

Original article

Standard skin prick testing and sensitization to inhalant allergens across Europe – a survey from the GA²LEN network*

Skin prick testing (SPT) is the standard method for diagnosing allergic sensitization but is to some extent performed differently in clinical centres across Europe. There would be advantages in harmonizing the standard panels of allergens used in different European countries, both for clinical purposes and for research, especially with increasing mobility within Europe and current trends in botany and agriculture. As well as improving diagnostic accuracy, this would allow better comparison of research findings in European allergy centres. We have compared the different SPT procedures operating in 29 allergy centres within the Global Allergy and Asthma European Network (GA²LEN). Standard SPT is performed similarly in all centres, e.g. using commercial extracts, evaluation after 15–20 min exposure with positive results defined as a wheal > 3 mm diameter. The perennial allergens included in the standard SPT panel of inhalant allergens are largely similar (e.g. cat: pricked in all centres; dog: 26 of 29 centres and *Dermatophagoides pteronyssinus*: 28 of 29 centres) but the choice of pollen allergens vary considerably, reflecting different exposure and sensitization rates for regional inhalant allergens. This overview may serve as reference for the practising doctor and suggests a GA²LEN Pan-European core SPT panel.

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Table 1. Standard skin prick test allergens used at the Global Allergy and Asthma European Network (GA²LEN) centres working in clinical care (additional allergens are added according to patient history). Northern Europe

	Northern Europe					
	Göteborg	Helsinki	Odense	Oslo	Oslo Voksentoppen	Stockholm
Cat	Cat	Cat	Cat	Cat	Cat	Cat
Dog	Dog	Dog	Dog	Dog	Dog	Dog
<i>Dermatophagoides pteron.</i>	<i>Dermatophagoides pteron.</i>	<i>Dermatophagoides pteron.</i>	<i>Dermatophagoides pteron.</i>	<i>Dermatophagoides pteron.</i>	<i>Dermatophagoides pteron.</i>	<i>Dermatophagoides pteron.</i>
<i>Dermatophagoides farinae</i>			<i>Dermatophagoides farinae</i>			<i>Dermatophagoides farinae</i>
<i>Phleum pratense</i> (timothy)	<i>Phleum pratense</i> (timothy)	Grass, mixed ¹	<i>Phleum pratense</i> (timothy)	<i>Phleum pratense</i> (timothy)	<i>Phleum pratense</i> (timothy)	<i>Phleum pratense</i> (timothy)
Birch	<i>Betula verrucosa</i> (birch)	Birch	Birch	Birch	Birch	Birch
<i>Alternaria</i>		<i>Alternaria</i>		<i>Alternaria alt./ A. tenuis</i>	<i>Alternaria alt./ A. tenuis</i>	<i>Alternaria</i>
<i>Artemisia</i>	<i>Artemisia vulgaris</i> (mugwort)	<i>Artemisia</i>	<i>Artemisia vulgaris</i> (mugwort)	<i>Artemisia</i>	<i>Artemisia</i>	<i>Artemisia</i>
<i>Cladosporium</i>	<i>Cladosporium herbarum</i>	<i>Cladosporium</i>	<i>Cladosporium herbarum</i>	<i>Cladosporium herbarum</i>	<i>Cladosporium herbarum</i>	<i>Aspergillus</i> Horse
	Horse Latex	Horse Latex		Horse Latex	Horse Latex	
	Cow epithelia			Cow's milk	Cow epithelia	
	<i>Festuca pratensis</i>			Peanut	<i>Alnus glutinosa</i> (alder)	
				Cod	<i>Corylus avellana</i> (hazel)	
				Hen's egg white	Golden hamster epithelia	
					Rabbit	
Number of allergens tested	9	11	11	11	14	10
Manufacturer	ALK	ALK		ALK	Allergopharma	ALK

¹Different grass mixes containing *Dactylis glomerata*, *Lolium perenne*, *Festuca rubra*, *Poa pratensis*, *Phleum pratense*, *Secale cereale*, *Holcus lanatus*, *Anthoxanthum odoratum*, *Arrhenatherum elatius*, *Agrostis stolonifera*, *Alopecurus pratensis*, *Festuca pratensis*.

Mobility is increasing in Europe and allergists increasingly find themselves consulted by patients from other countries. In order to correctly diagnose inhalant allergies in these patients it is useful to know the most important inhalant allergens in the different countries of Europe as they show a difference in distribution depending on the region. Furthermore, harmonization of skin prick testing (SPT) across Europe is desirable so that findings from clinical practice as well as for clinical research are more comparable. This should be in terms of the choice of a standard panel of allergens, the source of extracts or using molecular standards and the technical procedure of testing.

Skin testing for diagnosis of inhalant allergy has been used since the 19th century and is recommended as a first-line method to detect type I hypersensitivity to inhalant allergens. Regional variations in rates of sensitization to inhalant allergens have been shown in

several large European studies such as the European Community Respiratory Health Survey (ECHRS) (1) and the International Study of Asthma and Allergies in Childhood (ISAAC) (2) and other multi-country studies, e.g. for adults in Iceland/Belgium/Sweden (3), and children in New Zealand/Wales/South Africa/Sweden (4) or Poland/Italy (5), and general population surveys, e.g. in Switzerland (6) and Denmark (7).

Currently, there is no published review summarizing the data for Europe. GA²LEN, the Global Allergy and Asthma European Network, is a project selected during the Sixth Framework Programme of the European Union (EU) to overcome the fragmentation of allergy and asthma research in Europe. In this project, we have gathered the data available from the literature and added a survey to compile the data from 29 GA²LEN centres in 16 European countries.

Table 2. Standard skin prick test allergens used at the Global Allergy and Asthma European Network (GA²LEN) centres working in clinical care (additional allergens are added according to patient history). Central Europe

Central Europe													
Amsterdam	Berlin/Dermatology	Berlin/Pediatrics	Ghent/ORTL	Ghent/Pediatrics	Ghent/Pulmonology	Krakow	Loth	Munich LMU/ Pediatrics	Munich TU	Utrecht	Vienna	Zurich	
Cat	Cat	Cat	Cat	Cat	Cat	Cat	Cat	Cat	Cat	Cat	Cat	Cat	
Dog	Dog	Dog	Dog	Dog	Dog	Dog	Dog	Dog	Dog	Dog	Dog	Dog	
<i>Dermatophagoides pteron.</i>	<i>Dermatophagoides pteron.</i>	<i>Dermatophagoides pteron.</i>	<i>Dermatophagoides pteron.</i>	<i>Dermatophagoides pteron.</i>	<i>Dermatophagoides pteron.</i>	<i>Dermatophagoides pteron.</i>	<i>Dermatophagoides pteron.</i>	<i>Dermatophagoides pteron.</i>	<i>Dermatophagoides pteron.</i>	<i>Dermatophagoides pteron.</i>	<i>Dermatophagoides pteron.</i>	<i>Dermatophagoides pteron.</i>	
Grass, mixed ¹	Grass, mixed ¹	<i>Phleum pratense</i> (timothy)	Grass, mixed ¹	<i>Phleum pratense</i> (timothy)	<i>Phleum pratense</i> (timothy)	<i>Phleum pratense</i> (timothy)	Grass, mixed ¹	Grass, mixed ¹	Grass, mixed ¹	Grass, mixed ¹	Grass, mixed ¹	Grass, mixed ¹	
Tree mix (hazel, birch, alder; ARTU)	Birch	Birch	Tree mix (hazel, birch, alder; ALK)	Tree mix (hazel, birch, alder; ALK)	Birch	Birch	Tree mix (hazel, birch, alder; ALK)	Birch	Tree mix (hazel, birch, alder; ALK)	Tree mix (hazel, birch, alder; ALK)	<i>Betula alba</i> (birch)	Birch	
	<i>Alternaria</i>	<i>Alternaria</i>		<i>Alternaria tenuis</i>	<i>Alternaria tenuis</i>	<i>Alternaria alternata</i>	<i>Alternaria alternata</i>	<i>Alternaria alternata</i>	<i>Alternaria tenuis</i>	<i>Alternaria tenuis</i>	<i>Alternaria alternata</i>	<i>Alternaria</i>	
Mould mix (ARTU)	<i>Artemisia</i>	<i>Artemisia</i>		<i>Artemisia</i>	<i>Artemisia</i>	<i>Artemisia</i>					<i>Artemisia vulgaris</i> (mugwort)	<i>Artemisia</i>	
	<i>Cladosporium herbarum</i>	<i>Cladosporium herbarum</i>		<i>Cladosporium herbarum</i>	<i>Cladosporium herbarum</i>	<i>Cladosporium herbarum</i>			<i>Cladosporium herbarum</i>		<i>Cladosporium</i>	<i>Cladosporium</i>	
	<i>Aspergillus fumigatus</i>		Mould mixture ³	<i>Aspergillus fumigatus</i>	<i>Aspergillus fumigatus</i>			<i>Aspergillus niger</i>				<i>Aspergillus</i>	
Weed mix (ARTU)	Latex		<i>Acerus siro</i>	Hazelnut	June grass		Feathers	Horse	Horse	Horse	Horse	Horse	
	Alder				Guinea pig		Golden hamster epithelia	Secale	Guinea pig	Guinea pig	Guinea pig	Latex	
	Beech		<i>Lepidoglyphus destructor</i>	<i>Penicillium notatum</i>			<i>Acerus siro</i>	Wheat, cultivated	Guinea pig	Wheat, cultivated	<i>Secale cereale</i> (rye)	<i>Secale cereale</i> (rye)	
	<i>Corylus avellana</i>		<i>Tyrophagus putrescentiae</i>	Alder	Barley, cultivated		<i>Lepidoglyphus destructor</i>	Alder	Rabbit	Rabbit	<i>Candida albicans</i>	<i>Candida albicans</i>	
	Oak		Tree mix (ash, willow, poplar; HAL)	Waybread or plantain	Oats, cultivated		<i>Tyrophagus putrescentiae</i>	<i>Corylus avellana</i>	Sheep wool	Sheep wool	<i>Fraxinus excelsior</i> (ash)	<i>Penicillium</i>	
	Ambrosia (ragweed)		Weed mix ²		Perennial ryegrass		Tree mix ⁴	<i>Salix</i>	Feathers, mixed	Feathers, mixed	<i>Sambucus nigra</i> (elder)	Silk	
	Ribwort				Rye, cultivated		Weed mix ⁵	Goat's feathers	Goat hair	Goat hair	Ambrosia (ragweed)	<i>Alnus glutinosa</i> (alder)	
	<i>Urtica urens</i>				Velvet grass		Flowers ⁶	Budgerigar feathers	Budgerigar feathers	Budgerigar feathers	<i>Plantago lanceolata</i> (ribwort)	<i>Fraxinus excelsior</i> (ash)	
					Wheat, cultivated			Tree mix ¹⁴	Tree mix ¹⁸	Tree mix (hazel, birch, alder; ALK)	<i>Corylus avellana</i> (hazel)	<i>Corylus avellana</i> (hazel)	
					<i>Barylis cinerea</i>			Weed mix ⁵	Weed mix ⁵	Weed mix ⁵	Ambrosia (ragweed)	Ambrosia (ragweed)	
					<i>Curcularia lunata</i>								
					Alder								
					Beech								
					<i>Corylus avellana</i>								
					Elm								
					Oak								
					<i>Plantago</i> (plane)								
					Poplar								
					Orchard								
Number of allergens tested	7	18	6	12	6	6	13	14	15	18	18	21	
Manufacturer	ARTU	ALK, Alkystal (latex), Allergopharma (Cladosporium)	ALK	HAL	HAL	HAL	Stallergene, ALK (Aspergillus)	Allergopharma	Allergopharma	ALK	HAL, ALK/Alkystal (Latex)	ALK, Stallergene (grass, birch, artemisia, alder, hazel, ambrosia, scale, ash)	

¹Different grass mixes containing *Dactylis glomerata*, *Lolium perenne*, *Festuca rubra*, *Poa pratensis*, *Phleum pratense*, *Secale cereale*, *Holcus lanatus*, *Anthoxanthum odoratum*, *Arrhenatherum elatius*, *Agrostis stolonifera*, *Alopecurus pratensis*, *Festuca pratensis*.²Tree mix II: *Betula verrucosa*, *Quercus robur*, *Platanus acerifolia*, *Fagus sylvatica*, ALLERGOPHARMA.³Mould mix: *Aspergillus fumigatus*, *Penicillium notatum*, *Alternaria alternata*, *Mucor mucedo*, *Cladosporium cladosporioides*; HAL.⁴Tree mix I: *Alnus glutinosa*, *Corylus avellana*, *Populus deltoides*, *Ulmus campestris*, *Salix caprea*; ALLERGOPHARMA.⁵Weed mix: *Urtica dioica*, *Plantago lanceolata*, *Artemisia vulgaris*, *Taraxacum officinale*, ALLERGOPHARMA.⁶Flower mix: *Aster maritimus*, *Delphinium consolida*, *Chrysanthemum*, golden rod; ALLERGOPHARMA.⁷Weed mix: Mugwort, plantain, rumex, nettle; HAL.

Table 3. Standard skin prick test allergens used at the Global Allergy and Asthma European Network (GA²LEN) centres working in clinical care (additional allergens are added according to patient history). Southern Europe

	Southern Europe						
	Athens	Coimbra	Genua	Madrid	Montpellier	Palermo	Rome
	Cat	Cat	Cat	Cat	Cat	Cat	Cat
	Dog	Dog	Dog	Dog	Dog	Dog	
	<i>Dermatophagoides pteron.</i>	<i>Dermatophagoides pteron.</i>	<i>Dermatophagoides pteron.</i>	<i>Dermatophagoides pteron.</i>	<i>Dermatophagoides pteron.</i>	<i>Dermatophagoides pteron.</i>	<i>Dermatophagoides pteron.</i>
	<i>Dermatophagoides farinae</i>	<i>Dermatophagoides farinae</i>	<i>Dermatophagoides farinae</i>	<i>Dermatophagoides farinae</i>	<i>Dermatophagoides farinae</i>	<i>Dermatophagoides farinae</i>	
	Grass, mixed ¹	Grass, mixed ¹ Tree mix ⁵	Grass, mixed ¹ <i>Betula verrucosa</i> (birch)	<i>Cynodon dactylon</i>	Grass, mixed ¹ Birch	Grass, mixed ¹ <i>Betula alba</i> (birch)	Grass, mixed ¹
	<i>Alternaria</i>	<i>Alternaria tenuis</i>	<i>Alternaria alternata</i>	<i>Alternaria</i>	<i>Alternaria</i>	<i>Alternaria tenuis</i>	<i>Alternaria</i>
	<i>Artemisia</i>	Weed mix ³		<i>Artemisia</i>	<i>Artemisia</i>	<i>Artemisia vulgaris</i> (mugwort)	Weed mix ²
	<i>Cladosporium</i>	<i>Cladosporium herbarum</i>		<i>Cladosporium</i>	<i>Cladosporium</i>	<i>Cladosporium</i>	
	<i>Aspergillus</i>	<i>Aspergillus fumigatus</i>	<i>Aspergillus fumigatus</i>	<i>Aspergillus</i>	<i>Aspergillus</i>		
	<i>Olea europea</i>	<i>Olea europea</i>	Latex <i>Olea europea</i>	<i>Olea europea</i>	Latex <i>Olea europea</i>	Latex <i>Olea europea</i>	
	<i>Parietaria</i>	<i>Parietaria judaica</i>	<i>Parietaria judaica</i>	<i>Lolium</i>	<i>Parietaria</i>	<i>Parietaria judaica</i>	<i>Parietaria officinalis</i>
	Feathers	<i>Candida albicans</i>	<i>Parietaria officinalis</i>	Phragmites c (red grass)	Cockroach	<i>Candida albicans</i>	Ambrosia (ragweed)
	Cockroach	<i>Dermatophagoides microceras</i>	<i>Corylus avellana</i>	<i>Secale</i>	<i>Botrytis</i>	<i>Penicillium</i> mix (<i>Digitatum</i> , <i>Expansum</i> , <i>Notatum</i>)	
	<i>Cynodon dactylon</i>	<i>Blatella germanica</i> (cockroach)	<i>Cupressus sempervirens</i>	<i>Blatella germanica</i> (cockroach)	<i>Penicillium</i>	<i>Cupressus sempervirens</i>	
	<i>Fusarium</i>	<i>Acarus siro</i>	White carpinus (hornbeam)	<i>Blatella orientalis</i> (cockroach)	Cypress	Weed mix	
	<i>Penicillium</i>	<i>Tilia cordata</i>		<i>Lepidoglyphus destructor</i>	<i>Plantago</i> (plane)	<i>Parietaria officinalis</i>	
	Cypress	<i>Pinus radiata</i>		<i>Fusarium</i>	Ambrosia (ragweed)	<i>Salsola kali</i>	
	<i>Fraxinus</i>	Tree mix ⁴		<i>Penicillium</i>			
	<i>Plantago</i> (plane)			<i>Cupressus arizonina</i>			
	Poplar			<i>Platanus hybrida</i>			
	<i>Chenopodium</i>			<i>Parietaria judaica</i>			
				<i>Plantago lanceolata</i>			
				<i>Salsola kali</i>			
Number of allergens tested	21	19	15	23	19	18	7
Manufacturer	Allergopharma/ Stallergene	ALK	Stallergene		Stallergene		Lofarma

¹Different grass mixes containing *Dactylis glomerata*, *Lolium perenne*, *Festuca rubra*, *Poa pratensis*, *Phleum pratense*, *Secale cereale*, *Holcus lanatus*, *Anthoxanthum odoratum*, *Arrhenatherum elatius*, *Agrostis stolonifera*, *Alopecurus pratensis*, *Festuca pratensis*.²*Artemisia vulgaris*, *Helianthus annuus*, *Iva axillaris*, *Solidago virgaurea*, *Xanthem strumarium*; LOFARMA.³Weed mix: *Artemisia*, *Chenopodium*, *Parietaria*, *Plantago*; ALK.⁴Tree mix: *Platanus*, *Populus*, *Salix*, *Ulmus*; ALK.⁵Tree mix: *Betula*, *Fraxinus*, *Olea*, *Quercus*, *Robinia*; ALK.

Table 4. Standard skin prick test allergens used at the Global Allergy and Asthma European Network (GA²LEN) centres working in clinical care (additional allergens are added according to patient history). UK

	UK		
	London	Southampton	Southampton/Pediatrics
	Cat	Cat	Cat
	Dog	Dog	Dog
	<i>Dermatophagoides pteron.</i>	<i>Dermatophagoides pteron.</i>	<i>Dermatophagoides pteron.</i>
	<i>Phleum pratense</i> (timothy)	<i>Dermatophagoides farinae</i>	<i>Phleum pratense</i> (timothy)
	3-trees silver birch (hazel, birch, alder)	Grass, mixed ¹	Birch
	<i>Alternaria</i>	Birch	
	<i>Artemisia</i>		
	<i>Cladosporium</i>		
	<i>Aspergillus</i>	<i>Aspergillus fumigatus</i>	
	Horse	Horse	
		Rabbit	
		Feathers, mixed	
		<i>Candida albicans</i>	
		Tree mix I (early blossoming) ³	
		Tree mix II (mid blossoming) ²	
		Rape	
Number of allergens tested	10	14	5
Manufacturer	ALK		

¹Different grass mixes containing *Dactylis glomerata*, *Lolium perenne*, *Festuca rubra*, *Poa pratensis*, *Phleum pratense*, *Secale cereale*, *Holcus lanatus*, *Anthoxanthum odoratum*, *Arrhenatherum elatius*, *Agrostis stolonifera*, *Alopecurus pratensis*, *Festuca pratensis*.

²Tree mix II: *Betula verrucosa*, *Quercus robur*, *Platanus acerifolia*, *Fagus sylvatica*; ALLERGOPHARMA.

³Tree mix I: *Alnus glutinosa*, *Corylus avellana*, *Populus deltoides*, *Ulmus campestris*, *Salix caprea*; ALLERGOPHARMA.

Methods

All GA²LEN centres that work in clinical allergology submitted their standard prick test procedures. Additionally, sensitization rates were assessed by 14 centres based on the results of their patient collective. Population-based sensitization data was collected in 11 studies conducted by eight centres.

Results

Current practice of skin prick testing

All centres use a number of common standards including the use of positive and negative controls, asking the patient about medication that could interfere with the skin test and taking a 3 mm diameter cut off as the definition as a positive test. Most centres evaluate skin tests after 15–20 min. These procedures are in line with published practice guidelines (8–10), the EAACI Position Paper (11), the Nordic standards (12) and the ISAAC phase II protocol (13). Published data indicate the importance of using standardized techniques, including not re-using SPT lancets which can lead to false-positive results (14). All centres reported the use of a standard panel of allergens for the most frequent inhalant allergens (Tables 1–4; most frequently tested allergens, see Table 5) supplemented with additional suspected candidate allergens depending on the patient's history. In some centres a different standard panel is used for children.

Table 5. Inhalant allergens most frequently included in skin prick testing (SPT) screening panel across all centres

	Frequency tested across all centres	
	Number of centres testing allergen in panel/overall number of centres	Percentage centres testing allergen in panel (%)
Cat	29/29	100
Dog	26/29	90
<i>Dermatophagoides pteroyssinus</i>	28/29	97
<i>Dermatophagoides farinae</i>	20/29	69
<i>Phleum pratense</i> (timothy)	29/29	100
Birch	26/29	90
<i>Alternaria</i>	20/29	69
<i>Artemisia</i>	19/29	66
<i>Cladosporium</i>	18/29	62
<i>Aspergillus</i>	13/29	45
Horse	10/29	34
Latex	9/29	31

Standardization of extracts

Ideally, allergen extracts should be standardized so that a given size of response should have a similar clinical relevance regardless of the specific allergen or extract used. In practice this has been extremely difficult to achieve because allergen extracts are biological mixtures containing a variety of different proteins, glycoproteins and polysaccharides. Manufacturers use in-house methods to standardize their products. This achieves a

Table 6. Sensitization rates to inhalant allergens (percentage of positive skin prick test results) in patients tested at Global Allergy and Asthma European Network (GA²LEN) centres working in clinical care. Northern Europe

Patient selection	Type of allergen	Northern Europe		
		Helsinki	Odense	Oslo overall
		Patients tested at centre	Patients tested at centre	Families with asthmatic children
<i>n</i>		54052	565	424
Cat (%)	Animal	25.4	23.0	30.0
Dog (%)	Animal	28.6	26.0	25.5
Cow (%)	Animal	3.9		
Feathers	Animal			
Guinea pig (%)	Animal			
Horse (%)	Animal	9.6	10.0	
<i>Cynodon dactylon</i>	Grass pollen			
<i>Festuca pratensis</i> (meadow, %)	Grass pollen	24.7		
Grass mix ¹	Grass pollen		36.0	
<i>Phleum Pratense</i> (timothy, %)	Grass pollen	24.2		
<i>Acarus siro</i> (%)	Insect			
Cockroach (%)	Insect			7.3
<i>Dermatophagoides</i> (%)	Insect			
<i>Dermatophagoides farinae</i> (%)	Insect		21.0	9.7
<i>Dermatophagoides pteronyssinus</i> (%)	Insect	6.9	25.0	12.5
<i>Lepidoglyphus destructor</i> (%)	Insect			
<i>Tyrophagus putrescentiae</i> (%)	Insect			
Latex (%)	Latex	1.0	10.0	
<i>Alternaria alternata</i> (%)	Mould		4.0	2.6
<i>Aspergillus</i> (%)	Mould			
<i>Aspergillus fumigatus</i> (%)	Mould			
<i>Botrytis</i>	Mould			
<i>Candida albicans</i> (%)	Mould			
<i>Cladosporium</i> (%)	Mould		4.0	5.4
<i>Cladosporium cladosporioides</i> (%)	Mould			
<i>Cladosporium herbarum</i> (%)	Mould	3.3		
<i>Fusarium</i> (%)	Mould			
Mould mix (%)	Mould			
<i>Penicillium</i> (%)	Mould			
3-trees (Alder, silver birch, hazel, %)	Tree pollen			
Alder (%)	Tree pollen			
<i>Betulla verrucosa</i> (%)	Tree pollen	30.0		
Birch Pollen (%)	Tree pollen		31.0	
<i>Corylus avellana</i> (%)	Tree pollen			
<i>Cupressus sempervirens</i>	Tree pollen			
Cypress pollen	Tree pollen			
<i>Fraxinus</i> (%)	Tree pollen			
<i>Olea europea</i> (%)	Tree pollen			
Plane tree	Tree pollen			
Poplar (%)	Tree pollen			
Tree mix ² (%)	Tree pollen			
Tree mix (willow, poplar, %)	Tree pollen			
Trees I ³ (%)	Tree pollen			
Trees II ⁴ (%)	Tree pollen			
Waybread (%)	Tree pollen			
White carpinus (%)	Tree pollen			
Ambrosia (ragweed, %)	Weed pollen			
<i>Artemisia vulgaris</i> (mugwort, %)	Weed pollen	15.8	15.0	8.7
<i>Chenopodium</i> (%)	Weed pollen			
Weed mix (%)	Weed pollen			
Flowers (%)	Weed pollen			
Parietaria (%)	Weed pollen			
<i>Plantago</i> (%)	Weed pollen			
Pollen mix ⁵	Pollen			
<i>Secale cereale</i> (%)				
Title of study				GAIN
Year tested		1995–2003	2003	2002
Reference				(32)

¹Grass mix – *Phleum pratense*, *Lolium perenne*, *Dactylis glomerata*.²Tree mix – *Betula pendula*, *Alnus glutinosa*, *Corylus avellana*.³Tree mix I – *Alnus glutinosa*, *Corylus avellana*, *Populus deltoides*, *Ulmus campestris*, *Salix caprea*; ALLERGOPHARMA.⁴Tree mix II – *Betula verrucosa*, *Quercus robur*, *Platanus acerifolia*, *Fagus sylvatica*; ALLERGOPHARMA.⁵Pollen mix – *Cupressus arizonina*, *Platanus hybrida*, *Olea europea*, *Secale*, *Lolium*, *Cynodon dactylon*, *Phragmites*, *Plantago lanceolata*, *Salsola kali*, mugwort, *Parietaria judaica*.

Skin testing for inhalant allergens across Europe

Table 7. Sensitization rates to inhalant allergens (percentage of positive skin prick test results) in patients tested at Global Allergy and Asthma European Network (GA²LEN) centres working in clinical care. Central Europe

Patient selection	Type of allergen	Central Europe					
		Amsterdam	Berlin	Ghent	Lodz	Munich, TU	Vienna
		Patients tested at centre	People with suspected allergy from population sample	Rhinitis patients at ORL department	Patients tested at centre	Patients tested at centre	Patients tested at centre
<i>n</i>		786	765	162	2325	665	126 (for 5 allergens); 62 (for other allergens)
Cat (%)	Animal	10.0	19.4	16.0	12.5	25.4	28.0
Dog (%)	Animal	17.0	12.8	9.9	8.6	9.2	3.0
Cow (%)	Animal						
Feathers	Animal				5.1		
Guinea pig (%)	Animal			3.1			3.0
Horse (%)	Animal						3.0
<i>Cynodon dactylon</i>	Grass pollen						
<i>Festuca pratensis</i> (meadow, %)	Grass pollen						
Grass mix ¹	Grass pollen	26.0	33.8	22.8	22.8	32.5	46.0
<i>Phleum Pratense</i> (timothy, %)	Grass pollen						
<i>Acarus siro</i> (%)	Insect			8.0	11.5		29.0
Cockroach (%)	Insect						
<i>Dermatophagoides</i> (%)	Insect						29.0
<i>Dermatophagoides farinae</i> (%)	Insect			26.5	20.5		
<i>Dermatophagoides pteronyssinus</i> (%)	Insect	37.0	10.1	35.2	19.9	15.7	
<i>Lepidoglyphus destructor</i> (%)	Insect			10.5	10.5		
<i>Tyrophagus putrescentiae</i> (%)	Insect			10.5	12.9		
Latex (%)	Latex		0.9				0.0
<i>Alternaria alternata</i> (%)	Mould		1.7	2.5	7.3	16.4	11.0
<i>Aspergillus</i> (%)	Mould						
<i>Aspergillus fumigatus</i> (%)	Mould			1.8			
<i>Botrytis</i>	Mould						
<i>Candida albicans</i> (%)	Mould						3.0
<i>Cladosporium</i> (%)	Mould		1.1				2.0
<i>Cladosporium cladosporioides</i> (%)	Mould			1.2			
<i>Cladosporium herbarum</i> (%)	Mould						
<i>Fusarium</i> (%)	Mould						
Mould mix (%)	Mould	6.3		4.3			
<i>Penicillium</i> (%)	Mould			1.2			
3-trees (Alder, silver birch, hazel, %)	Tree pollen			8.6			
Alder (%)	Tree pollen			8.6			
<i>Betulla verucosa</i> (%)	Tree pollen						
Birch Pollen (%)	Tree pollen		31.5	7.4		29.1	32.0
<i>Corylus avellana</i> (%)	Tree pollen			6.8			
<i>Cupressus semperverdis</i>	Tree pollen						
<i>Cypress pollen</i>	Tree pollen						
<i>Fraxinus</i> (%)	Tree pollen						11.0
<i>Olea europea</i> (%)	Tree pollen						
Plane tree	Tree pollen						
Poplar (%)	Tree pollen						
Tree mix ² (%)	Tree pollen	13.0					
Tree mix (willow, poplar, %)	Tree pollen			4.9			
Trees I ³ (%)	Tree pollen				13.5		
Trees II ⁴ (%)	Tree pollen				17.2		
Waybread (%)	Tree pollen			5.6			
White carpinus (%)	Tree pollen						
Ambrosia (ragweed, %)	Weed pollen						11.0
<i>Artemisia vulgaris</i> (mugwort, %)	Weed pollen		15.2	4.3		12.8	18.0
<i>Chenopodium</i> (%)	Weed pollen						
Weed mix (%)	Weed pollen	1.3		8.6	20.1		
Flowers (%)	Weed pollen				17.9		
<i>Parietaria</i> (%)	Weed pollen					0.7	
<i>Plantago</i> (%)	Weed pollen						6.0
Pollen mix ⁵	Pollen						
<i>Secale cereale</i> (%)							29.0
Title of study			PANE				
Year tested		4 years	1999–2000	1999–2000	2003	2003	2004
Reference			(35)				

¹Grass mix – *Phleum pratense*, *Lolium perenne*, *Dactylis glomerata*.

²Tree mix – *Betula pendula*, *Alnus glutinosa*, *Corylus avellana*.

³Tree mix I – *Alnus glutinosa*, *Corylus avellana*, *Populus deltoides*, *Ulmus campestris*, *Salix caprea*; ALLERGOPHARMA.

⁴Tree mix II – *Betula verrucosa*, *Quercus robur*, *Platanus acerifolia*, *Fagus sylvatica*; ALLERGOPHARMA.

⁵Pollen mix – *Cupressus arizonina*, *Platanus hybrida*, *Olea europea*, *Secale*, *Lolium*, *Cynodon dactylon*, *Phragmites*, *Plantago lanceolata*, *Salsola kali*, mugwort, *Parietaria judaica*.

Table 8. Sensitization rates to inhalant allergens (percentage of positive skin prick test results) in patients tested at Global Allergy and Asthma European Network (GA²LEN) centres working in clinical care. Southern Europe

Patient selection	Type of allergen	Southern Europe				
		Athens	Genua	Madrid	Montpellier	Palermo
		Asthmatic children 7–9 yrs.; Children tested at centre 6–15 yrs.	Children tested at centre	Rhinitis or asthma patients	Patients tested at centre	Patients tested at centre
<i>n</i>		130; 827			404	2000
Cat (%)	Animal	30–43	30.0	15.0	25.0	13.0
Dog (%)	Animal	9–19.7		14.0	13.0	11.0
Cow (%)	Animal					
Feathers	Animal	14–16.5				
Guinea pig (%)	Animal					
Horse (%)	Animal					
<i>Cynodon dactylon</i>	Grass pollen	23–27				
<i>Festuca pratensis</i> (meadow, %)	Grass pollen					
Grass mix ¹	Grass pollen	43–44	50.0			12.0
<i>Phleum Pratense</i> (timothy, %)	Grass pollen					
<i>Acarus siro</i> (%)	Insect					
Cockroach (%)	Insect	5.5		25.0	13.0	
<i>Dermatophagoides</i> (%)	Insect		80.0	20.0		
<i>Dermatophagoides farinae</i> (%)	Insect	19–23			38.0	15.0
<i>Dermatophagoides pteronyssinus</i> (%)	Insect	35.8–37			43.0	16.0
<i>Lepidoglyphus destructor</i> (%)	Insect					
<i>Tyrophagus putrescentiae</i> (%)	Insect					
Latex (%)	Latex		15–20		2.5	
<i>Alternaria alternata</i> (%)	Mould	19.5–20.5	10.0	14.0	10.7	
<i>Aspergillus</i> (%)	Mould	5.5			3.2	
<i>Aspergillus fumigatus</i> (%)	Mould		10.0			
<i>Botrytis</i>	Mould				2.7	
<i>Candida albicans</i> (%)	Mould					
<i>Cladosporium</i> (%)	Mould	2.5			2.7	
<i>Cladosporium cladosporioides</i> (%)	Mould					
<i>Cladosporium herbarum</i> (%)	Mould					
<i>Fusarium</i> (%)	Mould	6.0				
Mould mix (%)	Mould					
<i>Penicillium</i> (%)	Mould	3.0			2.9	
3-trees (Alder, silver birch, hazel, %)	Tree pollen					
Alder (%)	Tree pollen					
<i>Betulla verucosa</i> (%)	Tree pollen		40.0			
Birch Pollen (%)	Tree pollen				8.2	
<i>Corylus avellana</i> (%)	Tree pollen		40.0			
<i>Cupressus semperverdis</i>	Tree pollen		30.0			
Cypress pollen	Tree pollen				34.8	
<i>Fraxinus</i> (%)	Tree pollen	29.0				
<i>Olea europea</i> (%)	Tree pollen	33–38	40.0		25.0	10.0
Plane tree	Tree pollen				15.0	
Poplar (%)	Tree pollen	6.0				
Tree mix ² (%)	Tree pollen					
Tree mix (willow, poplar, %)	Tree pollen					
Trees I ³ (%)	Tree pollen					
Trees II ⁴ (%)	Tree pollen					
Waybread (%)	Tree pollen					
White carpinus (%)	Tree pollen		30.0			
Ambrosia (ragweed, %)	Weed pollen				6.7	
<i>Artemisia vulgaris</i> (mugwort, %)	Weed pollen	25.0			10.4	
<i>Chenopodium</i> (%)	Weed pollen	18.0				
Weed mix (%)	Weed pollen				33.0	
Flowers (%)	Weed pollen					
<i>Parietaria</i> (%)	Weed pollen	25–27.5	80.0		9.8	20.0
<i>Plantago</i> (%)	Weed pollen	10.0				
Pollen mix ⁵	Pollen			66.0		
<i>Secale cereale</i> (%)						
Title of study			ECRHS			
Year tested		1998; 1996			2003	2003
Reference				(34)	(48)	

¹Grass mix – *Phleum pratense*, *Lolium perenne*, *Dactylis glomerata*.²Tree mix – *Betula pendula*, *Alnus glutinosa*, *Corylus avellana*.³Tree mix I – *Alnus glutinosa*, *Corylus avellana*, *Populus deltoides*, *Ulmus campestris*, *Salix caprea*; ALLERGOPHARMA.⁴Tree mix II – *Betula verrucosa*, *Quercus robur*, *Platanus acerifolia*, *Fagus silvatica*; ALLERGOPHARMA.⁵Pollen mix – *Cupressus arizonina*, *Platanus hybrida*, *Olea europea*, *Secale*, *Lolium*, *Cynodon dactylon*, Phragmites, *Plantago lanceolata*, *Salsola kali*, mugwort, *Parietaria judaica*.

Skin testing for inhalant allergens across Europe

Table 9. Sensitization rates to inhalant allergens (percentage of positive skin prick test results) in patients tested at Global Allergy and Asthma European Network (GA²LEN) centres working in clinical care. ECHRS

Patient selection	Type of allergen	ECHRS						
		Only asthmatics						
		ECRHS Overall	ECHRS Northern	ECRHS Central	ECHRS Southern	ECHRS UK/Ireland	ECHRS Australia/NZ	ECRHS Portland
<i>n</i>								
Cat (%)	Animal	31.4	52.7	31.6	18.7	27.8	22.7	28.1
Dog (%)	Animal							
Cow (%)	Animal							
Feathers	Animal							
Guinea pig (%)	Animal							
Horse (%)	Animal							
<i>Cynodon dactylon</i>	Grass pollen							
<i>Festuca pratensis</i> (meadow, %)	Grass pollen							
Grass mix ¹	Grass pollen							
<i>Phleum Pratense</i> (timothy, %)	Grass pollen	41.3	39.4	38.1	34.0	44.4	44.8	48.7
<i>Acarus siro</i> (%)	Insect							
Cockroach (%)	Insect							
<i>Dermatophagoides</i> (%)	Insect							
<i>Dermatophagoides farinae</i> (%)	Insect							
<i>Dermatophagoides pteronyssinus</i> (%)	Insect	47.7	23.5	48.2	34.0	58.1	67.2	41.0
<i>Lepidoglyphus destructor</i> (%)	Insect							
<i>Tyrophagus putrescentiae</i> (%)	Insect							
Latex (%)	Latex							
<i>Alternaria alternata</i> (%)	Mould	11.9	10.2	13.7	4.7	17.6	10.5	28.2
<i>Aspergillus</i> (%)	Mould							
<i>Aspergillus fumigatus</i>	Mould							
<i>Botrytis</i>	Mould							
<i>Candida albicans</i> (%)	Mould							
<i>Cladosporium</i> (%)	Mould							
<i>Cladosporium cladosporioides</i> (%)	Mould							
<i>Cladosporium herbarum</i> (%)	Mould	5.8	9.9	4.3	0.7	6.8	4.5	10.3
<i>Fusarium</i> (%)	Mould							
Mould mix (%)	Mould							
<i>Penicillium</i> (%)	Mould							
3-trees (Alder, silver birch, hazel, %)	Tree pollen							
Alder (%)	Tree pollen							
<i>Betulla verucosa</i> (%)	Tree pollen							
Birch Pollen (%)	Tree pollen	19.4	39.8	18.0	10.0	8.8	13.1	33.3
<i>Corylus avellana</i> (%)	Tree pollen							
<i>Cupressus semperverdis</i>	Tree pollen							
<i>Cypress pollen</i>	Tree pollen							
<i>Fraxinus</i> (%)	Tree pollen							
<i>Olea europea</i> (%)	Tree pollen							
Plane tree	Tree pollen							
Poplar (%)	Tree pollen							
Tree mix ² (%)	Tree pollen							
Tree mix (willow, poplar, %)	Tree pollen							
Trees I ³ (%)	Tree pollen							
Trees II ⁴ (%)	Tree pollen							
Waybread (%)	Tree pollen							
White carpinus (%)	Tree pollen							
Ambrosia (ragweed, %)	Weed pollen	2.6	3.8	3.6	2.7	2.9	0.3	7.7
<i>Artemisia vulgaris</i> (mugwort, %)	Weed pollen							
<i>Chenopodium</i> (%)	Weed pollen							
Weed mix (%)	Weed pollen							
Flowers (%)	Weed pollen							
<i>Parietaria</i> (%)	Weed pollen							
<i>Plantago</i> (%)	Weed pollen							
Pollen mix ⁵	Pollen							
<i>Secale cereale</i> (%)								
Title of study								
Year tested								
Reference		(1)						

¹Grass mix – *Phleum pratense*, *Lolium perenne*, *Dactylis glomerata*.

²Tree mix – *Betula pendula*, *Alnus glutinosa*, *Corylus avellana*.

³Tree mix I – *Alnus glutinosa*, *Corylus avellana*, *Populus deltoides*, *Ulmus campestris*, *Salix caprea*; ALLERGOPHARMA.

⁴Tree mix II – *Betula verrucosa*, *Quercus robur*, *Platanus acerifolia*, *Fagus silvatica*; ALLERGOPHARMA.

⁵Pollen mix – *Cupressus arizonina*, *Platanus hybrida*, *Olea europea*, *Secale*, *Lolium*, *Cynodon dactylon*, *Phragmites*, *Plantago lanceolata*, *Salsola kali*, mugwort, *Parietaria judaica*.

measure of consistency batch-to-batch but cannot ensure standardization between manufacturers. Clinical data from the Netherlands indicates that results obtained with different extracts do not provide comparable results (15). The importance of standardization beyond manufacturer's units lead to the development of five certified World Health Organization (WHO)-reference materials. This aspect was also emphasized in the position paper of the EAACI from 1993 (16).

In Tables 1–4 the allergen extracts used for standard SPT at the different centres are listed. An initiative to develop candidate certified reference materials consisting of purified natural or recombinant major allergens and validate existing sandwich enzyme-linked immunosorbent assay (ELISA) for the measurement of major allergens has been funded by the EU under the Fifth Framework Program. This project 'Development of Certified Reference Materials for Allergenic Products and Validation of Methods for their Quantification

CREATE (17) brings together allergen manufacturers, biotech companies, regulatory bodies, clinicians and research laboratories in order to pave the way for a successful implementation of allergen standardization based on mass units. CREATE focuses on the four main allergens birch (Bet v1), grass (Phl p1, Phl p5), olive (Ole e1) and house dust mite (Der p1, Der p2 and Der f1, Der f2) (18).

Sensitization rates – regional differences

Variation in the rates of sensitization (total rates and specific rates) in different European countries is probably an important factor for differential rates of allergic disease in various European countries. These relationships have been investigated in several multinational studies. The ECHRS (19) was a landmark study of allergic disease and asthma (20, 21). It was the first study to make broad comparisons across Europe,

Table 10. Overview of the studies published with results on standard skin prick testing

Country	Study population	Subgroup	Age group (years old)	Number of subjects	Year of study	SPT results stated	Author	Year published
France	Children and adults	Asthmatic families	0 to >80	1847	Not stated	No specific SPT results stated	Kauffmann et al.	1999
Norway	Children and adults	100 Norwegian families of 7–35-year-old sibling pairs with asthma	>7 years	424	1998–99	x	Lodrup Carlsen et al.	2002
Spain	Adults	Patients with rhinitis and/or asthma	6–68	171	Not stated	x	Sastre et al.	1996
Sweden	Adults	Asthmatics sensitized to cat or dog	18–60	129	Not stated	x	Plaschke et al.	1999
Denmark	Adolescents and adults	General population	15–69	1112 (635 symptomatic; 477 control)	1990–91	No specific SPT results stated	Linneberg et al.	2001
Denmark	Adolescents and adults	General population	15–41	312; 482	1990; 1998	(x) summarized	Linneberg et al.	2000
Germany	Children and adults	General population	0 to >80	814	1999–2000	x	Zuberbier et al.	2004
Switzerland	Adults	General population	18–60	8537	1991–93	x	Wuthrich	2001
UK	Adults	General population	30–65	1359; 74	1974; 1988		Sibbald et al.	1990
Denmark	Adolescents	Unselected 8th grade school children	14–16	1501	1996–97	x	Mortz et al.	2003
Germany	Children	Unselected school children	9–11	1303; 1642	1991–92; 1995–96	x	von Mutius et al.	1998
The Netherlands	Children	Unselected school children	7–12	450	Not stated	x	van Amsterdam et al.	2003
The Netherlands	Children	Unselected school children	7–12	3000	Not stated	(x) summarized	Anyo et al.	2002
Poland, Italy	Children	Unselected school children	9 years	336	1998–99	x	Ronchetti et al.	2003
UK	Children	Birth cohort	4 years	981	1989–90	x	Arshad et al.	2001
Germany	Children	Unselected pre-school children	5–7	1273	1991	x	Schäfer et al.	1996

Table 11. Sensitization rates to inhalant allergens in population-based studies (percentage of positive skin prick test results assessed in different population samples)

Population sample	Type of allergen	North				Central				UK		Southern
		Finland	Finland	Oslo, Norway	The Netherlands	Poland	Munich, Germany (1991)	Munich, Germany (1991–1992)	Munich, Germany (1995–1996)	Zurich, Switzerland	Rome, Italy	
		General population (25–54 years)	Adolescents (15–17 years; M/F)	Control subjects with no rhinitis	School children (7–12 years)	School children (9 years)	Children (5–7 years)	Children (9–11 years)	Children (9–11 years)	General population (18–60 years)	Birth cohort (4 years)	
<i>n</i>		790	708	104	450	138	1095	1303	1642	8537	981	4936
Cat (%)	Animal	12.7	18–36/11–28	14.4	8.8	3.6	9.8	3.3	3.1	3.8	5.8	6.3
Dog (%)	Animal	12.9	7–19/3–10	11.5	4.1			2.8	2.6	2.8	2.7	
Horse (%)	Animal	2.9	23/18									
Cow (%)	Animal	2.6										
Grass mix ¹ (%)	Grass pollen		23/14	17.3	14.4	8.7	12.8	9.1	11.5	12.7	7.8	27.5
Timothy grass (%)	Grass pollen	10.3	23/13									
Cockroach (%)	Insect	7.2		7.7								
<i>Dermatophagoides</i> (%)	Insect						7.4	4.6	8.1	8.9	11.9	25.2
<i>Dermatophagoides farinae</i> (%)	Insect		15–21/13–18	7.7	14.1	3.6						
<i>Dermatophagoides pteronyssinus</i> (%)	Insect	7.0		4.8	17.2	9.4						
Latex												
<i>Alternaria alternata</i> (%)	Mould	2.2		1.9	1.9	0.7				1.1	5.1	3.40
<i>Alternaria tenuis</i> (%)	Mould											
<i>Cladosporium</i> (%)	Mould	3.3		1.9						<1	2.2	
Birch Pollen (%)	Tree pollen	12.3	15/11				5.9	8.4	14.2	7.9		
<i>Corylus avellana</i> (%)	Tree pollen							3.8	6.7			
<i>Alnus</i> sp. (<i>alder</i>) (%)	Tree pollen		14/9		3.8	2.2						
Tree mix ² (%)	Tree pollen										4.0	13.50
<i>Olea europaea</i> (%)	Tree pollen											2.80
Ambrosia (ragweed) (%)	Weed pollen											15.60
Parietaria (%)	Weed pollen											5.40
<i>Artemisia vulgaris</i> (mugwort) (%)	Weed pollen	7.8	19/11	12.5								
<i>Chrysanthemum leucanthemum</i> (%)	Weed pollen		12/7									
Title of study				GAIN						Sapaldia		
Year tested		1998	1978	2002	Not stated	1998–2000		1991–1992	1995–1996	1991–1993	1989–1990	1998–1999
Reference		(37)	(41)	(32)	(39)	(5)	(49)	(42)	(42)	(6)	(43)	(5)
												S. Bonini

¹Grass mix – *Phleum pratense*, *Lolium perenne*, *Dactylis glomerata*.²Tree mix – *Betula verrucosa*, *Alnus glutinosa*, *Corylus avellana*.

M, male; F, female.

Turkey (22) and Albania (23) with a standardized study protocol including data on more than 12 000 subjects aged 20–44 years. Large differences in the prevalence of allergic diseases were found with high rates in English-speaking countries and low prevalence rates in the Mediterranean region and eastern Europe. The ISAAC was a large global study in children using questionnaires on prevalence of asthma and rhinoconjunctivitis (2) that included the assessment of SPT and immunoglobulin E (IgE) in a population of 3000 primary school children (24).

Approximate rates of sensitization as assessed by SPT in patients tested at 14 allergy centres from the GA²LEN network are documented in Tables 6–8. We recognize that patient populations are not representative of the general population and reflect patterns of referral and differences in local health services. In the ECHRS (Table 9), rates of sensitization to *Alternaria alternata* and *Cladosporium herbarum* were highest in the UK/Ireland and northern Europe when compared with southern Europe. In contrast, much higher rates of sensitization to olive and *Parietaria judaica* were observed in southern Europe (Tables 6–9) (1). House dust mite was the most frequent allergen to show positive responses in 15 of 35 centres, cat in eight, cat and mite equally in one, timothy grass pollen in eight and *Cladosporium* in two (25). Specific results for the ECHRS have been reported in numerous publications (3, 26–34).

Population-based studies with assessment of type I sensitizations have been conducted in Germany (35), Denmark (7), with a follow-up study 8 years later (36), in Switzerland (6), Finland (37), Italy and in the UK (37). Limited to children or adolescents additional data exists for the Netherlands (23, 39), Denmark (40), Finland (41), Germany (42), UK (43) and Poland/Italy (5). An overview of selected studies including type I sensitization as assessed by SPT is given in Table 10, and the sensitization rates found in these studies with general populations are listed in Table 11.

Discussion

In recent years, mobility for work has increased dramatically within Europe. Moreover, leisure travel has become much more common. Climatic and agricultural changes are also influencing sensitization to inhalant allergens, for example, the botanical range of *Artemisia* and *Parietaria* have expanded in recent years and new crops, including olive trees, are now grown much more frequently in central Europe. These changes are superimposed on other trends in the prevalence of allergy and asthma (44, 45). A critical appraisal of studies investigating these trends with objective measurements has been undertaken in a review by Wieringa et al. (44, 45).

There is general agreement across the different centres participating in this study on the common ‘core’ panel of

airborne allergens that should be used for investigating patients with asthma and rhinitis. There would be clear advantages in further harmonizing this panel across different centres, both within each country and between countries. Both technical factors (skin prick technique, timing of assessment, etc.) and the source of the allergen extracts should ideally be harmonized to make results truly comparable. Further improvements could be achieved by moving to the use of recombinant allergens as opposed to the current biological preparations. There may be some advantage in increasing the scope of the core panel to cover allergens that are found commonly in other parts of Europe. This would help allergists to recognize sensitization to allergens from different regions that may be encountered by patients travelling elsewhere on holiday or business and would also allow us to recognize relevant sensitization in patients who have migrated.

Conclusion

Especially with increasing mobility across Europe it is important to keep in mind that sensitization to inhalant allergens differ regionally. The sensitization frequencies in the different countries that are compiled in this article may serve as a point of reference. Several EU initiatives (46) are now supporting the harmonization of allergen research, clinical practice and training across Europe (47). The development of a standardized Pan-European inhalant allergen panel is a desirable objective and would help to generate more relevant data for future clinical practice and clinical research. The use of a common core panel, does not preclude the use of extended, centre-specific, panels or specific allergens for special patients. A standard SPT panel for Europe is proposed by GA²LEN (see Table 12).

Table 12. Pan-European standard prick test panel**

Cat
Dog
<i>Dermatophagoides pteronyssinus</i>
<i>Dermatophagoides farinae</i>
Blatella
Tree mix Northern (Birch, hazel, alder)*
Olive
Cypress
Plane
Grass mix
<i>Artemisia</i>
Ambrosia
<i>Parietaria</i>
<i>Alternaria</i>
<i>Cladosporium</i>
<i>Aspergillus</i>

*may be tested as single allergens
**may be supplemented with other suspected candidate allergens

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