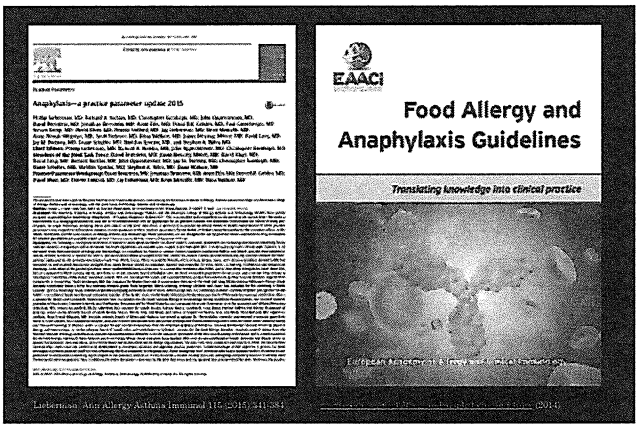
- None
- The opinions expressed in this presentation are solely those of the presenters and do not reflect the official views or policy of Department of Defense, or its Components

Learning Objectives

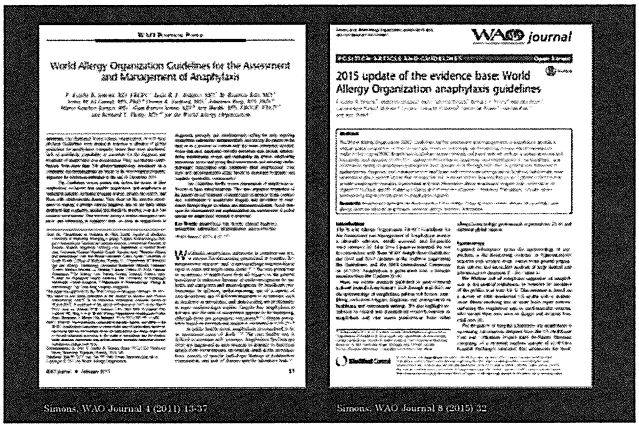
- Appraise and apply the definitions of anaphylaxis to events occurring in your office
- Recognize the limitations of evidence based medicine for anaphylaxis treatment
- Critique the response plan for anaphylaxis in your office

Overview

- Definition
- Etiology
- Clinical presentation
- Management
  - Evidence and guidelines
  - "Real world" in our practice



Lieberman. Ann Allergy Asthma Immunol 115 (2015) 341-384



Simons. WAO Journal 4 (2011) 13-37 Simons. WAO Journal 8 (2015) 32

Definition

- Lack of consensus across time and specialties

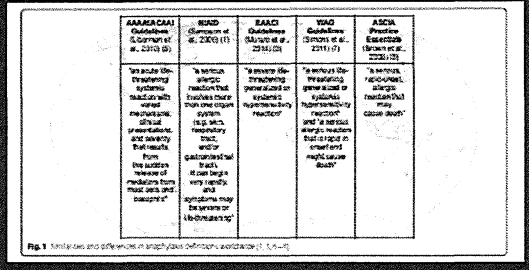


Fig. 1 Similarities and differences in anaphylaxis definitions worldwide [1, 3, 4, 6–8].

Turner, Allergy Asthma Clin Immunol 14 (2018) 12

Definition

TABLE I. Clinical criteria for diagnosing anaphylaxis

Anaphylaxis is highly likely when any one of the following 3 criteria are fulfilled:

1. Acute onset of an illness (minutes to several hours) with involvement of the skin, mucosal tissue, or both (eg, generalized hives, pruritus or flushing, swollen lips-tongue-uvula)
   AND AT LEAST ONE OF THE FOLLOWING
   a. Respiratory compromise (eg, dyspnea, wheeze-bronchospasm, stridor, reduced PEF, hypoxemia)
   b. Reduced BP or associated symptoms of end-organ dysfunction (eg, hypotonia [collapse], syncope, incontinence)
2. Two or more of the following that occur rapidly after exposure *to a likely allergen for that patient* (minutes to several hours):
   a. Involvement of the skin-mucosal tissue (eg, generalized hives, itch-flush, swollen lips-tongue-uvula)
   b. Respiratory compromise (eg, dyspnea, wheeze-bronchospasm, stridor, reduced PEF, hypoxemia)
   c. Reduced BP or associated symptoms (eg, hypotonia [collapse], syncope, incontinence)
   d. Persistent gastrointestinal symptoms (eg, crampy abdominal pain, vomiting)
3. Reduced BP after exposure to *known allergen for that patient* (minutes to several hours):
   a. Infants and children: low systolic BP (age specific) or greater than 30% decrease in systolic BP*
   b. Adults: systolic BP of less than 90 mm Hg or greater than 30% decrease from that person's baseline

PEF, Peak expiratory flow; *BP*, blood pressure.

*Low systolic blood pressure for children is defined as less than 70 mm Hg from 1 month to 1 year, less than (70 mm Hg + [2 × age]) from 1 to 10 years, and less than 90 mm Hg from 11 to 17 years.

Sampson, JACI 117 (2006) 391-7

Definition

- "There will undoubtedly be patients who present with symptoms not yet fulfilling the criteria of anaphylaxis, yet in whom it would be appropriate to initiate therapy with epinephrine . . ."
  - Patient with a history of near-fatal anaphylaxis to peanut who ingested peanut and within minutes is experiencing urticaria and generalized flushing
  - Patient receiving immunotherapy who developed hives alone (minutes after injection)

Lieberman, Ann Allergy Asthma Immunol 115 (2015) 341-384

Avoid the Drama?

- For immunotherapy related reactions
- Substitute the term "systemic reaction" for anaphylaxis

Definition & WAO Grading System

TABLE I. World Allergy Organization Subcutaneous Immunotherapy Systemic Reaction Grading System (see text)

Grade 1	Grade 2	Grade 3	Grade 4	Grade 5
*Symptom(s)/sign(s) of 1 organ system present**	*Symptom(s)/sign(s) of more than 1 organ system present*			Death
Cutaneous Generalized pruritus, urticaria, flushing, or sensation of heat or warmth† or Angioedema (not laryngeal, tongue or uvular) or Upper respiratory Rhinitis - (eg, sneezing, obstruction, nasal pruritus and/or nasal congestion) or Throat-clearing (itchy throat) or Cough perceived to originate in the upper airway, not the lung, larynx, or trachea or Gastrointestinal Erythema, pruritus or tearing Other Nausea, metallic taste, or headache	Lower respiratory Asthma (eg, cough, wheezing, shortness of breath [eg, less than 40% PEF or FEV$_1$ drop, responding to an inhaled bronchodilator) or Gastrointestinal Abdominal cramps, vomiting, or diarrhea or Other Uterine cramps	Lower respiratory Asthma (eg, 40% PEF or FEV$_1$ drop NOT responding to an inhaled bronchodilator) or Upper respiratory Laryngeal, uvula, or tongue edema with or without stridor	Lower or upper respiratory Respiratory failure with or without loss of consciousness or Cardiovascular Hypotension with or without loss of consciousness	

Cox, JACI 120 (2007) 608-74

In-Office Etiology

- Therapeutics
  - Allergen Immunotherapy (most common)
  - Immunobiologics
- Diagnostics
  - Skin testing
  - Challenges (Up and coming?)
    - Food
    - Medication
    - Other

Wallace, Allergy Asthma Proc 34 (2013) 120-131

Incidence

- Immunotherapy risk of systemic reaction
  - Per injection risk
    - <1% (Cox 2011)
    - Approximately 0.2% (ranges 0.01 - 0.37%) (Cox 2010)
  - Per patient risk
    - 1-34% including conventional and rush schedules (Cox 2011)
    - 4-7% with conventional schedule (Wallace 2013)
- Food challenges
  - Risk varies widely
  - Dependent on population/patient selection
- Others etiologies generally rare

Cox JACI 127 (2011) S1-55
Cox JACI 125 (2010) 1035-74
Wallace, Allergy Asthma Proc 34 (2013) 120-121

Signs and Symptoms

TABLE E1. Frequency of occurrence of signs and symptoms of anaphylaxis*†‡

Signs and Symptoms	Percent
Cutaneous	
Urticaria and angioedema	85-90
Flushing	45-55
Pruritus without rash	2-5
Respiratory	
Dyspnea, wheeze	45-50
Upper airway angioedema	50-60
Rhinitis	15-20
Dizziness, syncope, hypotension	30-35
Abdominal	
Nausea, vomiting, diarrhea, cramping pain	25-30
Miscellaneous	
Headache	5-8
Substernal pain	4-6
Seizure	1-2

*On the basis of a compilation of 1885 patients reported in references.[1 through 14]
†Percentages are approximations.
‡Children may have a lower frequency of cutaneous symptoms in anaphylaxis.

Lieberman, JACI 126 (2010) 477-80

Signs, Symptoms, & Severity - Immunotherapy

- 701 survey of allergist for fatal and near fatal reactions1990–2001

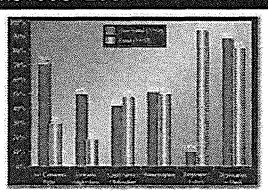


FIG 1. Comparison of clinical features during FRs and NFRs. Any cutaneous signs refers to hives, angioedema, and/or pruritus. Hypotension refers to either transient or sustained decrease in blood pressure, and shock refers to cardiovascular collapse.

Amin, JACI 117 (2006) 404-10

Severity - Immunotherapy

- Majority of systemic reactions are mild-moderate and severe reactions are uncommon (Cox 2011)
- Survey by ACAAI & AAAAI of 1,922 SCIT prescribers reporting 8502 SRs (Liss 2011)
  - 74% were WAO grade 1
  - 23% were WAO grade 2
  - 3% were WAO grade 3
- AAAAI survey covering 1990-2001 (Amin 2006)
  - Near fatal reactions 1 to 5.4 per million injections
  - Fatal reactions 1 per 2.4 million injections

Cox JACI 127 (2011) S1-55
Liss JACI 127 (2011) 1288-1293
Amin JACI 117 (2006) 404-10

Severity - Immunotherapy

- 1,328 patients, 93,136 injections from 2005-2012

Epinephrine Delivery in SCIT-associated systemic reactions (SR)	
WAO severity of SCIT-associated SRs	N (%)
Total	266 (100)
WAO grade 1 or 2	255 (96)
WAO grade 3 or 4	11 (4)
WAO grade 5	0
Doses of epinephrine administered	
Total	266 (100)
1 Dose	266 (100)
2 Doses	81 (30.5)
3 Doses	12 (4.5)

Wong, Ann Allergy Asthma Immunol 116 (2016) 154-5

Signs, Symptoms, & Severity - Food Challenge

- 900 food challenges from 2005-2015 in Netherlands
- Mixture of in-office clinical open food challenges (OFC) and research double-blind placebo controlled food challenges (DBPCFC)
- 35% (312/900) challenges were positive, 175 OFC and 137 DBPCFC

Outcomes of food challenges	In-office Clinical OFC (n=175)	Research DBPCFC (n=137)
Single organ system	141 (81%)	88 (64%)
Multiple organ system	34 (19%)	49 (36%)
Multiple organ system	(n=34)	(n=49)
Skin & respiratory	17 (50%)	3 (6%)
Skin & GI	10 (29%)	40 (82%)
Skin, respiratory, & GI	5 (15%)	6 (12%)
Respiratory & GI	1 (3%)	0
GI & hypotension	1 (3%)	0
Treated with epinephrine	17% (30/175)	7% (10/137)

Vander Valk, Ann Allergy Asthma Immunol 120 (2018) 300-5

Signs, Symptoms, & Severity Food Challenge

- 701 in-office clinical OFCs from 2008–2010 at the Jaffe Food Institute

TABLE I. Results of all challenges, broken down by specific food and organ system of reaction

			Reaction organ involvement				
Food	No. (% of all challenges)	No. positive (%)	Skin	Oral/nasal symptoms	Lower respiratory	Gastrointestinal	>1 System
Peanut	124 (17.7)	26 (21.0)	16	1	1	6	2
Tree nuts	121 (17.0)	22 (18.2)	7	13	0	1	1
Egg	112 (16.0)	15 (13.4)	8	2	1	1	3
Milk	55 (7.8)	22 (40.0)	14	6	0	2	0
Soy	54 (7.7)	10 (18.5)	7	2	1	0	0
Fish*	49 (6.9)	6 (12.2)	4	2	0	0	0
Sesame	44 (6.3)	7 (15.9)	4	1	0	1	1
Shellfish†	29 (4.1)	3 (10.3)	1	2	0	0	0
Wheat	28 (4.0)	6 (21.4)	4	0	0	0	2
Other	85 (12.1)	15 (17.6)	10	2	0	2	1
All foods	701	132 (18.8)	75	31	3	13	10
			(57%)	(23%)	(2%)	(10%)	(8%)

*Fish causing reactions include codfish, halibut, tilapia, and tuna.
†All shellfish were cases of shrimp.

Lieberman. JACI 128 (2011) 1129-1

Risk Factors for Increased Severity

- Patient factors
  - Increased age
  - Greater skin test/serologic sensitivity to allergen
- Comorbidities
  - Mastocytosis
  - MCAS/increased serum tryptase – inconsistent data
  - Asthma – history, poor control, reduced FEV1
  - Cardiac disease
  - COPD

Lieberman. Ann Allergy Asthma Immunol 115 (2015) 341-384
Simons. WAO Journal 8 (2015) 32

Risk Factors for Increased Severity

- Medications
  - Beta blockers
  - ACE inhibitors - inconsistent data
- Co-factors – limited data, situational
  - SCIT during peak pollen season – inconsistent data
  - Exercise
  - EtOH
  - NSAIDs
  - Acute infection
  - Stress
  - Perimenstrual

Lieberman. Ann Allergy Asthma Immunol 115 (2015) 341-384
Simons. WAO Journal 8 (2015) 32

Risk Factors for Increased Severity

- Patient presentation
  - Rapid onset of symptoms
    - Study of SCIT deaths n=13 known time of onset
    - 7/13 < 10 min, 4/13 < 13 min
  - Airway signs or symptoms – upper and lower
  - Hypotension

Reid. JACI 82 (1988) 8-15
Ann. JACI 117 (2006) 169-75
Finkelman. JACI 96 (1995) 8-14

Planning for In-office Systemic Reactions

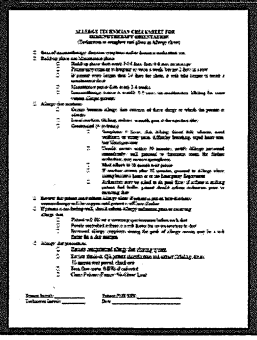
- Educating patients
  - Expectations
  - Policies and procedures
  - Prevention – questionnaires regarding changes in health, medication changes, changes in asthma, events after last shot, etc.
  - Symptoms – tell staff
- Educating staff
  - Training – BLS, ACLS, PALS as appropriate
  - Expectations
  - Policies and procedures
  - Prevention – read questionnaires, peak flows, etc.
  - Symptoms – observe waiting area

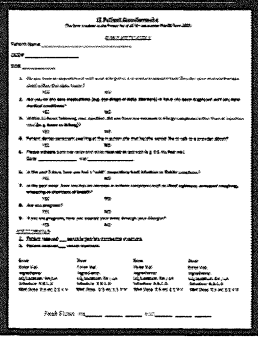
Lieberman. Ann Allergy Asthma Immunol 115 (2015) 341-384
Wallace. Allergy Asthma Proc 34 (2013) 120-131

Planning for In-office Systemic Reactions

- Educating patients
  - Informed consent
  - Immunotherapy briefing – 15 min with nurses/technicians
    - Policies and procedures
    - Symptoms – tell staff
  - Questionnaires

Planning for In-office Systemic Reactions



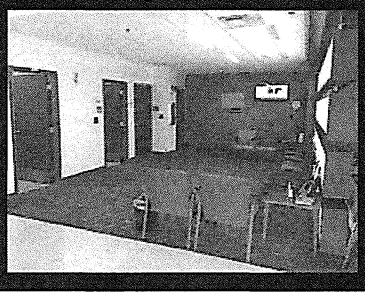


Planning for In-office Systemic Reactions

- Educating staff
- Training
  - Physicians – BLS, ACLS, and PALS
  - RNs – BLS and ACLS
    - Lots of documented OJT training
  - LVNs, Technicians
    - BLS
    - 6 week school in Maryland for technicians
    - Lots of documented OJT training
  - Weekly 1 hour nurse technician training +/- physicians

Planning for In-office Systemic Reactions

- Observe waiting area



Planning for In-office Systemic Reactions

- Develop in-office anaphylaxis action plan
  - Educate staff on plan and their roles
  - Practice implementing plan – simulation exercises
  - Revise plan as needed
  - Consider Q3 month refreshers, simulations, etc
- Prepare in-office anaphylaxis emergency cart +/- treatment area

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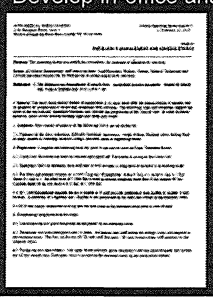
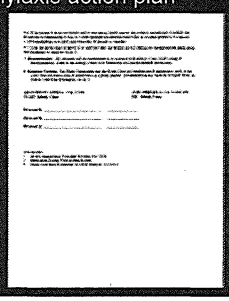
Wallace. Allergy Asthma Proc 34(2013): 120-131

Planning for In-office Systemic Reactions

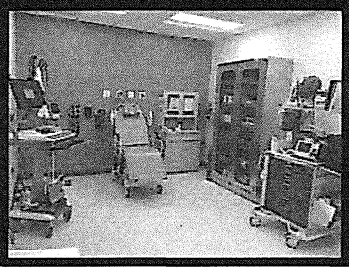
- Develop in-office anaphylaxis action plan





Planning for In-office Systemic Reactions

- Prepare in-office anaphylaxis emergency cart +/- treatment area



Anaphylaxis Emergency Cart

- Basic supplies – 1st line
  - Written protocol, forms/flow chart to document events
  - Stethoscope and blood pressure cuff (infant – large adult)
  - Gloves – latex free preferred
  - IV butterflies (gauge 19-23)
  - Syringes (1, 10, 20 ml)
  - Needles 1-2 inches, 18-23 gauge
  - Alcohol, tape, tourniquets
- Basic Supplies – 2nd line
  - AED
- Basic Supplies – 3rd line
  - EKG

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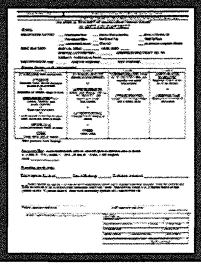
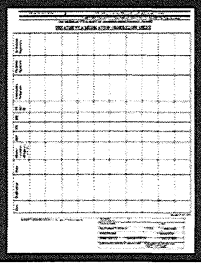
Wallace. Allergy Asthma Proc 34 (2013) 120-131

Anaphylaxis Emergency Cart

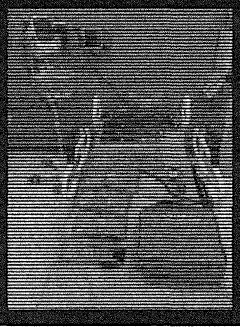
- Basic supplies – 1st line
  - Written protocol, forms, flow chart





Anaphylaxis Emergency Cart

- Basic supplies – 1st line
  - Stethoscope
  - Blood pressure cuffs (infant – large adult)



Anaphylaxis Emergency Cart

- Basic supplies – 1st line
  - Gloves – latex free preferred
  - IV butterflies (gauge 19-23)
  - Syringes (1, 10, 20 ml)
  - Needles 1-2 inches, 18-23 gauge
  - Alcohol, tape, tourniquets

Anaphylaxis Emergency Cart

- Basic Supplies – 2nd line
  - AED
- Basic Supplies – 3rd line
  - EKG
- Our option
  - Manual monitor & defibrillator
  - Pediatric Braselow Bag

Anaphylaxis Emergency Cart

- Airway support equipment – 1st line
  - Pulse oximeter
  - Bag-valve mask with ambubag (adult and child)
  - Disposable face masks (infant, toddler, adult)
  - Oropharyngeal airways (6-10 cm)
  - Nasal pharyngeal airways (6-9 mm)
  - Oxygen – E-cylinder 2 and wrench, >1,100 psi
  - Nasal cannula
  - O2 extension tubing
  - Nebulizer, facemasks, tubing
- Airway support equipment – 2nd line
  - Laryngeal mask airways (LMA) (sizes 2-5)
  - Suction and tubing
- Airway support equipment – 3rd line
  - Equipment for intubation

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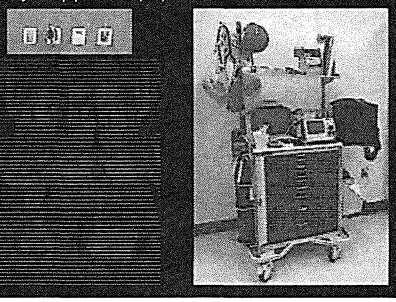
Anaphylaxis Emergency Cart

- Airway support equipment – 1st, 2nd, & 3rd line



Anaphylaxis Emergency Cart

- IV support equipment – 1st line
  - IV catheters (gauge 14-22)
  - IV administration sets, extension tubing, T hubs, 3 way stopcocks
  - IV fluids – normal saline (2, 1-liter bags)
  - IV pole, IV site coverage materials, arm boards
- IV support equipment – 2nd & 3rd line

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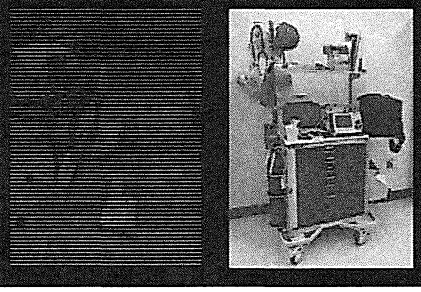
Wallace. Allergy Asthma Proc 34 (2013) 120-131

Anaphylaxis Emergency Cart

- IV support equipment – 1st line



Anaphylaxis Emergency Cart

- Medications – 1st line
  - Epinephrine 1:1,000
    - 3 ampules or 1 multidose vial
  - Albuterol inhalation solution 0.5%
  - Glucagon 1 mg/ml (2 vials)
- Medication – 2nd line
  - Diphenhydramine 50 mg/ml IV
  - Cetirizine 10 mg tabs, 5 mg/ml liquid
  - Ranitidine 25 mg/ml IV
  - Methylprednisolone 125 mg vial
  - Prednisone 5 or 10 mg tabs, prednisolone syrup 15 mg/5 ml
- Medication – 3rd line
  - Dopamine 200 mg/5 ml ampule x 1
  - Atropine 0.5 mg/ml IV

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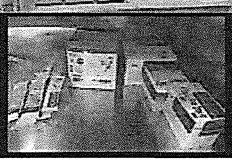
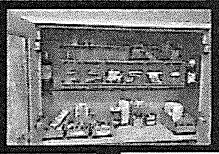
Anaphylaxis Emergency Cart

- Medications – 1st line
  - Epinephrine 1:1,000
    - 3 ampules or 1 multidose vial
  - Albuterol inhalation solution 0.5%
  - Glucagon 1 mg/ml (2 vials)
- Medication – 2nd line
  - Diphenhydramine 50 mg/ml IV
  - Cetirizine 10 mg tabs, 5 mg/ml liquid
  - Ranitidine 25 mg/ml IV
  - Methylprednisolone 125 mg vial
  - Prednisone 5 or 10 mg tabs, prednisolone syrup 15 mg/5 ml



Anaphylaxis Emergency Cart

- Medication – 3rd line
  - Dopamine 200 mg/5 ml ampule x 1
  - Atropine 0.5 mg/ml IV
- Our option
  - Diphenhydramine 12.5 mg/ml liquid
  - Ranitidine 150 mg tabs
  - Racemic epinephrine
  - Albuterol Atrovent ampules for nebulizer
  - IV Hydrocortisone
  - Ondansetron 4 mg tabs
  - Acetaminophen 325 mg tabs
  - Ibuprofen 400 mg tabs



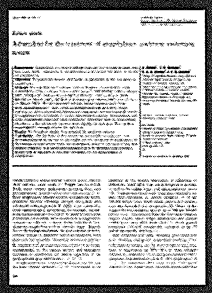
Anaphylaxis Action Plan

1. Remove/stop inciting allergen if possible (rarely applies)
2. Assess airway, breathing, circulation, orientation
   - Initiate rescue breathing (bag valve) or CPR if appropriate
3. Give epinephrine 0.3 mg- 0.5 mg (0.01 mg/kg for children)
   - IM in the vastus lateralis
   - Repeat every 5-15 min as indicated

Lieberman. Ann Allergy Asthma Immunol 115 (2015) 341-384

Use of Epinephrine in Anaphylaxis

- No studies satisfied inclusion criteria
- We are unable to make any new recommendations
- Recommended on less than optimal evidence that IM administration of adrenaline be first-line therapy
- 2012 repeat analysis with same conclusions



Sheikh. Allergy 64 (2009) 204-12
Sheikh. Cochrane Database Syst Rev 15 (2012)

Early Dosing Epinephrine

- Anaphylaxis in ragweed sensitized dogs
  - Epinephrine administered at maximal hypotension
  - IV vs IM vs SQ dosing compared
  - Higher plasma concentrations seen in IV and IM
- Sustained benefit not seen if epinephrine dosed after cardiovascular collapse fully developed

Boutsis. Int Arch Allergy and Immunol 128 (2002) 151-164

Early Dosing Epinephrine

- Retrospective review of fatal & near fatal food anaphylaxis
  - 13 children with anaphylaxis to food
  - 6 fatal reactions
    - Symptoms onset 3-30 minutes
    - 33% (2/6) received epinephrine in first hour (25 & 60 min)
  - 7 non-fatal reactions
    - Symptoms within 5 minutes
    - 100% (7/7) received epinephrine within 30 min

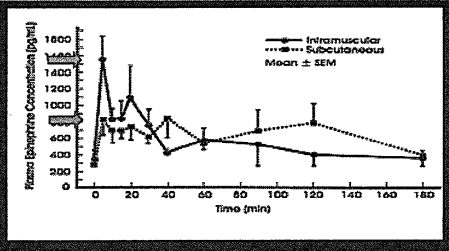
Sampson. NEJM 327 (1992) 380-4

Epinephrine IM vs Sub Q

- Epinephrine absorption in children
- 17 children
  - 9: Epinephrine 0.01 mg/kg SQ
  - 8: Epinephrine 0.3 mg IM from auto-injector
- Monitored:
  - Plasma epinephrine concentration
  - Heart rate
  - Blood pressure
  - Adverse effects

Simons. JACI 101 (1998) 33-7

Epinephrine Absorption in Children



- No difference in heart rate or blood pressure

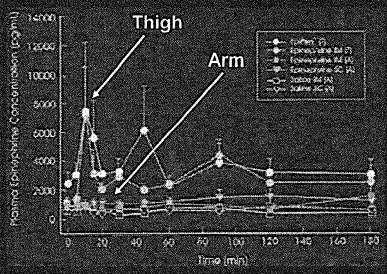
Simons. JACI 101 (1998) 33-7

Epinephrine IM vs Sub Q

- Crossover study in healthy men age 18 to 35
- 4 injections of epinephrine 0.3 mg SQ and IM and 2 injections of saline
- Differing IM locations
  - Deltoid
  - Thigh

Simons JACI 108 (2001) 871-3

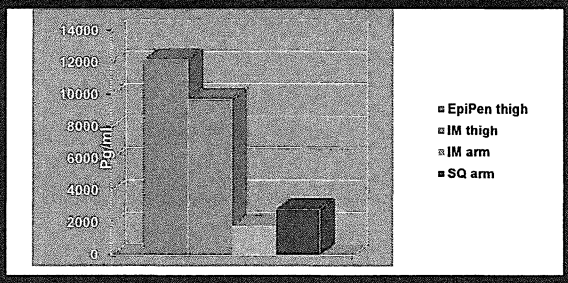
Epinephrine Absorption in Adults



- No clinical endpoints were reported

Simons JACI 108 (2001) 871-3

Epinephrine Absorption in Adults



Simons JACI 108 (2001) 871-3

Needle Length for IM Injection

- CDC - Syringe + needle
- Auto-injectors

Auto-injector	Dose	Manufacturer	Needle length
Pediatric			
Auvi-Q	0.1 mg	Sanofi-Aventis, LLC	7.5 mm
Adrenaclick	0.15 mg	Alameda Pharmaceuticals, LLC	11.7 mm
Auvi-Q	0.15 mg	Sanofi-Aventis, LLC	12.7 mm
Epipen	0.15 mg	Mylan Inc.	12.7 mm
Adult			
Adrenaclick	0.3 mg	Alameda Pharmaceuticals, LLC	11.7 mm
Auvi-Q	0.3 mg	Sanofi-Aventis, LLC	11.7 mm
Epipen	0.3 mg	Mylan Inc.	15.9 mm

- Consider effects of compression +/- pressure for auto-injectors
  - May reduce needle length to reach IM
  - May increase the risk of intra-osseous injection

Song. Curr Opin Allergy Clin Immunol 16 (2016) 391-6

www.cdc.gov/vaccines/hcp/acip-recs/general-recs/administration

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Song. Curr Opin Allergy Clin Immunol 16 (2016) 391-6

www.cdc.gov/vaccines/hcp/acip-recs/general-recs/administration

Auto-injector vs Syringe

- Auto-injectors
  - Limited to 3 doses with fixed needle lengths
    - 0.1 mg with 7.5 mm needle
    - 0.15 mg with 11.7 - 12.7 mm needle
    - 0.3 mg with 11.7 - 15.9 mm needle
  - Fixed delivery depth based upon needle length and applied pressure
  - Quickly easily available for use
  - Designed to be used through clothing
  - Designed for lateral thigh (vastus lateralis)
  - List price from $300 - $4,900

Dreborg. Ann Allergy Asthma Immunol 120 (2018) 548-53
Med Lett Drugs Ther 60 (2018) 83

Auto-injector vs Syringe

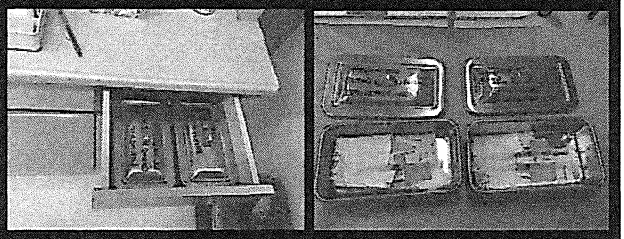
- Syringe
  - Adjustable epinephrine dosing
    - Can draw to desired 0.01 mg/kg if desired from multi-use or 1 mg single use vial
    - Can pre-draw 0.15 mg, 0.3 mg, 0.5 mg +/- 0.1 mg/ml
  - Choice of needle length
    - 0.5 inch – 1.5 inch = 13 – 38 mm
  - Can choose desired location (lateral thigh vs deltoid vs ?)
  - Can alter depth of delivery
  - Not designed to be used through clothing but …
  - May be inconvenient/error prone to draw "on the spot"
  - May be inconvenient to expose desired injection location
  - Daily cost = $2.04 (pre-draw 3 doses - 0.15 mg, 0.3 mg, 0.5 mg)

Wong Ann Allergy Asthma Immunol 116 (2016) 169-3

Anaphylaxis Action Plan

3. Give epinephrine
   - Responding physician has the option of epinephrine via differing delivery methods
     - Pre-drawn epinephrine
       - 0.15 mg initially loaded with 1 inch (25 mm) needle
       - 0.3 mg initially loaded with 1 inch (25 mm) needle
       - 0.5 mg initially loaded with 1 inch (25 mm) needle
       - Alternative needle lengths of ½ inch (13 mm), 5/8 inch (16 mm), 1.5 inch (38 mm)
     - Epinephrine autoinjectors – 0.15 mg or 0.3 mg

Anaphylaxis Action Plan



Anaphylaxis Action Plan

3. Give epinephrine
- Data from our practice - 266 SRs to SCIT
  - First dose of epinephrine (n=266)
    - 96% (254/266) IM in deltoid all 0.3 mg
    - 2% (6/266) IM in vastus lateralis, 3 = 0.3 mg, 3 = unknown
    - 2% (6/266) unknown
  - Second dose of epinephrine (n=81)
    - 74% (60/81) IM in deltoid all 0.3 mg
    - 23% (19/81) IM in vastus lateralis, 2 = 0.3 mg, 17 = unkown
    - 2% (6/266) unknown
  - Third dose of epinephrine (n=12)
    - 50% 6/12 IM in deltoid all 0.3 mg
    - 33% (4/12) IM in vastus lateralis all 0.3 mg
    - 17% (2/12) unknown

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Anaphylaxis Action Plan

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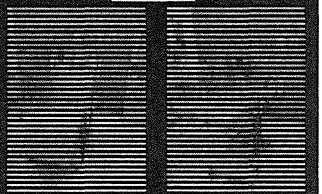
    - 33% (4/12) IM in vastus lateralis

Wong Ann Allergy Asthma Immunol 116 (2016) 169-3

Anaphylaxis Action Plan

4. Get help – in office vs. beyond if indicated
5. Position patient
   - Recumbent unless respiratory or nausea/vomit dictate otherwise (almost always seated-reclined initially in our practice)
   - Children - position of comfort



Lieberman Ann Allergy Asthma Immunol 116 (2016) 341-384

Anaphylaxis Action Plan

6. Oxygen – as needed nasal cannula – face mask, monitor pulse oximetry
7. Repeat epinephrine as indicated
   - 30% patients get a 2nd dose in our practice
   - 4.5% patients get a 3rd dose in our practice
8. Activate EMS +/- 911 if not responding or ≥ WAO grade 2 (WAO grade 3 or not responding in our practice)
9. IV fluids as indicated (uncommon for our practice

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Anaphylaxis Action Plan

Additional measures as indicated

10. Albuterol 2.5 – 5 mg nebulized as indicated (common for our practice)
11. Glucagon if on beta-blockers and not responding to epinephrine (never for our practice)
12. Epinephrine infusion if inadequate response to IM epinephrine and IV normal saline (never for our practice)
13. Intraosseous access if unable to access IV (never for our practice)

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Anaphylaxis Action Plan

Refractory anaphylaxis

14. Advanced airway – LMA, intubation, cricothyroidotomy (never for our practice)
15. Vasopressors Albuterol 2.5 – 5 mg nebulized as indicated (never for our practice)

Optional measures

16. H1 antihistamines – consider 25-50 mg of diphenhydramine IV (we commonly give cetirizine 10 mg liquid, less common liquid diphenhydramine, uncommonly IV or IM diphenhydramine)
17. Corticosteroids – administer 1-2 mg/kg of IV or oral corticosteroid (uncommon in our practice, not responding and/or WAO grade 3 or greater would get IV solumedrol, patients needing 3 doses of epinephrine but responding otherwise might receive oral steroids)

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Anaphylaxis Action Plan

Observation and monitoring

18. Observation in hospital – transport by EMS if additional treatment or observation indicated (uncommon in our practice. 2.6% =7/266)
19. Observation in office – observe in office until full recovery + additional 30-60 min
    - Common in our practice
    - Mean time to resolution of symptoms 24.2 min
    - Mean post epinephrine observation was 70.5 min
    - 95% reactions full resolution and discharged with less than 2 hour of observation

Discharge Management

20. Eduation – recognition and treatment of biphasic anaphylaxis (all of our patients)
21. Epinephrine auto-injector – training and prescription (all of our patients)
22. Anaphylaxis action plan – instructions how and when to use (all of our patients)

Lieberman. Ann Allergy Asthma Immunol 115 (2015) 341-384
Wang. Ann Allergy Asthma Immunol 116 (2016) 161-8

Summary

- Source material
- Definitions
- Causes
- Signs, symptoms, and risks
- Management and outcomes