

# Diagnosing Allergy

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# Introduction

- There is a wide array of diagnostic modalities available
- Skin tests are of paramount importance especially for IgE mediated and delayed allergy
- As immunologic diagnostic technology advances, *in-vitro* tests have assumed greater significance

# Introduction

- Lymphocyte functional assays are also recently being used for confirmation of humoral/cell-mediated conditions as well as delayed hypersensitivity reactions
- An increase in eosinophils and their products often occurs in the immediate- and late- phase responses
- Basophil activity can be assessed by the basophil activation test

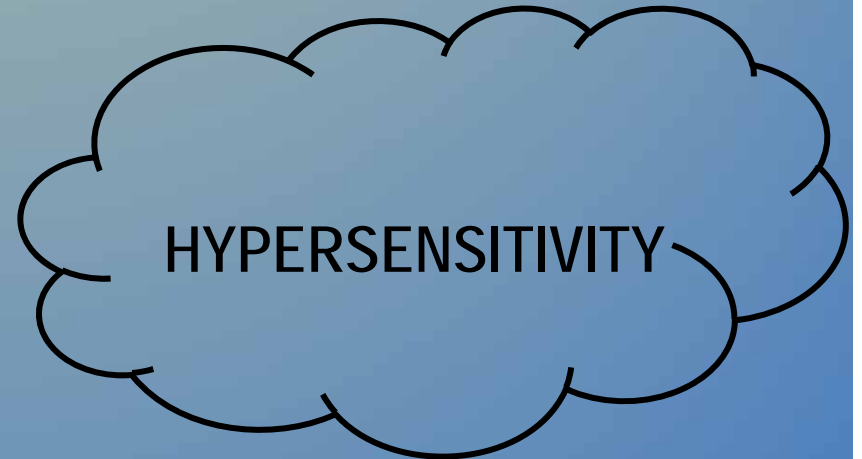
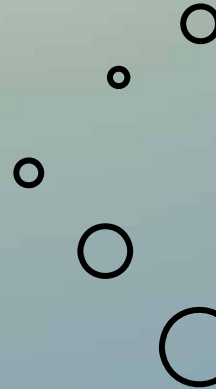
# But first.....the basics

ALLERGY

?

ATOPY

HYPERSENSITIVITY



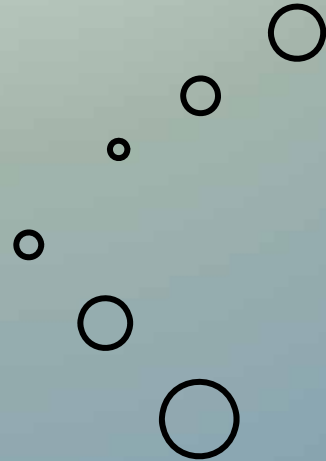
# But first.....the basics

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ATOPY

HYPERSENSITIVITY



# Definitions

## Hypersensitivity

- Objectively reproducible symptoms or signs initiated by exposure to a defined stimulus at a dose tolerated by normal persons

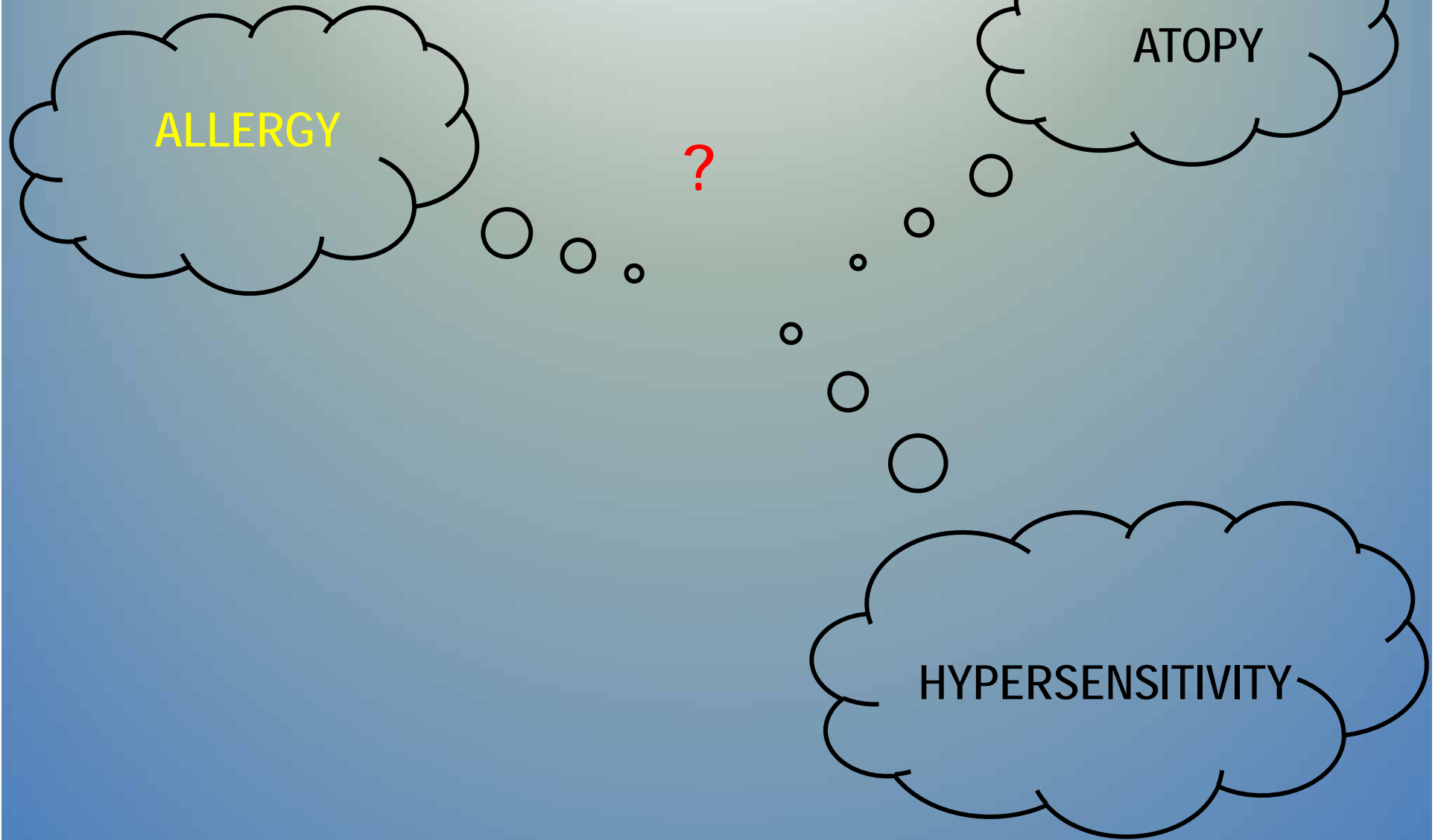
# But first.....the basics

ALLERGY

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ATOPY

HYPERSENSITIVITY



# Definitions

## Allergy

- A hypersensitivity reaction that is mediated by the immune system
- The reaction can be antibody- or cell-mediated
- Most often the antibody responsible for the reaction is IgE



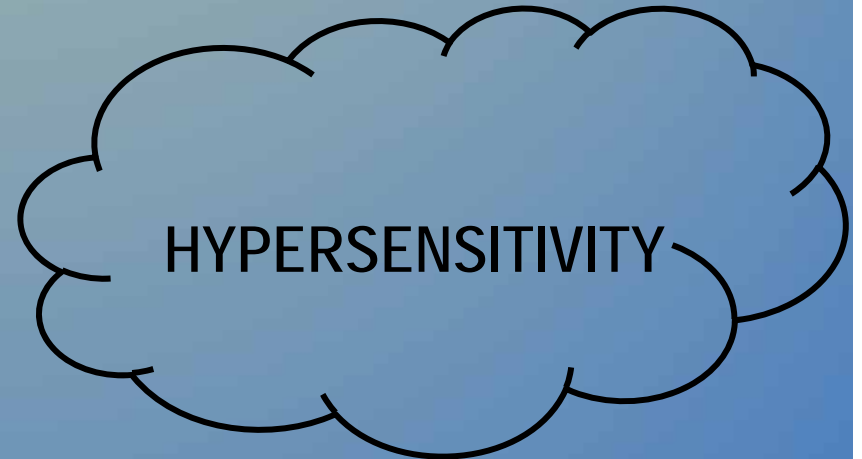
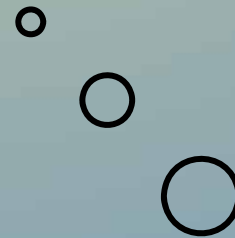
# But first.....the basics

ALLERGY

?

ATOPIY

HYPERSENSITIVITY



# Definitions

## Atopy

- A familial/personal tendency to become sensitised and produce IgE antibodies in response to ordinary exposure to allergens
- As a result, these individuals may develop the typical symptoms of asthma, allergic rhinitis or atopic eczema

# Diagnosis

## Principles

History

Physical  
examination

Special  
investigations

# History

- In no other medical disease is history more important
- Without a thorough history one cannot appropriately investigate

I exercised once, but found I was allergic to it. My skin flushed and my heart raced. I got sweaty and short of breath. Very dangerous.



# History

- Main complaint
- Age of onset
- Seasonality
- Time of onset
- Aggravating factors
- Relieving factors
- Family history of allergies
- Home/work/school environment
- Medications
- Dietary preferences
- Occupation/hobbies



# Physical examination

General – Shiners, Dennie's lines, Nasal crease, Atopic eczema, Nutritional status

Systematic examination

# Physical examination

Shiners



# Physical examination

Dennie's lines





# Physical examination

Nasal crease



# Special investigations

## Why should allergy tests be done?

- To identify and avoid trigger allergens
- To be able to provide relevant and effective therapy
- To be able to choose effective immunotherapy/  
desensitisation which is the only disease-modifying  
therapy available for allergy
- To identify patients whose symptoms are not due to  
allergy and thus prevent unnecessary drug  
therapy/unnecessary allergen avoidance

# Special investigations

Before ordering allergy tests, ask yourself.....

- Is the patient allergic?
- What are the clinically relevant allergens?
- Does the allergy contribute to the patient's symptoms?
- What is the suspected mechanism of allergy?

# Special investigations

- There are several different mechanisms of allergy
- As a result, there is a huge range of tests to diagnose these various mechanisms
- A negative test only excludes that particular mechanism of allergy, but not other types

# Special investigations

- It is imperative to distinguish between allergic reactions that are mediated by the immune system vs non-allergic reactions such as **intolerances, toxic effects** and **side-effects**
- Obviously we cannot do allergy testing for these reactions as they are not mediated by the immune system

# Hypersensitivity

Allergic

Non Allergic  
(side effect, toxic  
effect, intolerance)

IgE mediated

Non IgE  
Mediated

# Mechanisms

- **IgE mediated** reactions usually occur within minutes, up to 2 hours after exposure to the allergen.

## Classic symptoms include :

- Skin: itch, erythema, urticaria, angioedema
- Resp: rhinitis, cough, wheeze
- GIT: diarrhoea, vomiting
- Anaphylaxis

# Mechanisms

- **Non-IgE mediated** reactions are mediated by other mechanisms that may include T-cells, basophils and eosinophils
- Symptoms may be immediate but are generally more delayed

## Classic symptoms include:

eczema, urticaria, maculopapular rashes, GIT symptoms, rhinitis, respiratory and mucus membrane involvement



# What tests are available?

## *In vivo*

- Skin prick tests
- Patch tests
- Provocation tests

# What tests are available?

## *In vitro*

- Allergen specific IgE (ImmunoCAP<sup>®</sup>)
- ISAC
- Tryptase
- Basophil activation tests (flow-CAST)
- T-cell proliferation assays (MELISA)
- Nasal eosinophils

# Skin prick tests

- First described by Dr Charles Blackley in 1867
- Reliable, safe and cost effective in diagnosing IgE-mediated allergy
- Optimal results depend on quality of the extracts and proficiency of the tester
- Useful for : foods, aeroallergens, a few drugs and chemicals

# Skin prick tests

## Technique

- Allergen drops are placed on the skin
- A lancet, with a shoulder to prevent excess penetration into the dermis, is then passed through the droplet at 90° to the skin
- Each lancet must be discarded after a single use

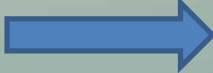
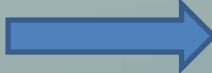
# Skin prick tests

- Various devices may be used
- No clear-cut advantage



# Skin prick tests

## Drugs that may affect SPT results

- Antihistamines - 1<sup>st</sup> gen  stop for 3 days
  - 2<sup>nd</sup> gen  up to 7 days
- Doxepin/Imipramine – 6 days
- Ranitidine – 1 day
- Methotrexate – 5-7 days
- Repetitive/prolonged application of high dose topical steroids – 3 weeks

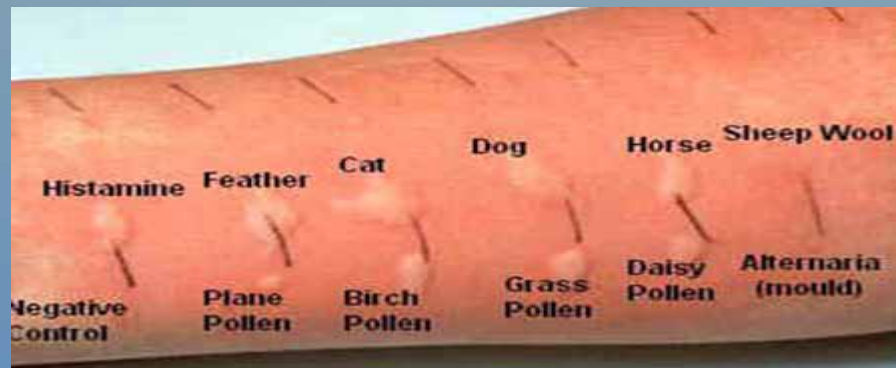
# Skin prick tests

- Use volar forearm or back
- Space droplets 2-2.5cm apart
- Avoid 3cm from antecubital fossa and 5cm from wrist
- Avoid areas of active dermatitis
- Earlier study reported smaller wheal sizes in children <2yrs; a more recent study demonstrated good reliability in infants



# Skin prick tests

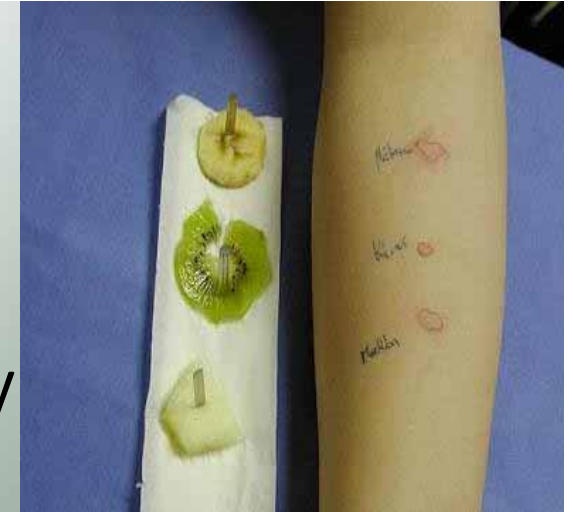
- Extracts used should be of known composition and potency
- Standardised commercial extracts are available for most aeroallergens and some food allergens
- The quality of the extract is important





# Skin prick tests

- Store extracts at  $<4^{\circ}$  to maintain stability
- Always use a positive (histamine) and negative (glycerinated saline) control
- In some cases, SPTs done with fresh fruit/foods may be more helpful using the prick-prick method
- Perform only where resuscitation equipment is available
- Small, but definite risk of systemic reactions



# Skin prick tests

## Reading the results



- Peak reactivity is 15-20 minutes
- Wheal and flare is recorded in millimetres
- Qualitative scoring (1+ - 4+ is no longer used)
- A positive result is a mean wheal diameter  $\geq 3\text{mm}$  than the negative control

# Skin prick tests

## Interpreting the result

- A positive test indicates the presence of specific IgE antibody
- **It does not indicate clinical allergy**
- The diagnostic value lies in comparing the results to the history of symptoms given by the patient

# Skin prick tests

Interpreting the result for inhalant allergy

Comparing SPT to nasal provocation challenges

- Sensitivity 85-87%
- Specificity 79-86%

# Skin prick tests

## Interpreting the result for food allergy

### Comparing SPT to food challenge

- Sensitivity and specificity depends on age of child and type of food

# Skin prick tests

## Interpreting the result for food allergy

Allergen	95% PPV <2yr	95% PPV >2 yr
Cow's milk	6mm	>8mm
Egg	5mm	>7mm
Peanut	4mm	>8mm

PPV = positive predictive value

Ref: Sporik et al

# Skin prick tests

## Common aeroallergens in South Africa

- House dust mite (Der p 1 and Der f 1)
- Rye and Bermuda grass
- Aspergillus, alternaria, cladosporium
- Cat
- Dog



# Skin prick tests

## Others to consider

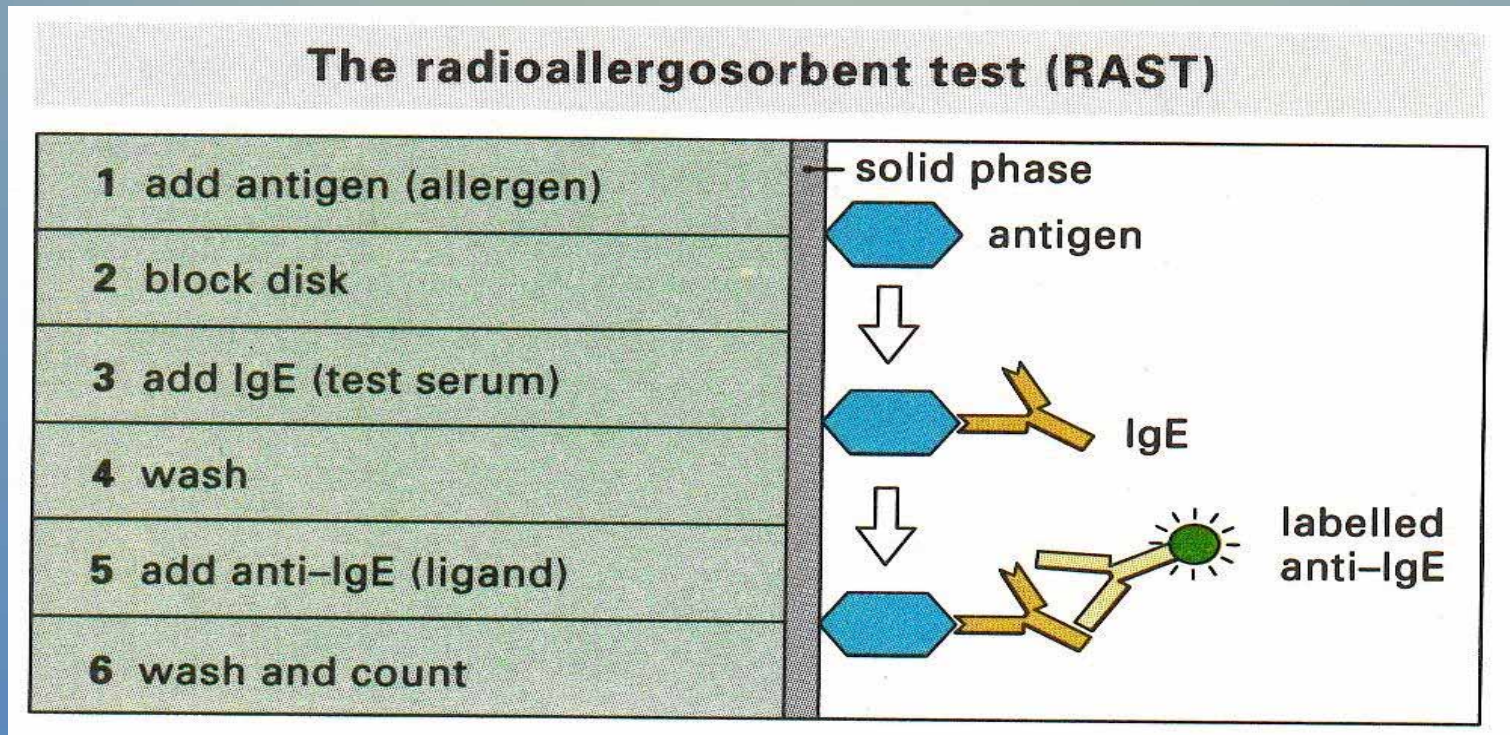
- **Farming areas** – zea mayz pollen, horse, blomia tropicalis
- **Health care worker** – latex, chlorhexidine
- **Grain industry** – storage mites, wheat, rye
- Tree and weed pollens are regional





# ImmunoCAP<sup>®</sup>

- First assay for specific IgE was reported in 1967 and was called the RAST



# ImmunoCAP®

- Technical improvements have resulted in a uniform method of reporting IgE antibody results in quantitative kU/l



# ImmunoCAP®

## Interpreting the results

- As with SPT, a positive test indicates the presence of IgE antibody but **not clinical allergy**
- Interpretation requires correlation with history, physical examination and occasionally observation after exposure to the allergen concerned

# ImmunoCAP®

## Interpreting the results



- For inhalant allergens, a result of  $>0.35\text{kU/l}$  is considered positive
- Sensitivity 60-80% and specificity 90%
- For food allergy,  $>0.35$  is also the cutoff but clinical reactivity is age dependent and interpretation is guided more by history

# ImmunoCAP®

## Interpreting the results for food allergy

IgE values at which there is a 95% chance of clinical reaction

Allergen	Child (kU/L)	<2yrs (kU/L)
Egg	7	2
Cow's milk	15	5
Peanut	14	
Fish	20	
Soy	30	
Wheat	26	

Sampson JACI 2001 (107) 891-896

# SPT vs specific IgE

SPT	Specific IgE
Inexpensive	More expensive
Immediate results	Delayed results
Unable to perform if extensive skin disease/dermatographism	Not influenced by skin disease or dermatographism
Affected by many drugs	Not affected by drugs
Small risk of anaphylaxis	No risk of anaphylaxis
Limited range of allergens	Wide range of allergens
Technique dependent	Not technique dependent

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# Multi-allergen IgE antibody screening assays

Used to rule allergy **in** or **out**

- Phadiatop – screening test for inhalant allergy
- Fx5 – screening test for food allergy

# Multi-allergen IgE antibody screening assays

## Phadiatop

- Reported as positive or negative
- Sensitivity 93%
- Specificity 89%
- A positive test indicates that the patient may be sensitive to **any of** house dust mites, grass pollens, tree and weed pollens, moulds, cat or dog dander
- A negative test means it is highly unlikely that the symptoms are due to IgE-mediated allergy

# Multi-allergen IgE antibody screening assays

## Fx5

A positive test indicates that the patient may be sensitive to **any of:**

- egg white
- cow's milk
- peanut
- wheat
- fish
- soya

# Component testing

- The identification of cross-reacting allergens (pan allergens) has led to a new concept in allergy diagnosis

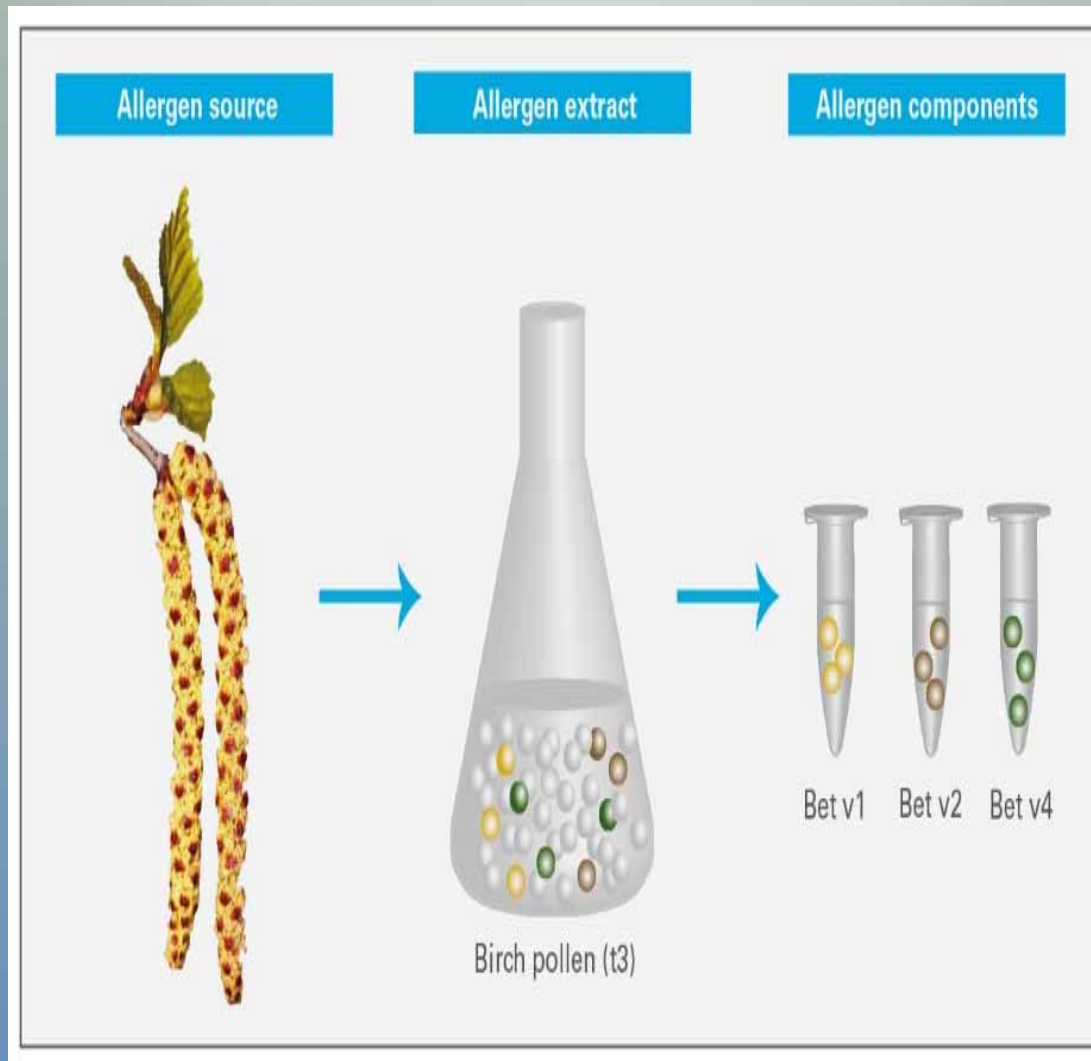


Component-resolved diagnostics

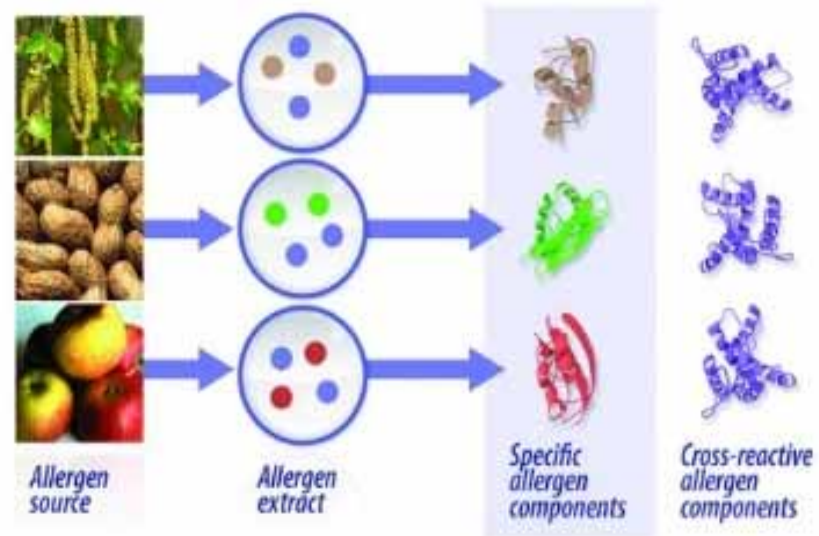
# Component testing

- Natural allergen sources contain many different proteins
- Not all are allergenic
- Some occur in many different foods and pollens

# Component testing



# Component testing



# Component testing

Panallergens include:

- CCD (cross-reacting carbohydrate determinants)
- Profilins
- PR-10 (Pathogenesis-related protein)
- Lipid transfer protein (LTP)
- Storage proteins



# Component testing

Provides additional diagnostic insight regarding

- Prediction of risk of severe reactions (risk assessment)
- Heat-stability/bio-degradability of certain allergens
- Which patients will best respond to a course of immunotherapy
- Prediction of cross reactivity

# Component testing

## Risk assessment

- Certain components predict a higher risk of developing anaphylaxis
- The protein AraH2, of peanut origin, is such a protein
- Those sensitised to LTP or storage proteins have a higher risk of reaction than those sensitised to CCD
- Obvious clinical implications – decreases the need for food challenges

# Component testing

## Heat stability/lability

- PR-10 proteins and profilins are heat sensitive
- Implication is that some allergic patients may be able to tolerate these foods in a cooked form

# Component testing

## Selection of patients for immunotherapy

- Immunotherapy is more successful in patients who are sensitised to the specific components found in each vaccine

# Pan-allergens

	CCD	PROFILIN	PR-10	LTP	STORAGE PROTEIN
Stability to heat/digestion	Stable but still not usually clinically relevant	Sensitive May tolerate cooked food	Sensitive May tolerate cooked food	Stable React to cooked food	Very stable React to cooked food
Location	N/A	Throughout fruit	Mainly pulp	Mainly peel	Seed/nut/kernel
Severity of reaction	Usually no symptoms	None or mild localised	Usually mild, may be severe	Systemic and severe reactions	Severe systemic reactions
Symptoms	Usually none	None or oral allergy syndrome	OAS and systemic symptoms	Systemic	Severe systemic, anaphylaxis

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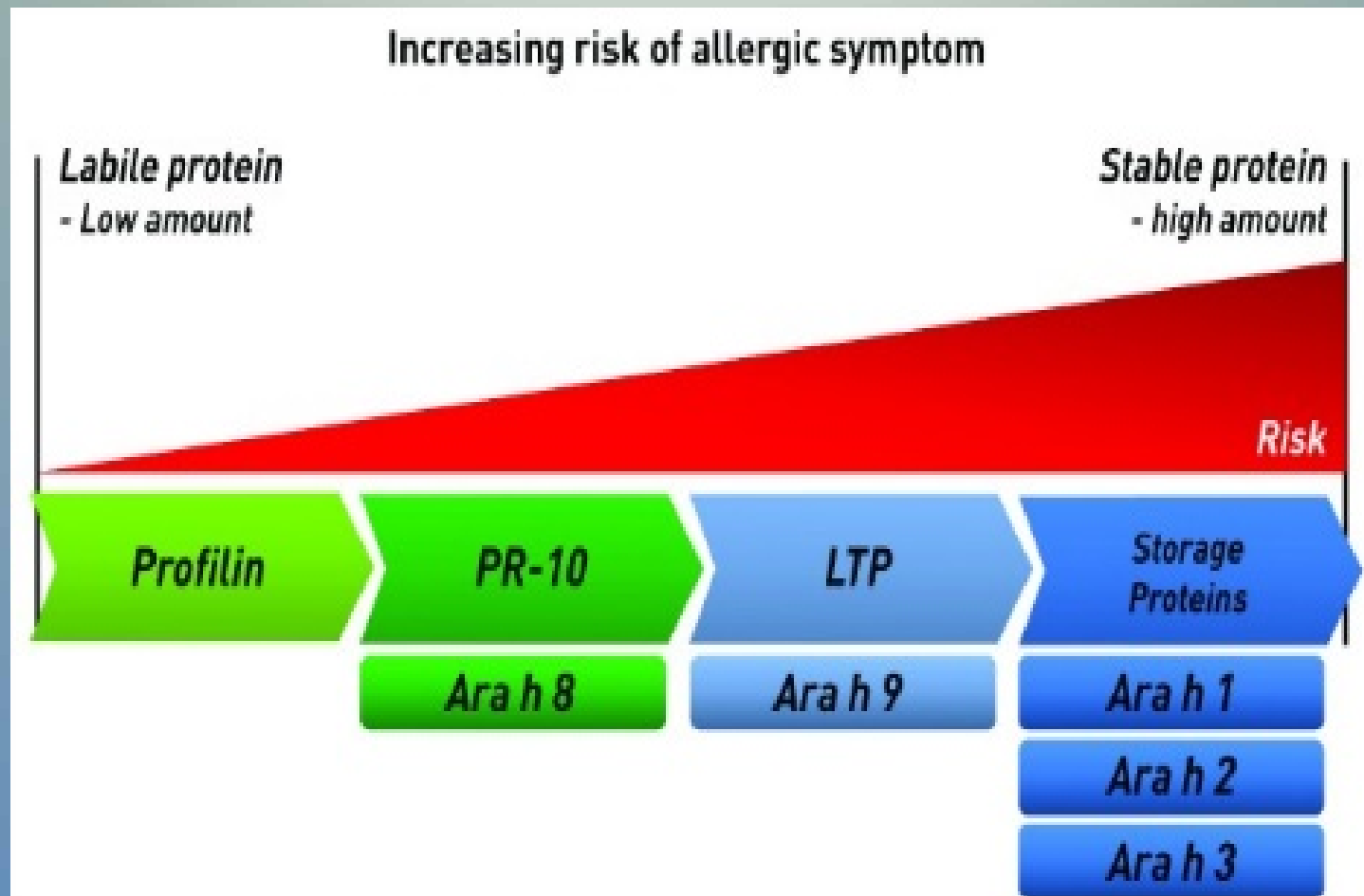
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# Risk assessment



# Component testing for foods

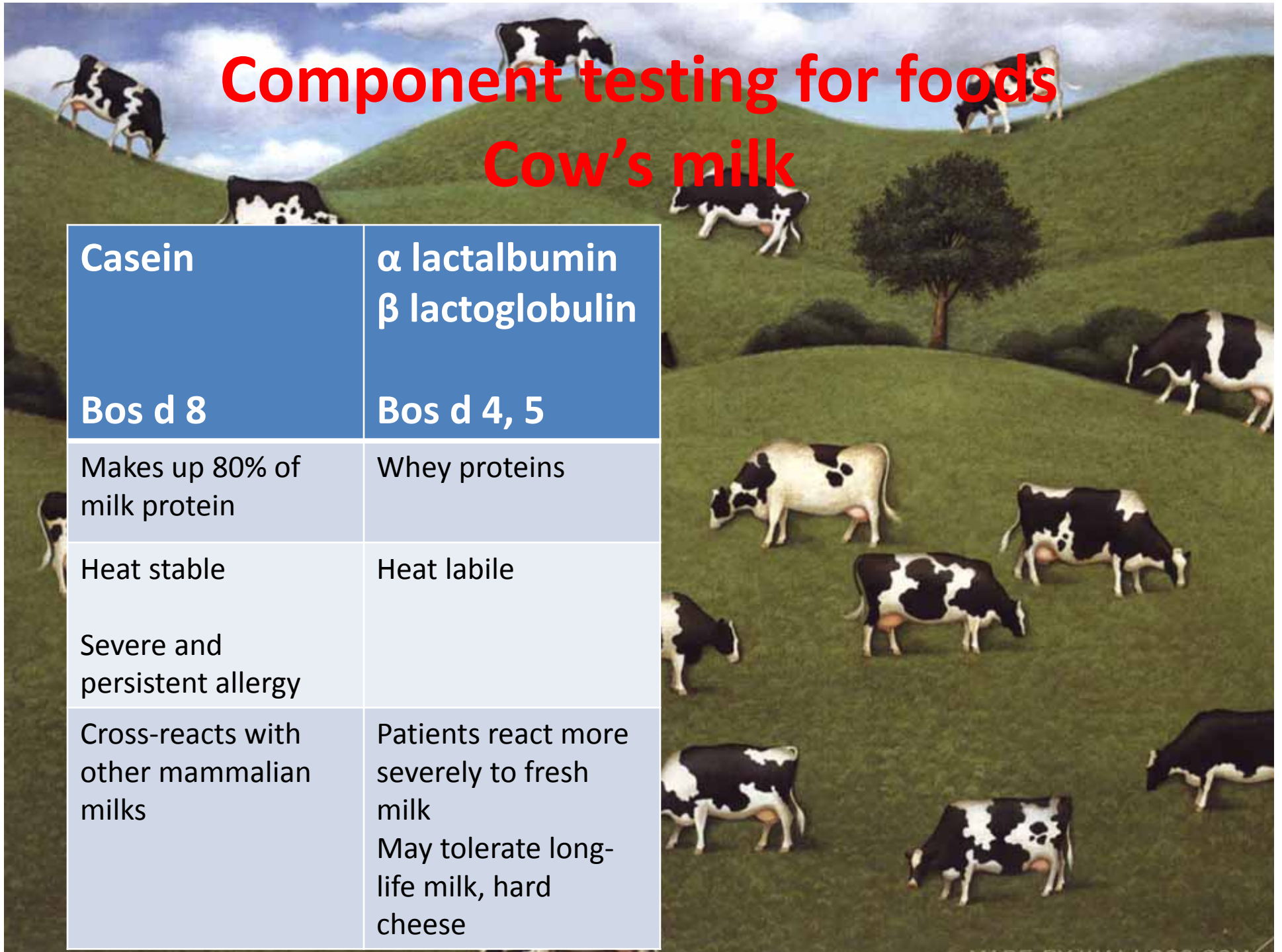
## Cow's milk

Casein	$\alpha$ lactalbumin $\beta$ lactoglobulin	Bovine serum albumin	Lactoferrin
Bos d 8	Bos d 4, 5	Bos d 6	
Makes up 80% of milk protein	Whey proteins	Occurs in milk and beef	
Heat stable	Heat labile	Heat labile	Heat labile
Severe and persistent allergy		May tolerate well cooked milk	Reacts to fresh milk
Cross-reacts with other mammalian milks	Patients react more severely to fresh milk May tolerate long-life milk, hard cheese	Cross reacts with other mammals	

# Component testing for foods

## Cow's milk

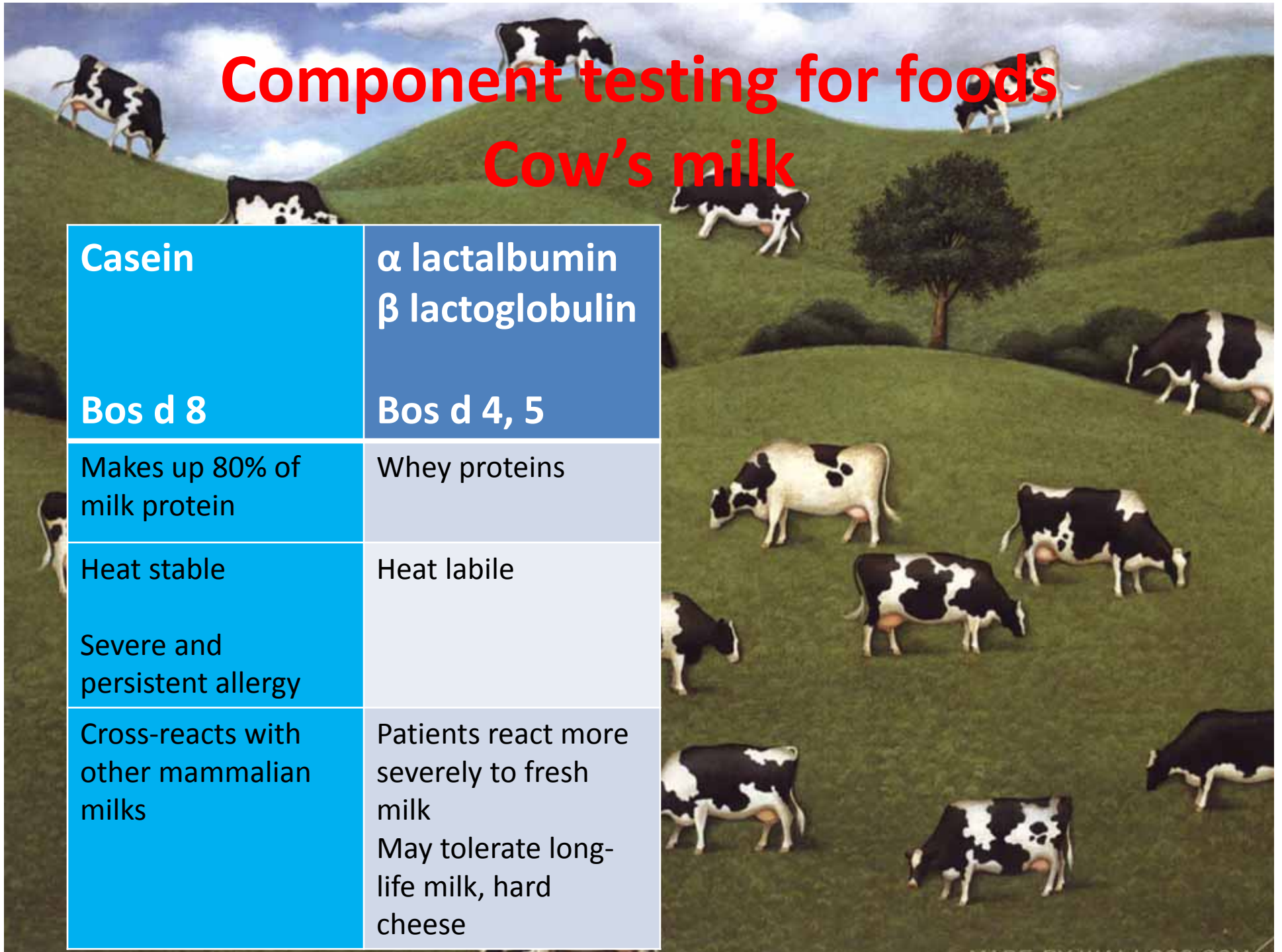
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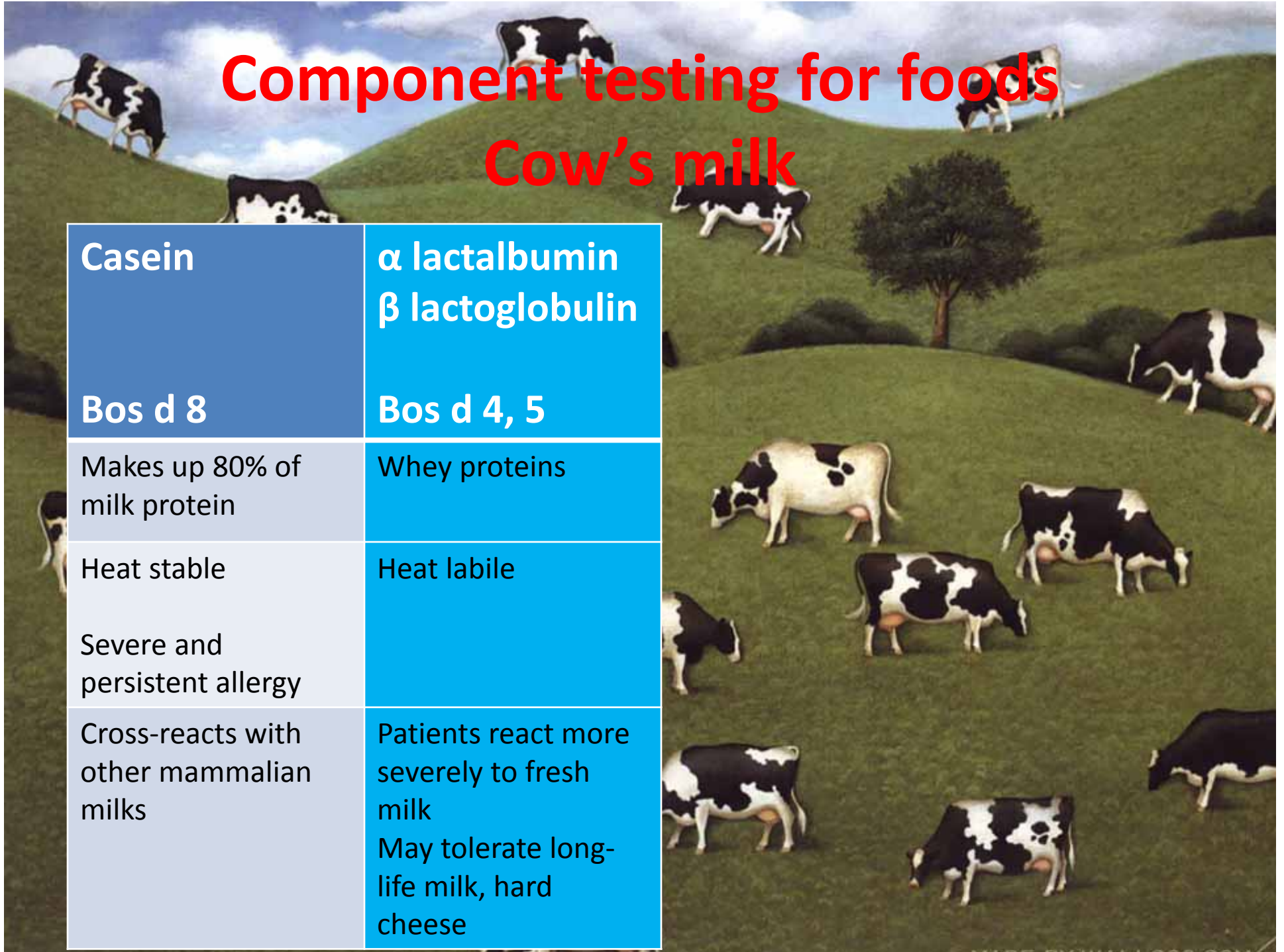
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# Component testing for foods

## Hen's egg

Ovomucoid	Ovalbumin	Egg serum albumin
Gal d 1	Gal d 2	Gal d 5
Heat stable	Heat labile	
Severe and persistent allergy	Often tolerates well cooked egg (baked egg)  Most abundant protein	Occurs in yolk, cross reacts with chicken serum albumin in chicken meat and feathers



# Component testing for foods

## Hen's egg

<b>Ovomucoid</b>	<b>Ovalbumin</b>
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# Component testing for foods

## Peanut

Storage proteins	Profilin	PR-10	LTP
Ara h 1, 2, 3, 6	Ara h 5	Ara h 8	Ara h 9
Heat stable	Heat labile	Heat labile	Heat stable
Risk of anaphylaxis	Marker of grass pollen cross reactivity	Marker of grass pollen cross reactivity	Systemic and local reactions incl OAS
Cross reacts with other nuts/seeds			

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# Component testing for foods

## Soya

<b>Storage proteins</b>	<b>PR-10</b>
Gly m 5, Gly m 6	Gly m 4
Heat stable	Heat labile
Severe systemic reactions	May cause OAS or severe reactions Associated with birch pollen allergy

# Component testing for foods

## Soya

Storage proteins

PR-10

Gly m 5, Gly m 6

Gly m 4

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Heat labile

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# Component testing for foods

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Storage proteins	PR-10
Gly m 5, Gly m 6	Gly m 4
Heat stable	Heat labile
Severe systemic reactions	May cause OAS or severe reactions Associated with birch pollen allergy

# Component testing for foods

## Wheat

Storage proteins		LTP
Omega 5 gliadin Tri a 19	$\alpha\beta\gamma$ W gliadins	Tri a 14
Systemic reactions	Severe reactions	Wheat dependent EIA
Persistence of allergy	Persistence of allergy	
Wheat dependent EIA		

# Component testing for foods

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# Component testing for foods

## Fish and shellfish

### FISH

Parvalbumin

Cyp c 1 and Gad c 1

Heat stable

Broad cross-reactivity

Lower levels in various species  
eg tuna

### SHELLFISH

Tropomyosin

Heat stable muscle protein

Crustaceans, molluscs,  
cockroach, mites – risk of cross  
reactivity

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# Component testing for animals

- Cross reactions can occur between animals
- The primary sensitiser should be identified before starting immunotherapy
- Cat – Fel d 1
- Dog – Can f 1, 2 and 5
- Horse – Equ c 1
- Equ c 1 and Fel d 4 cross react (both are lipocalins) – important when deciding on horse immunotherapy



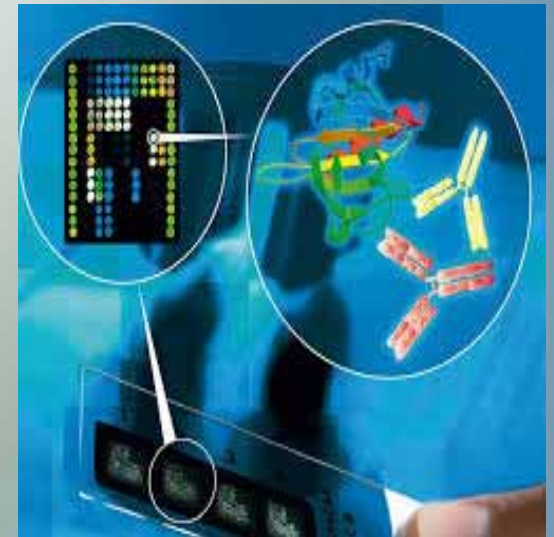
# Component testing

- Should not be used for screening or first-line tests
- Useful as a second-line test in poly-sensitized patients to distinguish genuine sensitivity from cross-reactions
- Available as individual components or on multiplex platforms such as the ISAC test

# ISAC

## Immuno solid-phase allergen chip

- A multiplex microchip array
- IgE is detected to multiple recombinant allergen components
- Requires only 20  $\mu$ l serum to measure specific IgE to 112 different allergens



# ISAC

What is the difference between the ISAC and standard IgE tests?

- ImmunoCAP<sup>®</sup> test is based on allergen extracts prepared from biological raw materials
- Major and minor allergen components are not always standardised
- ISAC - recombinant allergen components produced in a laboratory

# ISAC

## Useful for

- Patients with multiple allergies
- Patients with combined food and inhalant allergies
- Patients with suspected allergen cross-reactivity
- Patients who require a more in-depth interpretation of their allergies

# ISAC

## Drawbacks:

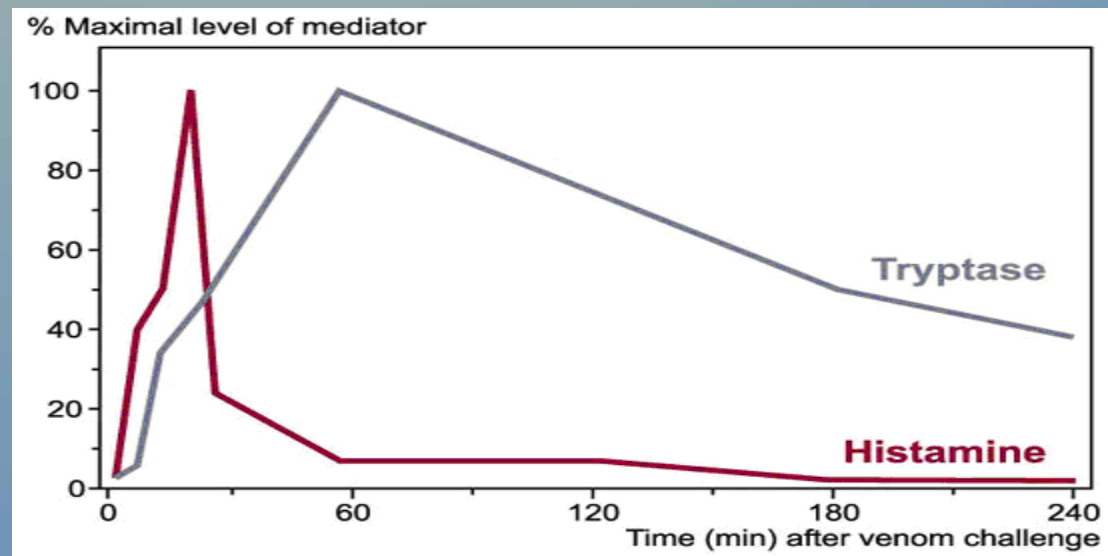
- Not useful for drug and occupational allergy
- Does not contain every allergen, thus history is still the most important guide as to which test to request
- Expensive



# Tryptase

**Tryptase** is a sensitive and specific marker of mast cell degranulation

- Helpful in the context of anaphylaxis
- Serum levels peak at 1 hour after a reaction and decline thereafter over 6 hours
- Repeat samples taken at 0, 1 and 6 hours after the event may confirm anaphylaxis



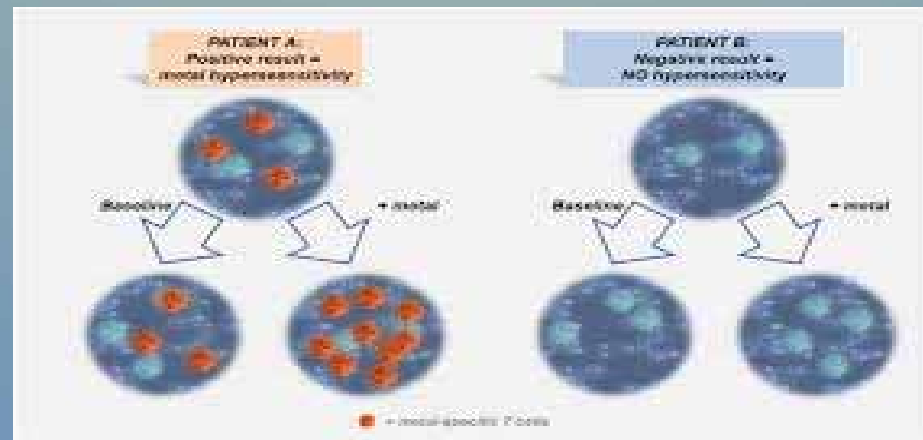
# CAST

- **CAST**= cellular antigen stimulation test
- Some patients have sensitivity to various foods, colourants, flavourants, preservatives or medications that are mediated by basophil activation
- The CAST test measures basophil activation markers by flow-cytometry after exposure of the patients blood to the relevant allergen
- Useful for reactions to colourants and preservatives and drug allergies



# MELISA

- Memory Lymphocyte Immunostimulation assay
- Tests for T-cell mediated reactions due to drugs, metals, latex and food



# Patch test

- First used in 1896, the patch test has evolved as the definitive diagnostic technique for allergic contact dermatitis
- This is of particular importance as >3700 substances have been identified as contact allergens

# Patch test



## Common patch test techniques



- **Finn chambers** – individual 8mm aluminium chambers, filled and applied
- **TRUE test** – preloaded template of 23 common contact allergens



# Patch test

- Placed on the back
- Keep on for 48 hrs
- Read at 48 and 72 or 96hrs
- Occasionally as late as 7 days



# Patch test






- 30% of relevant allergens are negative at 48 hrs but positive at 96hrs
- If positive reactions disappear by 96hrs, they may be due to irritants
- Weak sensitizers may need to be read at 7 dys



# Patch tests

## Common

- Health professions
- Beauticians
- Machinists
- Food processors
- Construction workers

-	negative
?+ 	doubtful
+ 	faint macular, erythema only weak(non- vesicular)positive
++ 	Strong(vesicular) positive erythema, infiltration, possibly papules
+++ 	extreme positive bullous reaction erythema, infiltration, papules, vesicles
R+ 	Irritant Reaction of different types Ring reaction

# Atopy patch test

- The Atopy patch test is a modification of the traditional patch test
- Evaluated in patients with atopic eczema and eosinophilic esophagitis as an adjunct for the diagnosis of food allergy
- Also used for drugs that cause mixed cutaneous reactions

# Atopy patch test

- Food placed in 12mm Finn chambers on patients back
- 2g of food in 2ml saline (or single ingredient commercially prepared food)
- Keep on for 48hrs
- Read results at 72hrs
- For drugs, read at 48, 96hrs and 7dys if negative



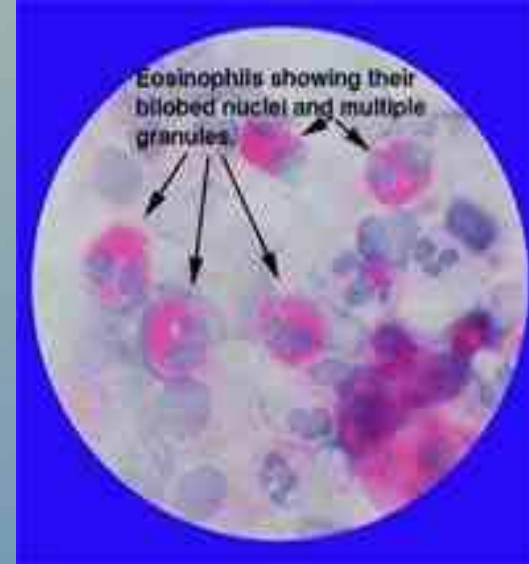
# Atopy patch test

- Clinical relevance still evolving
- Not yet standardized, nor reproducible



# Nasal eosinophils

- Helpful to distinguish between allergic and non-allergic rhinitis
- Sensitivity ~ 50%
- Specificity ~ 88%



# Clinical relevance

- Asthma/AR/AC
- Food allergy
- Atopic eczema
- Contact dermatitis
- Anaphylaxis
- Drug allergy
- Acute urticaria
- Chronic urticaria
- Insect venom allergy

# Asthma/rhinitis/conjunctivitis

- Consider seasonality and geography
- **Seasonal** – do tree pollens via SPT or specific IgE
- **Perennial** – do Phadiatop
  - if positive, do individual IgE or do SPTs for inhalants
- If negative, consider another mechanism: do CAST or nasal mucous for eosinophils

# Asthma/rhinitis/conjunctivitis

## Commonest perennial inhalant allergens in SA

- Bermuda grass and rye grass (cross reacts with most SA grasses)
- D pteronyssinus (cross reacts with D farinae)
- B tropicalis
- Alternaria
- Cladosporium
- Aspergillus
- Cat
- Dog



# Food allergy

- **History and examination**
- **Immediate reactions** – food mixes, specific IgE, SPT, components, oral food challenge
- **Delayed reactions** – CAST, MELISA, scope/biopsy, coeliac tests, reducing substances, H breath test, exclusion/reintroduction
- **Oral allergy syndrome** – do pollens and cross-reactive components (profilin, PR-10, LTP and CCD)

# Atopic eczema



- **History and examination**
- Most children with AE do not have food allergy
- 30-40% with moderate to severe AE may have a food allergy
- May have multiple false positives
- Test only for foods implicated on history

# Atopic eczema



- Specific IgE (or Fx5 screen followed by specific IgE if +)
- SPTs for foods, house dust mite and animal dander sensitisation
- (flow-CAST and APT)
- Elimination and reintroduction under supervision of a dietician
- Oral food challenge



# Contact dermatitis

- **History**
- **Examination**



- **Patch test** – True test, European baseline series (a mix of 26 different allergens), hairdressing, cosmetic and sunscreen series etc
- **MELISA** – nickel, latex, gold, aluminium, platinum

# Anaphylaxis

- **History**
- **Examination**
- Tryptase
- Specific IgE or flow-CAST based on clinical history (beware SPTs)
- EIA – omega 5 gliadin



# Drug allergy

- **History**
- **Examination**
- **Immediate reactions** – Specific IgE, SPT, CAST, drug provocation test
- **Delayed reactions** – C3, C4, skin biopsy, CAST, MELISA, Patch test, drug provocation

# Urticaria

Chronic

Acute

IgE mediated

Non IgE mediated

Food  
Drugs  
Latex  
Insect venom  
Animal dander

Viral  
Drugs  
Additives/preservatives  
Direct histamine release  
Scombroid  
Contact

# Urticaria

**Chronic**

**Acute**

**Spontaneous**

no obvious trigger

**Inducible**

specific trigger

**FBC & ESR**

**Avoid suspected drugs**

**TFT and antibodies**

**ASST, SPT, dipstix**

**Autoantibodies**

**Skin biopsy, Tryptase**

**Pseudoallergen free diet**

**Infectious diseases**

**Cold**

**Delayed pressure**

**Solar**

**Dermographic**

**Vibratory**

**Cholinergic**

**Heat**

**Aquagenic**

**Specific provocation tests**

# Insect venom

- **History**
- **Examination**
- Specific IgE
- (SPT)
- Component testing to identify primary sensitisation and cross-reactivity
- **Bee** - Api m 1 and Api m 10
- **Wasp** - Ves v 1 and Ves v 5
- **Paper wasp** - Pol d 5
- CCD



new!

# South African Allergic rhinitis guidelines 2014

consensus document

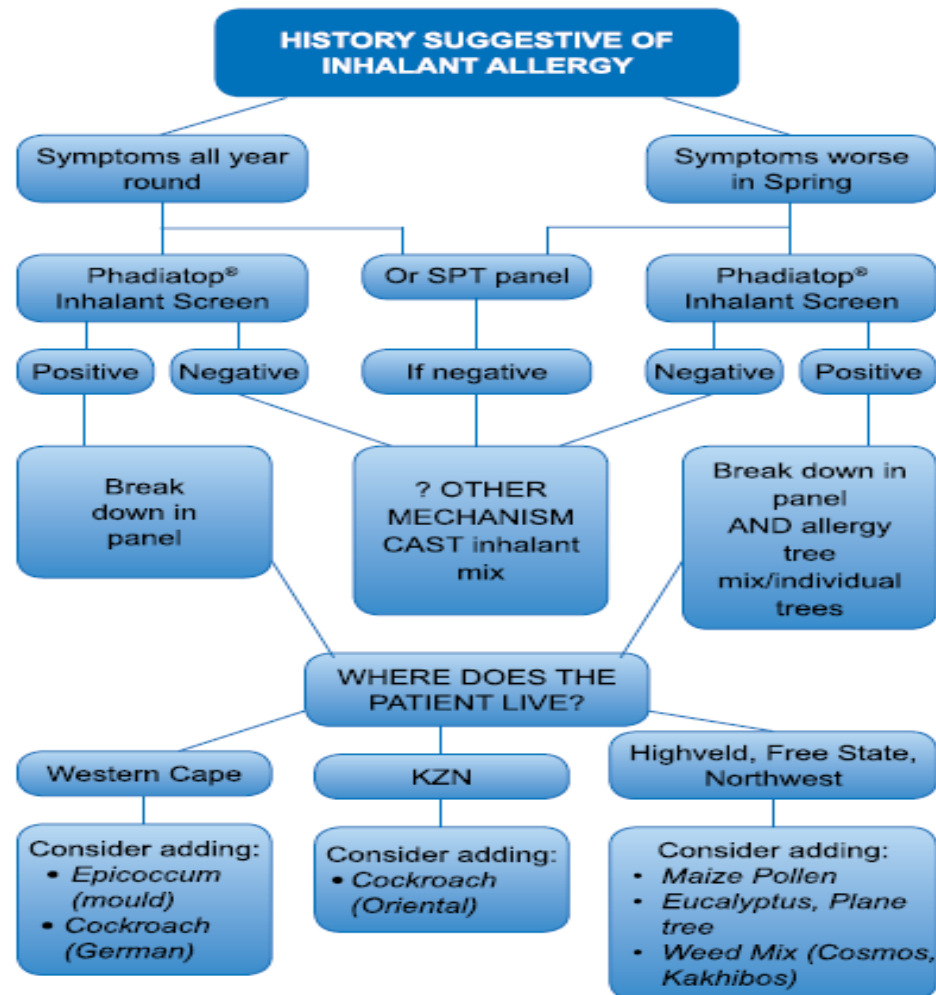
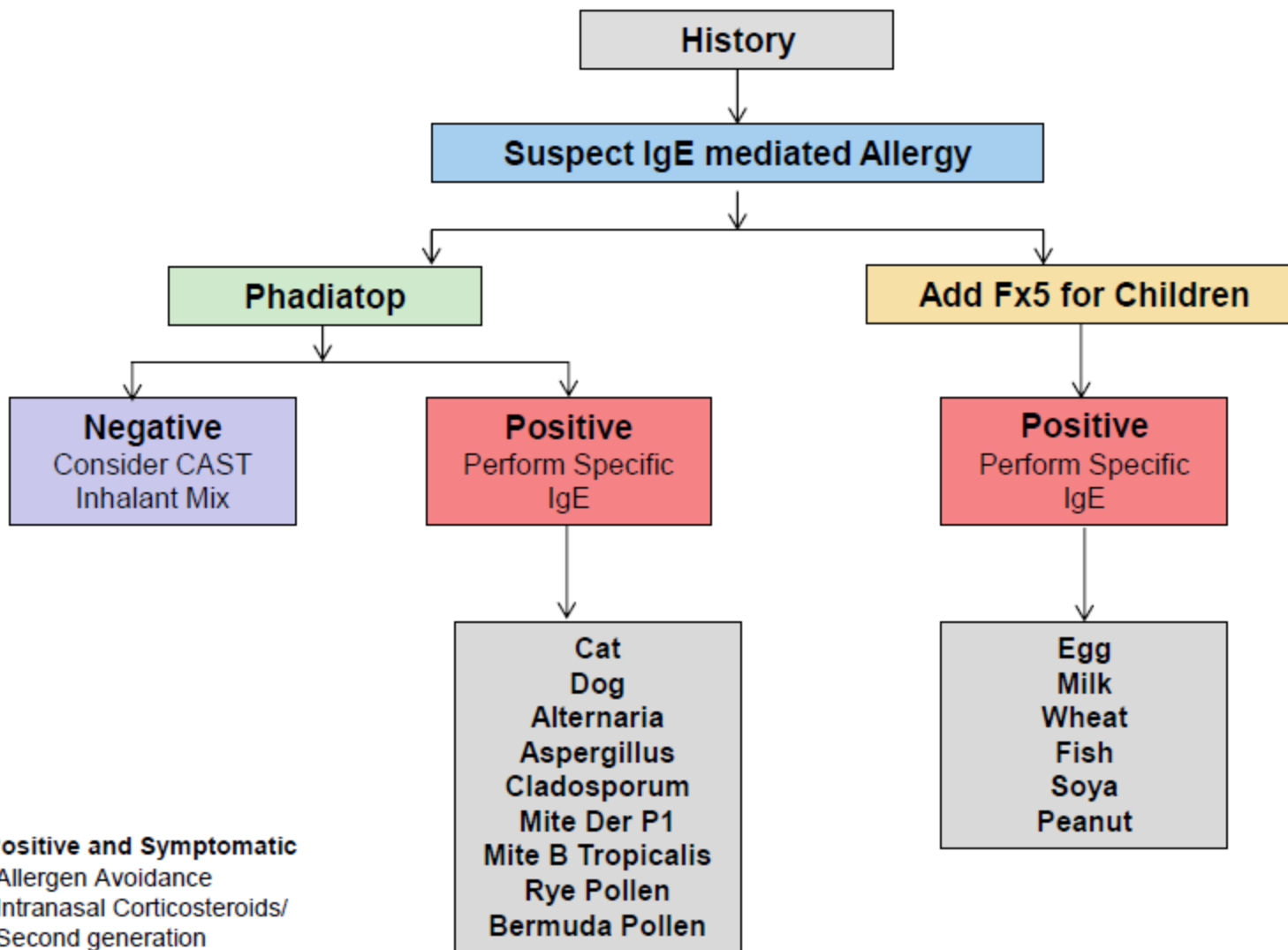


Figure 4.

# Diagnostic Algorithm for in-vitro Inhalant Allergy Testing

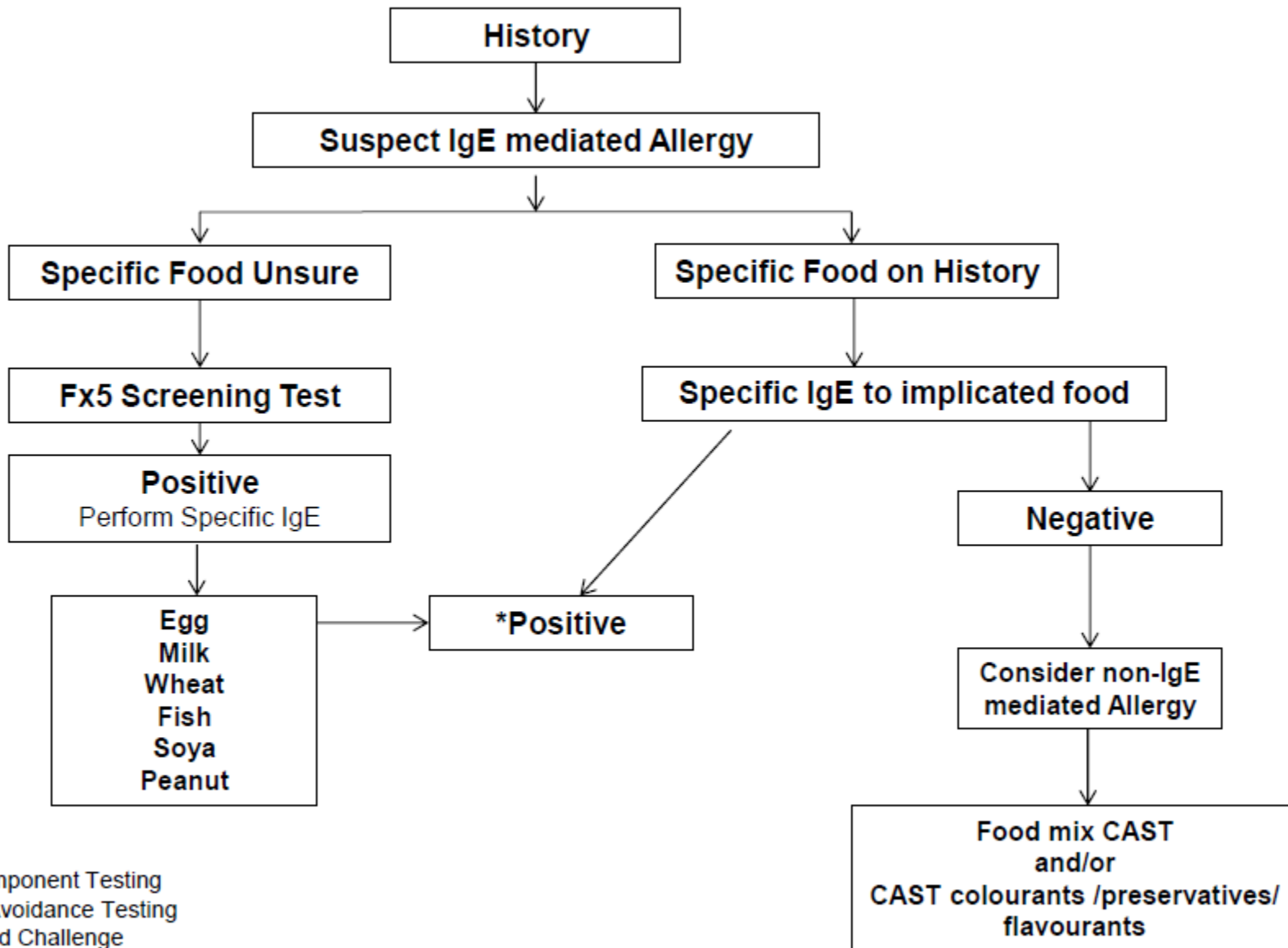


**If Positive and Symptomatic**

- Allergen Avoidance
- Intranasal Corticosteroids/  
Second generation  
Antihistamines
- Consider Allergen  
Immunotherapy



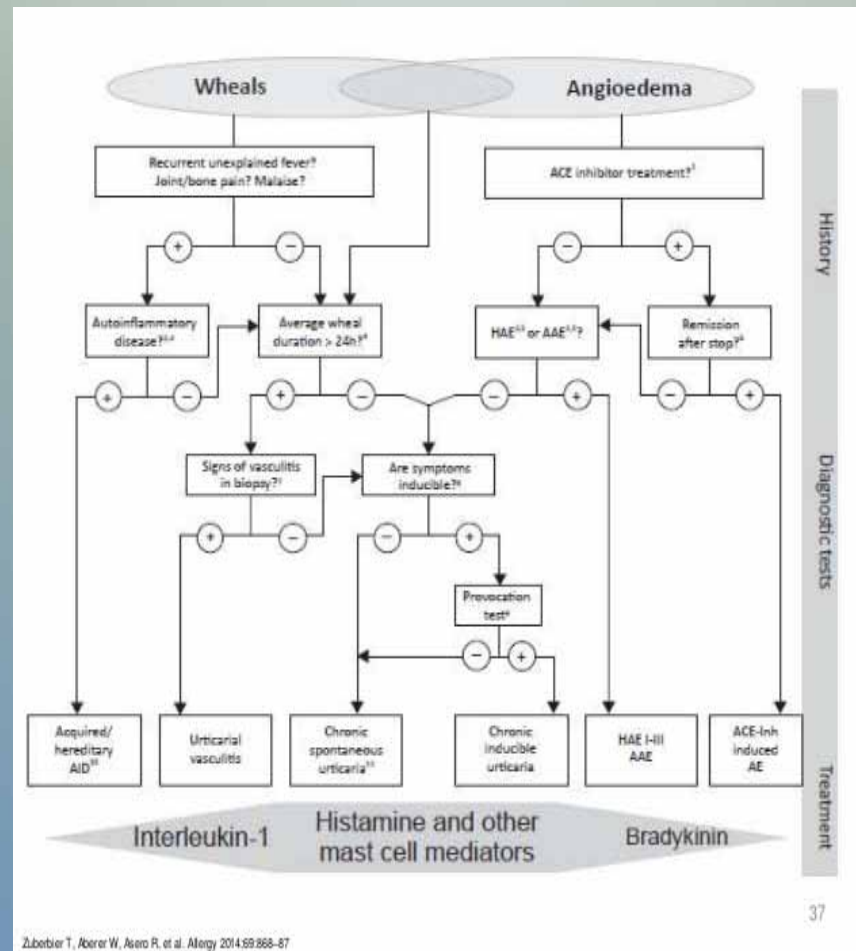
# Diagnostic Algorithm for in-vitro Food Allergy Testing



**\*Positive**

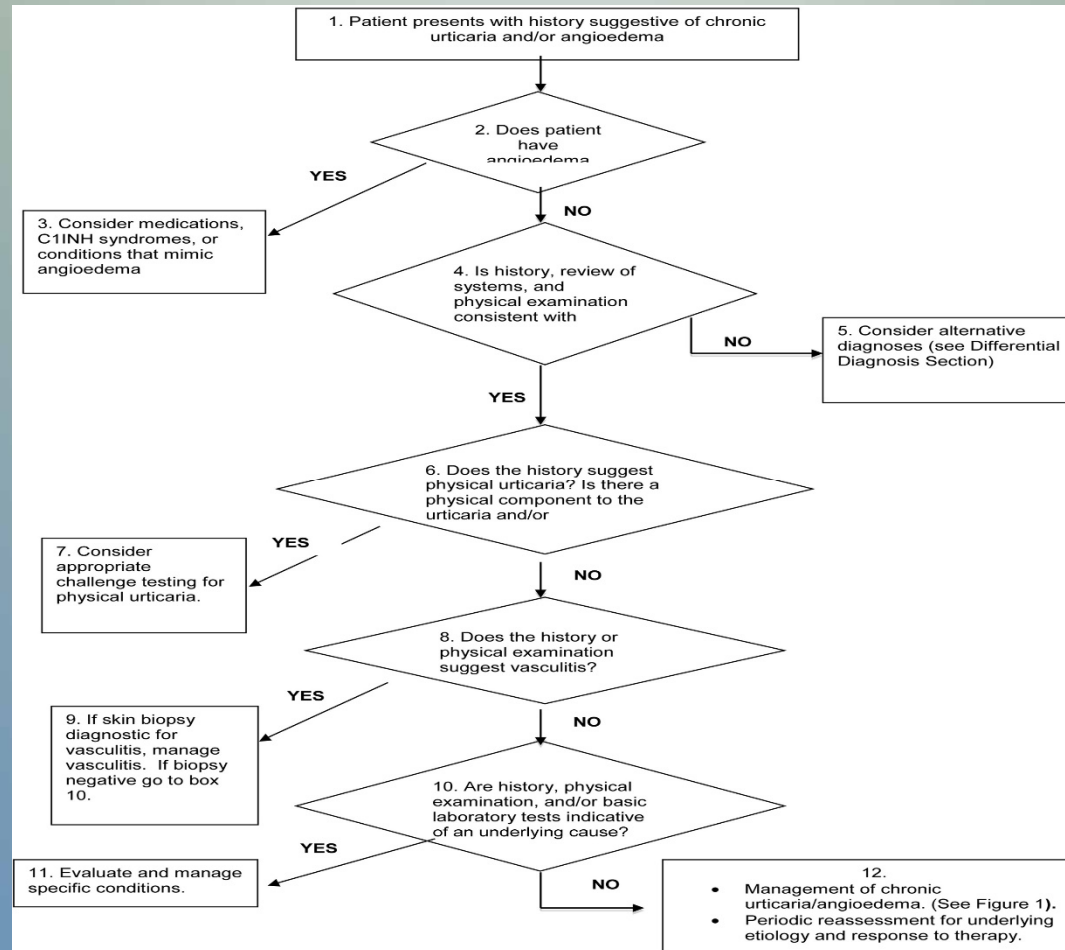
- Consider Component Testing
- Appropriate Avoidance Testing
- Consider Food Challenge

# EAACI/GA<sup>2</sup>LEN/EDF/WAO urticaria guideline 2014



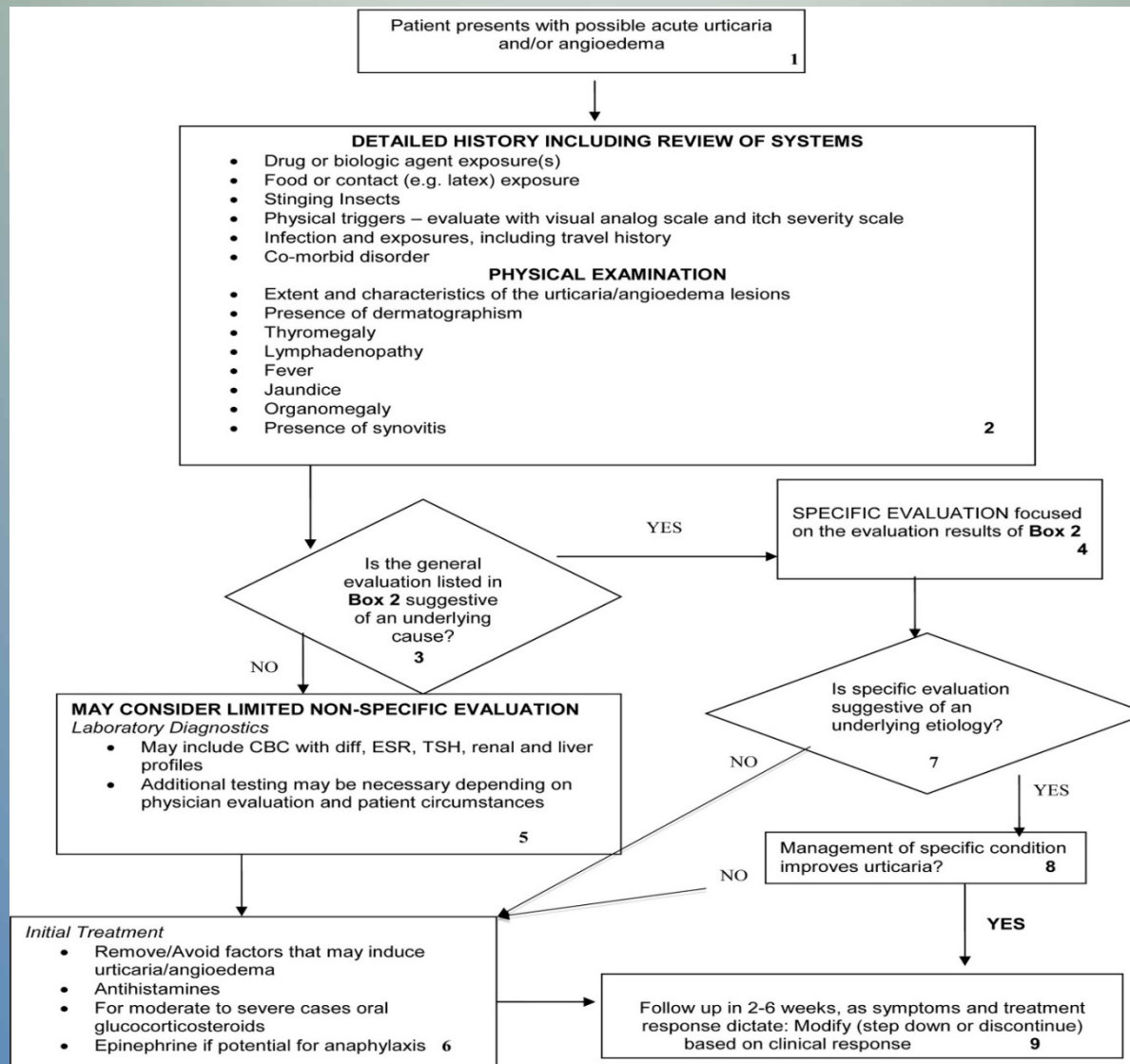
# Chronic urticaria guideline

































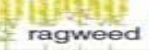

























JACI May 2014: 133(5)



# Acute urticaria guideline

JACI May 2014: 133(5)



If Allergic to:	Risk of Reaction to at Least One:	Risk:
<b>A legume*</b> peanut 	<b>Other legumes</b> peas  lentils  beans 	5% 
<b>A tree nut</b> walnut 	<b>Other tree nuts</b> brazil  cashew  hazelnut 	37% 
<b>A fish*</b> salmon 	<b>Other fish</b> swordfish  sole 	50% 
<b>A shellfish</b> shrimp 	<b>Other shellfish</b> crab  lobster 	75% 
<b>A grain*</b> wheat 	<b>Other grains</b> barley  rye 	20% 
<b>Cow's milk*</b> 	<b>Beef</b> hamburger 	10% 
<b>Cow's milk*</b> 	<b>Goat's milk</b> goat 	92% 
<b>Cow's milk*</b> 	<b>Mare's milk</b> horse 	4% 
<b>Pollen</b> birch  ragweed 	<b>Fruits/vegetables</b> apple  peach  honeydew 	55% 
<b>Peach*</b> 	<b>Other Rosaceae</b> plum  pear  apple  cherry 	55% 
<b>Melon*</b> cantaloupe 	<b>Other fruits</b> watermelon  banana  avocado 	92% 
<b>Latex*</b> latex glove 	<b>Fruits</b> kiwi  banana  avocado 	35% 
<b>Fruits</b> kiwi  avocado  banana 	<b>Latex</b> latex glove 	11% 



**Birch**



Apple Peach Plum Pear Cherry Apricot Almond  
**Rosaceae**



Carrot Celery Parsley Caraway Fennel Coriander Aniseed  
**Apiaceae**



Soybean Peanut  
**Fabaceae**  
(old Leguminosae)



Hazelnut  
**Betulaceae**



**Ragweed**



Cantaloupe Honeydew Watermelon Zucchini Cucumber  
**Cucurbitaceae**



Banana  
**Musaceae**



**Mugwort**



Celery Carrot Parsley Caraway Fennel Coriander Aniseed  
**Apiaceae**



Bell pepper  
**Solanaceae**



Black pepper  
**Piperaceae**



Mustard Cauliflower Cabbage Broccoli Garlic Onion  
**Brassicaceae**



Garlic Onion  
**Liliaceae**



**Orchard**



Cantaloupe Honeydew Watermelon  
**Cucurbitaceae**



Peanut  
**Fabaceae**  
(old Leguminosae)



White potato Tomato  
**Solanaceae**



**Timothy**



Swiss chard  
**Amaranthaceae**



Orange  
**Rutaceae**



*That's all Folks!*