



HAL
open science

ARIA-EAACI care pathways for allergen immunotherapy in respiratory allergy

Jean Bousquet, Oliver Pfaar, Ioana Agache, Anna Bedbrook, Cezmi Akdis, G Walter Canonica, Tomas Chivato, Mona Al-ahmad, Amir Abdul Latiff, Ignacio Ansotegui, et al.

► **To cite this version:**

Jean Bousquet, Oliver Pfaar, Ioana Agache, Anna Bedbrook, Cezmi Akdis, et al.. ARIA-EAACI care pathways for allergen immunotherapy in respiratory allergy. *Clinical and Translational Allergy*, 2021, 11 (4), pp.e12014. 10.1002/ctt2.12014 . hal-03642028

HAL Id: hal-03642028

<https://hal.umontpellier.fr/hal-03642028>

Submitted on 14 Apr 2022

HAL is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.



Distributed under a Creative Commons Attribution 4.0 International License

REVIEW

ARIA-EAACI care pathways for allergen immunotherapy in respiratory allergy

Jean Bousquet^{1,2,3}  | Oliver Pfaar⁴ | Ioana Agache⁵ | Anna Bedbrook³ | Cezmi A Akdis⁶ | G. Walter Canonica^{7,174} | Tomas Chivato⁸ | Mona Al-Ahmad^{9,175} | Amir H Abdul Latiff¹⁰ | Ignacio J Ansotegui¹¹ | Claus Bachert^{12,176,177} | Abdullah Baharuddin¹³ | Karl-Christian Bergmann¹ | Carsten Bindslev-Jensen^{14,177,178} | Leif Bjermer¹⁵ | Matteo Bonini^{16,179} | Sinthia Bosnic-Anticevich^{17,180} | Isabelle Bosse¹⁸ | Helen A. Brough¹⁹ | Luisa Brussino²⁰ | Moises A Calderon²¹ | Luis Caraballo^{22,181} | Victoria Cardona²³  | Pedro Carreiro-Martins^{24,182} | Tomas Casale²⁵ | Lorenzo Cecchi²⁶ | Alfonso M Cepeda Sarabia^{27,183} | Ekaterine Chkhartishvili²⁸ | Derek K Chu²⁹ | Ieva Cirule³⁰ | Alvaro A Cruz³¹ | Wienczyslawa Czarlewski³² | Stefano del Giacco³³ | Pascal Demoly^{34,184} | Philippe Devillier³⁵ | Dejan Dokic³⁶ | Stephen L Durham³⁷ | Motohiro Ebisawa³⁸ | Yehia El-Gamalt³⁹ | Regina Emuzyte⁴⁰ | Amiran Gamkrelidze⁴¹ | Jean Luc Fauquet⁴² | Alessandro Fiocchi⁴³ | Wytske J Fokkens^{44,185} | Joao A Fonseca^{45,186} | Jean-François Fontaine⁴⁶ | Radoslaw Gawlik⁴⁷ | Asli Gelincik⁴⁸ | Bilun Gemicioglu⁴⁹ | Jose E Gereda⁵⁰ | Roy Gerth van Wijk⁵¹ | R Maximiliano Gomez⁵² | Maia Gotua⁵³ | Ineta Grisle⁵⁴ | Maria-Antonieta Guzmán⁵⁵ | Tari Haahtela⁵⁶ | Susanne Halken⁵⁷ | Enrico Heffler⁷ | Karin Hoffmann-Sommergruber⁵⁸ | Elham Hossny⁵⁹ | Martin Hrubisko⁶⁰ | Carla Irani⁶¹ | Juan Carlos Ivancevich⁶² | Zhanat Ispayeva⁶³ | Kaja Julge⁶⁴ | Igor Kaidashev⁶⁵ | Omer Kalayci⁶⁶ | Musa Khaitov⁶⁷ | Ludger Klimek^{68,187} | Edward Knol⁶⁹ | Marek L Kowalski⁷⁰ | Helga Kraxner⁷¹ | Inger Kull^{72,188} | Piotr Kuna⁷³ | Violeta Kvedariene^{74,189} | Vicky Kritikos^{75,190} | Antti Lauerma⁷⁶ | Susanne Lau⁷⁷ | Daniel Laune⁷⁸ | Michael Levin⁷⁹ | Desiree E Larenas-Linnemann⁸⁰ | Karin C Lodrup Carlsen^{81,191} | Carlo Lombardi⁸² | Olga M Lourenço⁸³ | Bassam Mahboub⁸⁴ | Hans-Jørgen Malling⁸⁵ | Patrick Manning⁸⁶ | Gailen D Marshall⁸⁷ | Erik Melén^{88,188} | Eli O Meltzer⁸⁹ | Neven Miculinic⁹⁰ | Branislava Milenkovic^{91,193} | Mostafa Moin⁹² |

 This is an open access article under the terms of the Creative Commons Attribution License, which permits use, distribution and reproduction in any medium, provided the original work is properly cited.

© 2021 The Authors. Clinical and Translational Allergy published by John Wiley and Sons Ltd on behalf of European Academy of Allergy and Clinical Immunology.

Stephen Montefort⁹³ | Mario Morais-Almeida⁹⁴ | Charlotte G Mortz¹⁴ |
 Ralph Mösge⁹⁵  | Joaquim Mullo^{96,194} | Leyla Namazova Baranova⁹⁷ |
 Hugo Neffen⁹⁸ | Kristof Nekam⁹⁹ | Marek Niedozytko¹⁰⁰ | Mikaëla Odemyr¹⁰¹ |
 Robyn E O'Hehir^{102,195} | Markus Ollert^{103,196} | Liam O'Mahony¹⁰⁴ | Ken Ohta¹⁰⁵ |
 Yoshitaka Okamoto¹⁰⁶ | Kimi Okubo¹⁰⁷ | Giovanni B Pajno¹⁰⁸ |
 Oscar Palomares¹⁰⁹ | Susanna Palkonen¹¹⁰ | Petr Panzner¹¹⁰ |
 Nikolaos G Papadopoulos¹¹¹ | Hae-Sim Park¹¹² | Giovanni Passalacqua¹¹³ |
 Vincenzo Patella¹¹⁴ | Ruby Pawankar¹¹⁵ | Nhat Pham-Thi¹¹⁶ | Davor Plavec¹¹⁷ |
 Todor A Popov¹¹⁸ | Marysia Recto¹⁹² | Frederico S Regateiro^{119,197,198} |
 Carmen Riggioni^{120,199} | Graham Roberts¹²¹ | Monica Rodriguez-Gonzales¹²² |
 Nelson Rosario¹²³ | Menachem Rottem^{124,200} | Philip W Rouadi¹²⁵ |
 Dermot Ryan¹²⁶  | Boleslaw Samolinski¹²⁷ | Mario Sanchez-Borgest¹²⁸ |
 Faradiba S Serpa¹²⁹ | Joaquin Sastre¹³⁰ | Glenis K. Scadding¹³¹ |
 Mohamed H Shamji^{132,201} | Peter Schmid-Grendelmeier¹³³ | Holger J Schünemann²⁹ |
 Aziz Sheikh¹³⁴ | Nicola Scichilone¹³⁵ | Juan Carlos Sisul¹³⁶ | Mikhail Sofiev¹³⁷ |
 Dirceu Solé¹³⁸ | Talant Sooronbaev¹³⁹ | Manuel Soto-Martinez¹⁴⁰ |
 Manuel Soto-Quiros¹⁴¹  | Milan Sova¹⁴² | Jürgen Schwarze¹⁴³ |
 Isabel Skypala¹⁴⁴  | Charlotte Suppli-Ulrik^{145,202} | Luis Taborda-Barata^{146,203} |
 Ana Todo-Bom^{147,204} | Maria J Torres¹⁴⁸ | Marilyn Valentin-Rostan¹⁴⁹ |
 Peter-Valentin Tomazic¹⁵⁰ | Antonio Valero¹⁵¹ | Sanna Toppila-Salmi⁵⁶ |
 Ioanna Tsiligianni^{152,172} | Eva Untersmayr¹⁵³ | Marilyn Urrutia-Pereira¹⁵⁴ |
 Arunas Valiulis^{155,173} | Erkka Valovirta^{156,205} | Olivier Vandenplas¹⁵⁷ |
 Maria Teresa Ventura¹⁵⁸ | Pakit Vichyanond¹⁵⁹ | Martin Wagenmann¹⁶⁰ |
 Dana Wallace¹⁶¹ | Jolanta Walusiak-Skorupa¹⁶² | De Yun Wang¹⁶³ |
 Susan Wasserman¹⁶⁴ | Gary WK Wong¹⁶⁵ | Arzu Yorgancioglu¹⁶⁶ |
 Osman M Yusuf¹⁶⁷ | Mario Zernotti¹⁶⁸ | Luo Zhang^{169,206} | Mihaela Zidarn¹⁷⁰  |
 Torsten Zuberbier¹ | Marek Jutel^{171,207}

¹Department of Dermatology and Allergy, Comprehensive Allergy Center, Charité Universitätsmedizin Berlin, Humboldt-Universität zu Berlin, and Berlin Institute of Health, Berlin, Germany

²Allergology, University Hospital Montpellier, Montpellier, France

³MACVIA-France, Montpellier, France

⁴Department of Otorhinolaryngology, Head and Neck Surgery Section of Rhinology and Allergy, University Hospital Marburg, Philipps-Universität Marburg, Germany

⁵Allergy and Clinical Immunology, Transylvania University Brasov, Brasov, Romania

⁶Swiss Institute of Allergy and Asthma Research (SIAF), University of Zurich, Davos, Switzerland

⁷Department of Biomedical Sciences, Humanitas University, Pieve Emanuele, (MI) and Personalized Medicine, Asthma and Allergy, Humanitas Clinical and Research Center IRCCS, Milano, Italy

⁸School of Medicine, University CEU San Pablo, Madrid, Spain

⁹Department of Allergy and Microbiology, Faculty of Medicine, Al-Rashed Allergy Center, Kuwait University, Kuwait City, Kuwait

¹⁰Allergy & Immunology Centre, Pantai Hospital Kuala Lumpur, Malaysia

¹¹Department of Allergy and Immunology, Hospital Quironsalud Bizkaia, Erandio, Spain

¹²ENT Department, Upper Airways Research Laboratory, Ghent University Hospital, Ghent, Belgium

¹³Department of Otorhinolaryngology—Head and Neck Surgery, School of Medical Sciences, Universiti Sains Malaysia, Kubang Kerian, Kelantan, Malaysia

¹⁴Department of Dermatology and Allergy Centre, Odense University Hospital, Odense, Denmark

¹⁵Department of Respiratory Medicine and Allergology, University Hospital, Lund, Sweden

¹⁶Department of Cardiovascular and Thoracic Sciences, Fondazione Policlinico Universitario A Gemelli IRCCS, Università Cattolica del Sacro Cuore, Rome, Italy

¹⁷Woolcock Institute of Medical Research, University of Sydney, Australia

- ¹⁸Allergist, La Rochelle, France
- ¹⁹Paediatric Allergy, Department of Asthma, Allergy and Respiratory Science, Guys' Hospital, King's College London, London, UK
- ²⁰Department of Medical Sciences, Allergy and Clinical Immunology Unit, University of Torino & Mauriziano Hospital, Torino, Italy
- ²¹Imperial College and National Heart and Lung Institute, London, UK
- ²²Institute for Immunological Research, University of Cartagena, Cartagena, Colombia
- ²³Allergy Section, Department of Internal Medicine, Hospital Vall d'Hebron & ARADyAL Research Network, Barcelona, Spain
- ²⁴Serviço de Imunoalergologia, Hospital de Dona Estefânia, Centro Hospitalar de Lisboa Central, Lisbon, Portugal
- ²⁵Division of Allergy/immunology, University of South Florida, Tampa, Fla, USA
- ²⁶SOS Allergology and Clinical Immunology, USL Toscana Centro, Prato, Italy
- ²⁷Allergy and Immunology Laboratory, Metropolitan University, Simon Bolivar University, Barranquilla, Colombia
- ²⁸David Tatishvili Medical Center, David Tvildiani Medical University-AIETI Medical School, Tbilisi, Georgia
- ²⁹Departments of Medicine and Health Research Methods, McMaster University, Hamilton, ON, Canada
- ³⁰Latvian Association of Allergists, University Children Hospital, Riga, Latvia
- ³¹Fundação ProAR, Federal University of Bahia and GARD/WHO Planning Group, Salvador, Brazil
- ³²Medical Consulting Czarlewski, Levallois, France
- ³³Department of Medical Sciences and Public Health and Unit of Allergy and Clinical Immunology, University Hospital "Duilio Casula", University of Cagliari, Cagliari, Italy
- ³⁴Department of Pulmonology, Division of Allergy, Hôpital Arnaud de Villeneuve, University Hospital of Montpellier, France
- ³⁵Unité de Recherche en Pharmacologie Respiratoire, Pôle des Maladies des Voies Respiratoires, Hôpital Foch, Université Paris Saclay, Suresnes, France
- ³⁶Medical Faculty, University Clinic of Pulmology and Allergy, Skopje, Republic of Macedonia
- ³⁷National Heart and Lung Institute, Imperial College London, UK
- ³⁸Clinical Reserch Center for Allergy and Rheumatology, NHO Sagamihara National Hospital, Sagamihara, Japan
- ³⁹Pediatric Allergy and Immunology Unit, Children's Hospital, Ain Shams University, Cairo, Egypt
- ⁴⁰Faculty of Medicine, Clinic of Children's Diseases, Vilnius University, Vilnius, Lithuania
- ⁴¹National Center for Disease Control and Public Health of Georgia, Tbilisi, Georgia
- ⁴²CHU Clermont-Ferrand, Unité d'Allergologie de l'Enfant, Pole pédiatrique, Hopital Estaing, Clermont-Ferrand, France
- ⁴³Division of Allergy, The Bambino Gesù Children's Hospital IRCCS, Rome, Italy
- ⁴⁴Department of Otorhinolaryngology, Academic Medical Centers, Amsterdam, The Netherland
- ⁴⁵Faculdade de Medicina, CINTESIS, Center for Health Technology and Services Research, Universidade do Porto, Porto, Portugal
- ⁴⁶Allergist, Reims, France
- ⁴⁷Department of Internal Medicine, Allergology and Clinical Immunology, Silesian University of Medicine, Katowice, Poland
- ⁴⁸Division of Allergy and Immunology, Dışkapı Yıldırım Beyazıt Training and Research Hospital, Ankara, Turkey
- ⁴⁹Department of Pulmonary Diseases, Cerrahpasa Faculty of Medicine, Istanbul University-Cerrahpasa, Istanbul, Turkey
- ⁵⁰Allergy and Immunology Division, Clínica Ricardo Palma, Lima, Peru
- ⁵¹Department of Internal Medicine, Section of Allergology, Erasmus MC, Rotterdam, the Netherlands
- ⁵²Fundacion Ayre, Instituto Medico Alas, Salta, Argentina
- ⁵³Center of Allergy and Immunology, Georgian Association of Allergology and Clinical Immunology, Tbilisi, Georgia
- ⁵⁴Latvian Association of Allergists, Center of Tuberculosis and Lung Diseases, Riga, Latvia
- ⁵⁵Immunology and Allergy Division, Clinical Hospital, University of Chile, Santiago, Chile
- ⁵⁶Skin and Allergy Hospital, Helsinki University Hospital, Helsinki, Finland
- ⁵⁷Hans Christian Andersen Children's Hospital, Odense University Hospital, Odense, Denmark
- ⁵⁸Department of Pathophysiology and Allergy Research, Medical University of Vienna, Vienna, Austria
- ⁵⁹Pediatric Allergy and Immunology Unit, Children's Hospital, Ain Shams University, Cairo, Egypt
- ⁶⁰Department of Clinical Immunology and Allergy, Oncology Institute of St Elisabeth, Bratislava, Slovakia
- ⁶¹Department of Internal Medicine and Infectious Diseases, St Joseph University, Hotel Dieu de France Hospital, Beirut, Lebanon
- ⁶²Servicio de Alergia e Immunologia, Clínica Santa Isabel, Buenos Aires, Argentina
- ⁶³Department of Allergology and Clinical Immunology of the Kazakh National Medical University, Kazakhstan Association of Allergology and Clinical Immunology, Kazakhstan
- ⁶⁴Allergy Center of Childrens's Clinic of Tartu University Hospital, Tartu, Estonia
- ⁶⁵Ukrainina Medical Stomatological Academy, Poltava, Ukraine
- ⁶⁶Pediatric Allergy and Asthma Unit, Hacettepe University School of Medicine, Ankara, Turkey
- ⁶⁷National Research Center, Institute of Immunology, Federal Medicobiological Agency, Laboratory of Molecular Immunology, Russia
- ⁶⁸Department of Otolaryngology, Head and Neck Surgery, Universitätsmedizin Mainz, Mainz, Germany
- ⁶⁹Departments of Immunology and Dermatology/Allergology, University Medical Center Utrecht, The Netherlands
- ⁷⁰Department of Immunology and Allergy, Healthy Ageing Research Center, Medical University of Lodz, Poland
- ⁷¹Department of Otorhinolaryngology, Head and Neck Surgery, Semmelweis University, Budapest, Hungary
- ⁷²Department of Clinical Science and Education, Södersjukhuset, Karolinska Institutet, Stockholm, Sweden
- ⁷³Division of Internal Medicine, Asthma and Allergy, Barlicki University Hospital, Medical University of Lodz, Poland
- ⁷⁴Department of Pathology, Faculty of Medicine, Institute of Biomedical Sciences, Vilnius University Vilnius, Lithuania
- ⁷⁵Quality Use of Respiratory Medicines Group, Woolcock Institute of Medical Research, University of Sydney, Sydney, NSW, Australia
- ⁷⁶Department of Dermatology and Allergology, University of Helsinki and Helsinki University, Helsinki, Finland
- ⁷⁷Department of Pediatric Pneumology and Immunology, Charité Universitätsmedizin, Berlin, Germany
- ⁷⁸Yomed INNOV, Montpellier, France
- ⁷⁹Division of Paediatric Allergology, University of Cape Town, Cape Town, South Africa
- ⁸⁰Center of Excellence in Asthma and Allergy, Médica Sur Clinical Foundation and Hospital, México City, Mexico
- ⁸¹Department of Paediatrics, Oslo University Hospital, Oslo, Norway
- ⁸²Departmental Unit of Allergology & Respiratory Diseases, Fondazione Poliambulanza, Brescia, Italy

- ⁸³Faculty of Health Sciences and CICS – UBI, Health Sciences Research Centre, University of Beira Interior, Covilhã, Portugal
- ⁸⁴Department of Pulmonary Medicine, Rashid Hospital, Dubai, UAE
- ⁸⁵Danish Allergy Centre, University of Copenhagen, Copenhagen, Denmark
- ⁸⁶Department of Medicine (RCSI), Bon Secours Hospital, Dublin, Ireland
- ⁸⁷The University of Mississippi Medical Center, Division of Clinical Immunology and Allergy, Laboratory of Behavioral Immunology Research, Jackson, Mississippi, USA
- ⁸⁸Sachs' Children and Youth Hospital, Södersjukhuset, Stockholm, Sweden
- ⁸⁹Allergy, Allergy and Asthma Medical Group and Research Center, San Diego, California, USA
- ⁹⁰Croatian Pulmonary Society, Zagreb, Croatia
- ⁹¹Faculty of Medicine, Clinic for Pulmonary Diseases, Clinical Center of Serbia, University of Belgrade, Belgrade, Serbia
- ⁹²Immunology and Asthma and Allergy Research Institute, Tehran University of Medical Sciences, Tehran, Iran
- ⁹³Faculty of Medicine and Surgery, Mater Dei Hospital Malta, University of Medicine, La Valette, Malta
- ⁹⁴Allergy Center, CUF Descobertas Hospital, Lisbon, Portugal
- ⁹⁵CRI-Clinical Research International-Ltd, Hamburg, Germany
- ⁹⁶ENT Department, Rhinology Unit & Smell Clinic, Hospital Clínic, Barcelona, Spain
- ⁹⁷Scientific Centre of Children's Health, Russian National Research Medical University, Moscow, Russia
- ⁹⁸Center of Allergy, Immunology and Respiratory Diseases, Santa Fe, Argentina
- ⁹⁹Hospital of the Hospitaller Brothers in Buda, Budapest, Hungary
- ¹⁰⁰Department of Allergology, Medical University of Gdańsk, Gdańsk, Poland
- ¹⁰¹EFA, European Federation of Allergy and Airways Diseases Patients' Associations, Brussels, Belgium
- ¹⁰²Department of Allergy, Immunology and Respiratory Medicine, Central Clinical School, Monash University, Victoria, Australia
- ¹⁰³Department of Infection and Immunity, Luxembourg Institute of Health, Esch-sur-Alzette, Luxembourg
- ¹⁰⁴Departments of Medicine and Microbiology, APC Microbiome Ireland, University College Cork, Cork, Ireland
- ¹⁰⁵National Hospital Organization, Tokyo National Hospital, Tokyo, Japan
- ¹⁰⁶Department of Otorhinolaryngology, Chiba University Hospital, Chiba, Japan
- ¹⁰⁷Department of Otolaryngology, Nippon Medical School, Tokyo, Japan
- ¹⁰⁸Department of Pediatrics, Allergy Unit, University of Messina, Messina, Italy
- ¹⁰⁹Department of Biochemistry and Molecular Biology, School of Chemistry, Complutense University of Madrid, Madrid, Spain
- ¹¹⁰Department of Immunology and Allergology, Faculty of Medicine and Faculty Hospital in Pilsen, Charles University in Prague, Pilsen, Czech Republic
- ¹¹¹Division of Infection, Immunity & Respiratory Medicine, Royal Manchester Children's Hospital, University of Manchester, Manchester, UK
- ¹¹²Department of Allergy and Clinical Immunology, Ajou University School of Medicine, Suwon, South Korea
- ¹¹³Allergy and Respiratory Diseases, Ospedale Policlinico San Martino -University of Genoa, Italy
- ¹¹⁴Department of Medicine, Division of Allergy and Clinical Immunology, Agency of Health ASL Salerno, "Santa Maria della Speranza" Hospital, Battipaglia, Salerno, Italy
- ¹¹⁵Department of Pediatrics, Nippon Medical School, Tokyo, Japan
- ¹¹⁶Ecole Polytechnique Palaiseau, IRBA (Institut de Recherche bio-Médicale des Armées), Bretigny, France
- ¹¹⁷School of Medicine, Children's Hospital Srebrnjak, Zagreb, University J.J. Strossmayer, Osijek, Croatia
- ¹¹⁸University Hospital 'Sv Ivan Rilski', Sofia, Bulgaria
- ¹¹⁹Allergy and Clinical Immunology Unit, Centro Hospitalar e Universitário de Coimbra, Coimbra, Coimbra, Portugal
- ¹²⁰Pediatric Allergy and Clinical Immunology Department, Hospital Sant Joan de Déu, Barcelona, Spain
- ¹²¹Salford Royal NHS Foundation Trust NHS England North, Salford, UK
- ¹²²Pediatric Allergy and Clinical Immunology, Hospital Angeles Pedregal, Mexico City, Mexico
- ¹²³Hospital de Clinicas, University of Parana, Brazil
- ¹²⁴Division of Allergy Asthma and Clinical Immunology, Emek Medical Center, Afula, Israel
- ¹²⁵Department of Otolaryngology-Head and Neck Surgery, Eye and Ear University Hospital, Beirut, Lebanon
- ¹²⁶Usher Institute, Medical School, University of Edinburgh, Edinburgh, UK
- ¹²⁷Department of Prevention of Environmental Hazards, Allergology and Immunology, Medical University of Warsaw, Warsaw, Poland
- ¹²⁸Allergy and Clinical Immunology Department, Centro Medico-Docente La Trinidad, Caracas, Venezuela
- ¹²⁹Asthma Reference Center - Escola Superior de Ciências, Santa Casa de Misericórdia of Vitória-Espírito Santo, Vitoria, Brazil
- ¹³⁰Faculty of Medicine, Fundacion Jimenez Diaz, CIBERES, Autonoma University of Madrid, Spain
- ¹³¹The Royal National ENT Hospital, University College London, UK
- ¹³²Immunomodulation and Tolerance Group, Imperial College London, London, UK
- ¹³³Department of Dermatology, Allergy Unit, University Hospital of Zurich, Zürich, Switzerland
- ¹³⁴The Usher Institute of Population Health Sciences and Informatics, The University of Edinburgh, Edinburgh, UK
- ¹³⁵PROMISE Department, University of Palermo, Palermo, Italy
- ¹³⁶Sociedad Paraguaya de Alergia Asma e Inmunologia, Clinica Sisul, Allergy & Asthma, Asuncion, Paraguay
- ¹³⁷Finnish Meteorological Institute (FMI), Helsinki, Finland
- ¹³⁸Department of Pediatrics, Division of Allergy, Clinical Immunology and Rheumatology, Federal University of São Paulo, São Paulo, Brazil
- ¹³⁹Kyrgyzstan National Centre of Cardiology and Internal Medicine, Euro-Asian Respiratory Society, Bishkek, Kyrgyzstan
- ¹⁴⁰Department of Pediatrics, Division of Respiratory Medicine, Hospital Nacional de Niños, Universidad de Costa Rica, San Jose, Costa Rica
- ¹⁴¹Department of Pediatrics, Hospital Nacional de Niños, San José, Costa Rica
- ¹⁴²Department of Respiratory Medicine, University Hospital Olomouc, Czech Republic
- ¹⁴³Centre for Inflammation Research, Child Life and Health, The University of Edinburgh, Edinburgh, UK
- ¹⁴⁴Royal Brompton and Harefield NHS Foundation Trust, London, UK
- ¹⁴⁵Department of Respiratory Medicine, Copenhagen University Hospital Hvidovre, Copenhagen, Denmark
- ¹⁴⁶Department of Immunoallergology, Faculty of Health Sciences, Cova da Beira, Covilhã, Portugal
- ¹⁴⁷Imunoalergologia, Centro Hospitalar Universitário de Coimbra, Coimbra, Portugal
- ¹⁴⁸Allergy Unit, Málaga Regional University Hospital-IBIMA, Málaga, Spain
- ¹⁴⁹Allergist, Montevideo, Uruguay
- ¹⁵⁰Department of General ORL, H&NS, ENT-University Hospital Graz, Medical University of Graz, Graz, Austria
- ¹⁵¹Pneumology and Allergy Department, CIBERES, Clinical & Experimental Respiratory Immunoallergy, IDIBAPS, University of Barcelona, Barcelona, Spain
- ¹⁵²Department of Social Medicine, Health Planning Unit, Faculty of Medicine, University of Crete, Crete, Greece

- ¹⁵³Institute of Pathophysiology and Allergy Research, Center of Pathophysiology, Infectiology and Immunology, Medical University of Vienna, Vienna, Austria
- ¹⁵⁴Universidade Federal dos Pampa, Uruguai, Brazil
- ¹⁵⁵Faculty of Medicine, Vilnius University, Institute of Clinical Medicine & Institute of Health Sciences, Vilnius, Lithuania
- ¹⁵⁶Department of Lung Diseases and Clinical Immunology, University of Turku, Turku, Finland
- ¹⁵⁷Department of Chest Medicine, Centre Hospitalier Universitaire UCL Namur, Université Catholique de Louvain, Yvoir, Belgium
- ¹⁵⁸Unit of Geriatric Immunoallergy, University of Bari Medical School, Bari, Italy
- ¹⁵⁹Division of Allergy and Immunology, Department of Pediatrics, Faculty of Medicine, Siriraj Hospital, Mahidol University, Bangkok, Thailand
- ¹⁶⁰Department of Otorhinolaryngology, HNO-Klinik, Universitätsklinikum Düsseldorf, Germany
- ¹⁶¹Nova Southeastern University, Fort Lauderdale, Florida, USA
- ¹⁶²Department of Occupational Diseases and Environmental Health, Nofer Institute of Occupational Medicine, Lodz, Poland
- ¹⁶³Department of Otolaryngology, Yong Loo Lin School of Medicine, National University of Singapore, Singapore, Singapore
- ¹⁶⁴Department of Medicine, Clinical Immunology and Allergy, McMaster University, Hamilton, Ontario, Canada
- ¹⁶⁵Department of Paediatrics, Prince of Wales Hospital, The Chinese University of Hong Kong, Shatin, New Territories, Hong Kong, China
- ¹⁶⁶Department of Pulmonology, Celal Bayar University, Manisa, Turkey
- ¹⁶⁷The Allergy and Asthma Institute, Islamabad, Pakistan
- ¹⁶⁸Universidad Católica de Córdoba, Universidad Nacional de Villa María, Argentina
- ¹⁶⁹Department of Otolaryngology Head and Neck Surgery, Beijing TongRen Hospital, Beijing, China
- ¹⁷⁰Respiratory and Allergic Diseases, University Clinic, Golnik, Slovenia
- ¹⁷¹Department of Clinical Immunology, Wrocław Medical University, Wrocław, Poland
- ¹⁷²International Primary Care Respiratory Group IPCRG, Aberdeen, Scotland
- ¹⁷³European Academy of Paediatrics (EAP/UEMS-SP), Brussels, Belgium
- ¹⁷⁴Personalized Medicine, Asthma and Allergy, Humanitas Clinical and Research Center IRCCS, Rozzano, Milano, Italy
- ¹⁷⁵Department of Allergy, Al-Rashed Allergy Center, Kuwait City, Kuwait
- ¹⁷⁶International Airway Research Center, First Affiliated Hospital Guangzhou, Sun Yat-sen University, Guangzhou, China
- ¹⁷⁷Division of ENT Diseases, Department of ENT Diseases, CLINTEC, Karolinska Institutet, Karolinska University Hospital, Stockholm, Sweden
- ¹⁷⁸Research Center for Anaphylaxis (ORCA), Odense, Denmark
- ¹⁷⁹National Heart and Lung Institute, Royal Brompton Hospital & Imperial College London, UK
- ¹⁸⁰Woolcock Emphysema Centre and Sydney Local Health District, Glebe, New South Wales, Australia
- ¹⁸¹Foundation for the Development of Medical and Biological Sciences (Fundemeb), Cartagena, Colombia
- ¹⁸²NOVA Medical School, CEDOC, Comprehensive Health Research Center (CHRC), Lisboa, Portugal
- ¹⁸³SLaai, Sociedad Latinoamericana de Alergia, Asma e Immunologia, Branquilla, Colombia
- ¹⁸⁴Equipe EPAR - IPLESP, Sorbonne Université, Paris, France
- ¹⁸⁵EUFOR, Brussels, Belgium
- ¹⁸⁶Allergy Unit, CUF Porto, Portugal
- ¹⁸⁷Center for Rhinology and Allergology, Wiesbaden, Germany
- ¹⁸⁸Sach's Children and Youth Hospital, Södersjukhuset, Stockholm, Sweden
- ¹⁸⁹Faculty of Medicine, Institute of Clinical Medicine, Clinic of Chest Diseases and Allergology, Vilnius University, Vilnius, Lithuania
- ¹⁹⁰Department of Respiratory and Sleep Medicine, Royal Prince Alfred Hospital, Sydney, Australia
- ¹⁹¹Faculty of Medicine, Institute of Clinical Medicine, University of Oslo, Oslo, Norway
- ¹⁹²Department of Pediatrics, Section of Allergy and Immunology, UP-PGH, Manila, Philippines
- ¹⁹³Serbian Association for Asthma and COPD, Belgrade, Serbia
- ¹⁹⁴Clinical & Experimental Respiratory Immunoallergy, IDIBAPS, CIBERES, University of Barcelona, Spain
- ¹⁹⁵Alfred Health, Melbourne, Victoria, Australia
- ¹⁹⁶Department of Dermatology and Allergy Centre, Odense Research Center for Anaphylaxis (ORCA), Odense University Hospital, Odense, Denmark
- ¹⁹⁷Faculty of Medicine, Institute of Immunology, University of Coimbra, Coimbra, Portugal
- ¹⁹⁸Faculty of Medicine, ICBR - Coimbra Institute for Clinical and Biomedical Research, CIBB, University of Coimbra, Coimbra, Portugal
- ¹⁹⁹Institut de Recerca Sant Joan de Déu, Barcelona, Spain
- ²⁰⁰Rappaport Faculty of Medicine, Technion-Israel Institute of Technology, Haifa, Israël
- ²⁰¹Allergy and Clinical Immunology, Imperial College London, London, UK
- ²⁰²Institute of Clinical Medicine, University of Copenhagen, Copenhagen, Denmark
- ²⁰³University Hospital Centre, Covilhã, Portugal
- ²⁰⁴Faculty of Medicine, University of Coimbra, Coimbra, Portugal
- ²⁰⁵Terveystalo Allergy Clinic, Turku, Finland
- ²⁰⁶Otolaryngology, Beijing Institute of Otolaryngology, Beijing, China
- ²⁰⁷ALL-MED Medical Research Institute, Wrocław, Poland

Funding information

ARIA, Grant/Award Number: N/A

KEYWORDS

allergic rhinitis, asthma, immunotherapy, precision medicine

1 | INTRODUCTION

Allergen immunotherapy (AIT), the gradually increasing repeated administration of high doses of allergens to allergic patients, offers

the potential for immune tolerance against reactions to the natural exposures to specific allergens. AIT may lead to the long-lasting remission of allergic symptoms and is the only disease-modifying intervention in IgE-mediated allergic respiratory diseases.

This Pocket Guide was developed by an ARIA and EAACI joint study group from a background paper of the ARIA-MASK study group and from the EAACI guidelines on allergen immunotherapy.

Bousquet J, Pfaar O, Togias A, et al. (2019). ARIA Care pathways for allergen immunotherapy. *Allergy* 2019; 74: 2087–2102.

Agache, Lau S, Akdis CA, et al. EAACI guidelines on allergen immunotherapy: house dust mite-driven allergic asthma. *Allergy*, 2019;74:855-73.

AIT is a proven therapeutic option for the treatment of allergic rhinitis, conjunctivitis, and/or asthma using sublingual (SLIT) or sub-cutaneous (SCIT) routes.

However, AIT is more expensive than symptomatic treatments for allergic diseases (excluding biologicals). It is justified (i) in patients with rhinitis otherwise uncontrolled by symptomatic treatment or (ii) as an add-on to regular asthma treatment in controlled or partially-controlled asthmatic patients sensitised to house dust mites aiming to decrease asthma exacerbations, rescue and controller medication, and to improve quality of life.

Care pathways are structured multi-disciplinary care plans detailing the key steps of patient care. They promote the translation of guideline recommendations to their application in clinical practice.

Although many international and national AIT guidelines have been produced, this is the first care pathway for AIT.

This pocket guide applies to sublingual (SLIT) and sub-cutaneous (SCIT) immunotherapy for allergic rhinitis.

It has been revised by members from 65 countries (Figure 1).

2 | ALLERGENS TO BE ADMINISTERED

The decision to prescribe AIT should be based on relevant symptoms during allergen exposure, demonstration of sensitisation to the relevant allergens, and availability of good-quality extracts with proven efficacy and safety.

Some allergen extracts are approved for marketing in the EU (list in annex) with some others also approved by national health agencies.

For certain products, efficacy and safety have been demonstrated in appropriate clinical studies on adults and children. The extrapolation to untested products, allergens or a different population from the one evaluated in the trial is not appropriate and not in line with current guidelines as there is no class-effect in AIT.

Both monosensitised and polysensitised patients can be treated. However, in the latter case, the most clinically relevant allergen(s) should be used when symptoms are clearly present with allergen source exposure and when allergy tests confirm clinical findings.

3 | STRATIFICATION OF ALLERGIC PATIENTS

Precision medicine aims at the customisation of healthcare, tailored to the characteristics of each individual patient. The stratification of patients into subpopulations is the basis of clinical decision making (Figure 2).

In allergic diseases, patient stratification is required to:

- Propose the appropriate pharmacotherapy.
- Identify the most suitable candidates for AIT.
- Reduce the amount of time and resources needed to match the right patient to an optimal care management programme.
- Optimise costs as expensive therapeutic interventions are not necessary or suitable for all patients.

Patient stratification may also help to improve the patient's engagement.

3.1 | Precision medicine in the indication of AIT

1. Precise diagnosis with history, skin prick tests and/or specific IgE and, if applicable, component-resolved in vitro testing. In some cases, where the above-mentioned diagnostic tools do not allow for precise diagnosis, allergen provocation testing (nasal, ocular and, in some cases, bronchial) may be needed.
2. Proven indications: Allergic rhinitis, conjunctivitis and/or asthma.
3. Symptoms predominantly induced by the relevant allergen exposure.
4. Patient stratification:
 - Poor control of nasal or ocular symptoms despite optimal medications according to guidelines with documented adherence to treatment.
 - Exceptions to requiring optimum symptomatic treatment prior to considering AIT include unacceptable side effects of the medications.
 - Allergic asthma fully controlled under background asthma medication (see EAACI HDM-AIT GL)
 - However, for partially controlled asthma, HDM-AIT may facilitate achieving asthma control (see EAACI HDM-AIT GL)
5. Good clinical documentation of efficacy and safety for the AIT product with relevant trials.
6. The patient's (and caregiver's) views represent an essential component.

3.2 | Biomarkers

There are currently no in vivo or in vitro biomarkers validated for monitoring the efficacy of AIT although several potential candidates are currently being investigated.

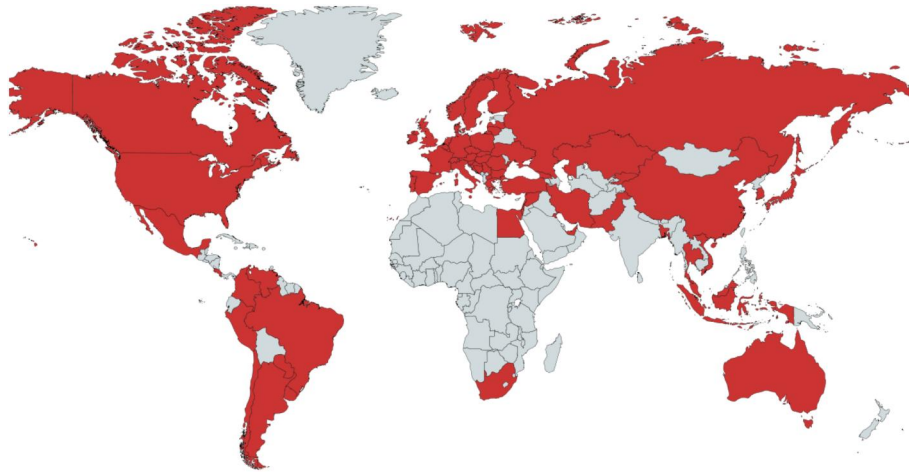


FIGURE 1 Countries with Pocket Guide members

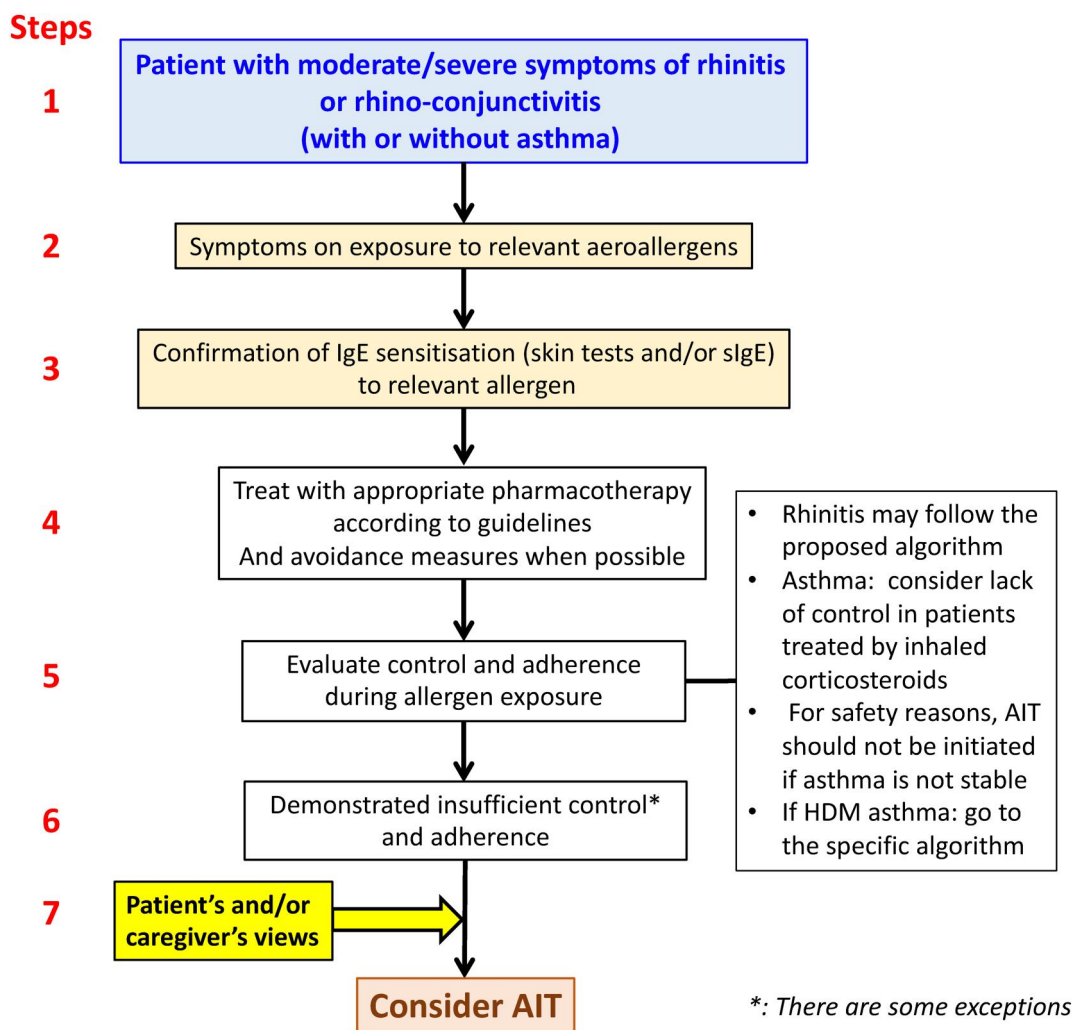


FIGURE 2 Proposed Flow of Precision Medicine approach in allergic diseases. *examples of exceptions: Thunderstorm-induced asthma, patient with moderate rhinitis and severe asthma during pollen season

4 | mHEALTH

Apps can be used:

- To acquire real-world evidence to confirm the efficacy of AIT in situations where randomised controlled trials are difficult to perform.
- To assess air quality index including pollen exposure and air pollution.
- By physicians and patients for stratification of patients and follow-up.

5 | RHINITIS (WITH OR WITHOUT CONJUNCTIVITIS) IN ADOLESCENTS AND ADULTS

The selection of pharmacotherapy and AIT for patients with AR and/or allergic conjunctivitis may be better supported by evidence algorithms to aid patients and healthcare professionals jointly determine the treatment and its step-up or step-down strategy depending on rhinitis control (shared decision-making).

A simple algorithm is proposed as an aid for physicians to determine the treatment of their patients (Figure 3).

5.1 | Treatment algorithm using visual analogue scale (VAS)

In the case of remaining ocular symptoms, add intra-ocular treatment.

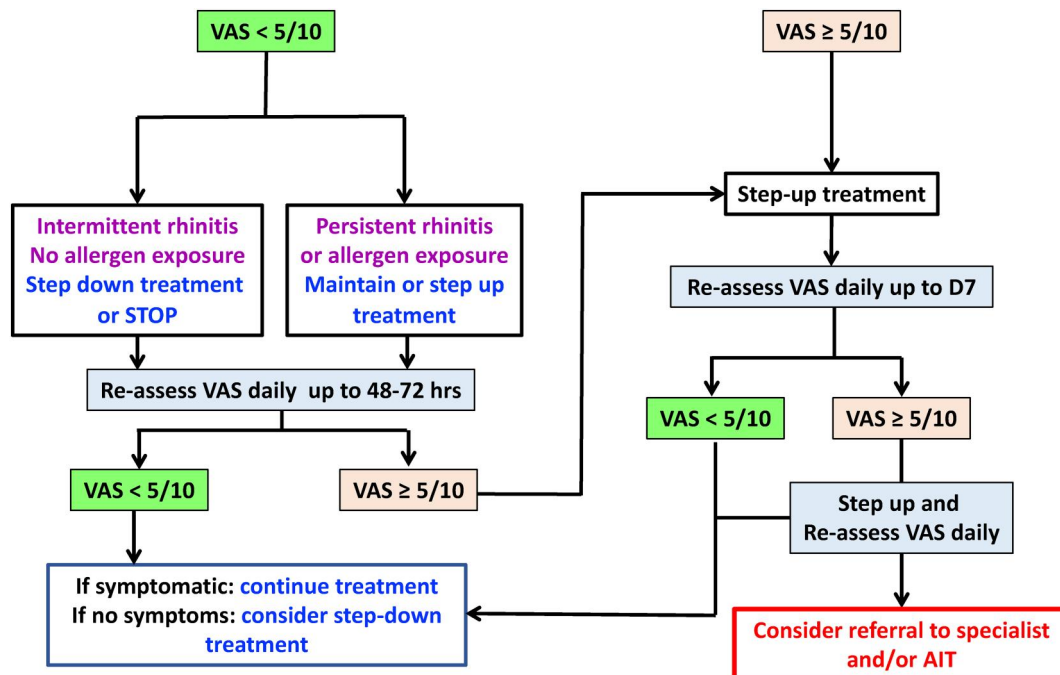


FIGURE 3 Treatment algorithm using visual analogue scale (VAS) for adolescents and adults AIT, allergen immunotherapy; VAS, visual analogue scale.

6 | RHINITIS (WITH OR WITHOUT CONJUNCTIVITIS) IN CHILDREN

AIT is effective, has long-term beneficial effects after cessation, and may delay or prevent the onset of asthma. AIT can be initiated in children with moderate/severe rhinitis that is not controlled by appropriate medications according to guidelines.

7 | ASTHMA

An algorithm for HDM-driven allergic asthma diagnosis and management is proposed by the EAACI guidelines.

For patients with concomitant allergic rhinitis and sensitised to house dust mite—with persisting asthma symptoms despite low-moderate dose of inhaled corticosteroids—SLIT can be considered, provided FEV1 is >70% predicted.

House dust mite SLIT should initially be considered as an add-on therapy to controller treatment, and reduction in asthma controllers should be performed gradually under the supervision of a physician.

Immunotherapy is not indicated for the treatment of acute exacerbations, and patients must be informed of the need to seek medical attention immediately if their asthma deteriorates suddenly (Figure 4).

8 | MULTIMORBIDITY

One strength of AIT is that it has the potential to control all allergic diseases related to a specific allergen, including rhinitis, conjunctivitis and asthma.

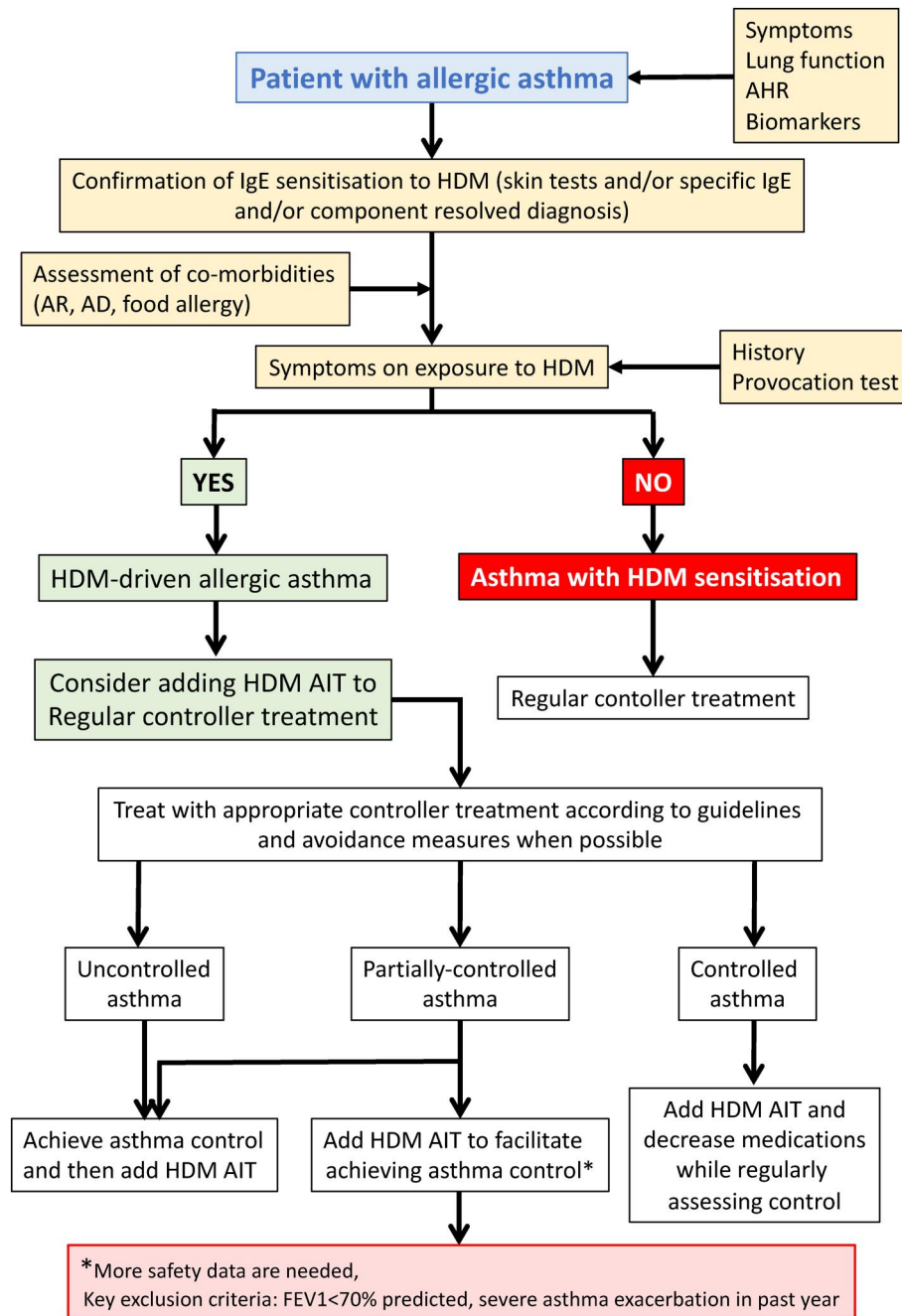


FIGURE 4 Algorithm for AIT in asthma

9 | SAFETY

9.1 | Subcutaneous immunotherapy (SCIT)

Local reactions: A typical reaction is redness and swelling at the injection site immediately or several hours after the injection. Sometimes, sneezing, nasal congestion or hives can occur.

Systemic reactions: Serious reactions to injections are very rare and require immediate medical attention. Symptoms of an anaphylactic reaction can include swelling in the throat, wheezing or tightness in the chest, nausea and dizziness. The most serious reactions

develop within 30 min after the injection, and patients are advised to wait in their doctor's surgery for at least 30 min after an injection. Severe bronchospasm can also occur, especially in patients where asthma is not controlled.

9.2 | Sublingual immunotherapy (SLIT)

Allergen drops or tablets have a more favourable safety profile than injections. The initial dose should be performed in the doctor's surgery, and patients are advised to remain in the surgery for at least 30 min

after administration. Thereafter, SLIT can be administered at home once the first dose has been given under the supervision of a physician.

Allergic reactions: The majority of patients will experience mild local reactions of the oropharyngeal passage. This is usually controlled by pre-dosing with an antihistamine 30 min before the administration of SLIT. Sometimes, sneezing, nasal congestion or hives can occur. Anaphylaxis is rarely described.

In some countries, SLIT tablets include a warning about possible severe allergic reactions, and adrenaline auto-injectors are routinely recommended. This is not the case in Europe.

CONFLICT OF INTEREST

I Agache is an Associate Editor Allergy and CTA.

CA reports grants from Allergopharma, grants from Idorsia, Swiss National Science Foundation, Christine Kühne-Center for Allergy Research and Education, European Commission's Horizon's 2020 Framework Programme, Cure, Novartis Research Institutes, AstraZeneca, scibase, advisory role in Sanofi/Regeneron, grants from Glaxo Smith-Kline, advisory role in scibase.

IA reports personal fees from Hikma, Roxall, AstraZeneca, Menarini, UCB, Faes Farma, Sanofi, Mundipharma, Bial, Amgen, Stallergenes.

SBA reports grants from TEVA, personal fees from TEVA, AstraZeneca, Boehringer Ingelheim, GSK, Sanofi, Mylan.

VC reports personal fees from ALK, Allergy Therapeutics, LETI, Thermofisher, Merck, Astrazeneca, GSK.

TC reports grants and personal fees from Stallergenes.

PD reports personal fees from ALK-Abello, Stallergenes-Greer, AstraZeneca, GlaxoSmithKline, Mylan, Sanofi.

SD reports personal fees and non-financial support from ALK Abello, personal fees from Adiga, Biomay, Allergopharma, Anergis, Allergy Therapeutics.

TH reports personal fees from GSK, Mundipharma, Orion Pharma.

SH reports other from ALK-Abelló, other from ALK-Abelló.

EH reports personal fees from Sanofi, Novartis, GSK, AstraZeneca, Circassia, Nestlé Purina.

JCI reports personal fees from Faes Farma, Laboratorios Casasco Argentina, Abbott de Ecuador, EuroFarma Argentina.

MJ reports personal fees from ALK-Abello, Allergopharma, Stallergenes, Anergis, Allergy Therapeutics, Circassia, Leti, Biomay, HAL, during the conduct of the study; personal fees from AstraZeneca, GSK, Novartis, Teva, Vectura, UCB, Takeda, Roche, Janssen, Medimmune, Chiesi.

LK reports grants and personal fees from Allergopharma, MEDA/Mylan, LETI Pharma, Sanofi, grants from Stallergenes, Quintiles, ASIT biotech, grants from ALK Abelló, Lofarma, AstraZeneca, GSK, Immunotk, personal fees from Allergy Therapeut., HAL Allergie, Cassella med; and Membership: AeDA, DGHNO, Deutsche Akademie für Allergologie und klinische Immunologie, HNO-BV, GPA, EAACI.

PK reports personal fees from Adamed, Berlin Chemie Menarini, Boehringer Ingelheim, AstraZeneca, Lekam, Novartis, Polpharma, GSK, Polpharma, Sanofi, teva.

VK reports other from GSK, non-financial support from Mylan, AstraZeneca, Dimuna, Norameda.

SL reports personal fees from DBV, Sanofi Aventis, Allergopharma, ALK, Nutricia, Bencard.

EM reports personal fees from Sanofi, Novartis, AstraZeneca and Chiesi.

JM reports personal fees and other from SANOFI-GENZYME & REGENERON, NOVARTIS, ALLAKOS, MITSUBISHI-TANABE, MENARINI, UCB, ASTRAZENECA, GSK, MSD, grants and personal fees from MYLAN-MEDA Pharma, URIACH Group.

MO reports personal fees from Hycor Diagnostics, Thermo Fisher Phadia.

YO reports personal fees from Torii Pharmaceutical Co., Ltd., Shionogi Pharmaceutical Co., Ltd.

OP received research grants from Immunotek S.L., Novartis and MINECO and has received fees for giving scientific lectures or participation in Advisory Boards from: Allergy Therapeutics, Amgen, AstraZeneca, Diater, GlaxoSmithKline, S.A, Immunotek S.L, Novartis, Sanofi-Genzyme and Stallergenes.

NGP reports personal fees from Novartis, Nutricia, HAL, MENARINI/FAES FARMA, SANOFI, MYLAN/MEDA, BIOMAY, AstraZeneca, GSK, MSD, ASIT BIOTECH, Boehringer Ingelheim, grants from Gerolymatos International SA, Capricare.

OP reports grants and personal fees from ALK-Abelló, Allergopharma, Stallergenes Greer, HAL Allergy Holding B.V./HAL Allergie GmbH, Bencard Allergie GmbH/Allergy Therapeutics, Lofarma, ASIT Biotech Tools S.A., Laboratorios LETI/LETI Pharma, Anergis S.A., Glaxo Smith Kline, grants from Biomay, Circassia, Pohl-Boskamp, Immunotek S.L., personal fees from MEDA Pharma/MYLAN, Mobile Chamber Experts (a GA2LEN Partner), Indoor Biotechnologies, Astellas Pharma Global, EUFOREA, ROXALL Medizin, Novartis, Sanofi-Aventis and Sanofi-Genzyme, Med Update Europe GmbH, streamedup! GmbH, John Wiley and Sons, AS.

DPreports grants and personal fees from GlaxoSmithKline, personal fees from Menarini, Pliva, Belupo, AbbVie, Novartis, MSD, Chiesi, Revenio, personal fees and non-financial support from Boehringer Ingelheim, non-financial support from Philips.

MR is on the Advisory board- A. Menarini - Speaker - AstraZeneca, Novartis, Sanofi, Mylan.

FSRreports speaker and advisory fees from AstraZeneca, Novartis, Sanofi, GSK, Teva and Lusomedicamenta.

GR reports payment to his Institution from Allergo Pharma.

BSreports personal fees from Allergopharma, during the conduct of the study; grants from National Health Programm, grant, personal fees from Polpharma, ASTRA, personal fees from Mylan, Adamed, patient ombudsman, national Centre for Research and Development, Polish Allergology Society.

JS reports grants and personal fees from Sanofi, personal fees from GSK, Novartis, AstraZeneca, Mundipharma, Faes Farma.

GS reports personal fees from ALK, and leads on the BSACI Rhinitis Guidelines and lead for EUFOREA on Allergic Rhinitis.

PSG reports personal fees from Allergopharma, ALK, grants from Bencard, grants and personal fees from Stallergenes.

JS reports personal fees from Mylan, F2F events.

ATB reports grants and personal fees from Teva, AstraZeneca, GSK Sanofi, Mundipharma, personal fees from Bial, Novartis.

MJT reports grants from European Commission, SEAIC, ISCIII, personal fees from Diater laboratory, Leti laboratory, Aimmune Therapeutics.

MW reports personal fees from ALK-Abello, Allergopharma, AstraZeneca, Bencard, Genzyme, GlaxoSmithKline, HAL Allergy, LETI, Meda Pharma, Novartis, Sanofi, Stallergenes, Teva.

DW reports other from Optinose, ALK, Sanofi; past Co-Chair of the Joint Task Force on Practice Parameters of the AAAAI and ACAAI. Second author of a recently published practice parameter on Rhinitis.

MW reports other from Aralez (Medexus), Pediapharm, Pfizer, Astra Zeneca, GSK, Alk.

MZ reports personal fees from Takeda.

TZ reports and Organizational affiliations: Committee member: WHO-Initiative "Allergic Rhinitis and Its Impact on Asthma" (ARIA). Member of the Board: German Society for Allergy and Clinical

Immunology (DGAKI). Head: European Centre for Allergy Research Foundation (ECARF). Secretary General: Global Allergy and Asthma European Network (GA²LEN). Member: Committee on Allergy Diagnosis and Molecular Allergology, World Allergy Organization (WAO).

ORCID

Jean Bousquet  <https://orcid.org/0000-0002-4061-4766>

Victoria Cardona  <https://orcid.org/0000-0003-2197-9767>

Ralph Mösges  <https://orcid.org/0000-0002-1928-810X>

Dermot Ryan  <https://orcid.org/0000-0002-4115-7376>

Manuel Soto-Quiros  <https://orcid.org/0000-0003-3425-3463>

Isabel Skypala  <https://orcid.org/0000-0003-3629-4293>

Mihaela Zidarn  <https://orcid.org/0000-0003-0515-5207>

How to cite this article: Bousquet J, Pfaar O, Agache I, et al. ARIA-EAACI care pathways for allergen immunotherapy in respiratory allergy. *Clin Transl Allergy*. 2021;e12014. <https://doi.org/10.1002/ctt2.12014>