

## Review



# Aligning the Good Practice MASK With the Objectives of the European Innovation Partnership on Active and Healthy Ageing

J Bousquet,<sup>1,2,3,4,5\*</sup> J Farrell,<sup>6</sup> M Illario,<sup>7,8</sup> and the ARIA-MASK study group

<sup>1</sup>CHU Arnaud de Villeneuve, Montpellier, France

<sup>2</sup>MACVIA-France, Montpellier, France

<sup>3</sup>INSERM U 1168, VIMA: Ageing and Chronic Diseases Epidemiological and Public Health Approaches, Villejuif, France

<sup>4</sup>UMR-S 1168, Université Versailles St-Quentin-en-Yvelines, Montigny le Bretonneux, France

<sup>5</sup>Charité - Universitätsmedizin Berlin, Humboldt-Universität zu Berlin, Berlin, Germany

<sup>6</sup>LANUA International Healthcare Consultancy, Belfast, Northern Ireland, UK

<sup>7</sup>Division for Health Innovation, Campania Region.

<sup>8</sup>Federico II University Hospital Naples (R&D and DISMET) Naples, Italy



**Received:** Aug 29, 2019

**Revised:** Nov 8, 2019

**Accepted:** Nov 10, 2019

### Correspondence to

Jean Bousquet, MD

CHU Arnaud de Villeneuve, 371 Avenue du Doyen Gaston Giraud, 34090 Montpellier, France.

Tel: +33-6-1142-8847

Fax: +33-467-416701

E-mail: jean.bousquet@orange.fr

**Copyright** © 2020 The Korean Academy of Asthma, Allergy and Clinical Immunology · The Korean Academy of Pediatric Allergy and Respiratory Disease

This is an Open Access article distributed under the terms of the Creative Commons Attribution Non-Commercial License (<https://creativecommons.org/licenses/by-nc/4.0/>) which permits unrestricted non-commercial use, distribution, and reproduction in any medium, provided the original work is properly cited.

### Disclosure

There are no financial or other issues that might lead to conflict of interest.

## ABSTRACT

The reference sites of the European Innovation Partnership on Active and Healthy Ageing (EIP on AHA) were renewed in 2019. The DG Santé good practice Mobile Airways Sentinel network (MASK) was reviewed to meet the objectives of the EIP on AHA. It included 1) Management of care process, 2) Blueprint of digital transformation, 3) EIP on AHA, innovation to market, 4) Community for monitoring and assessment framework, 5) Political, organizational, technological and financial readiness, 6) Contributing to European co-operation and transferability, 7) Delivering evidence of impact against the triple win approach, 8) Contribution to the European Digital Transformation of Health and Care and 9) scale of demonstration and deployment of innovation

**Keywords:** Mobile applications; rhinitis; asthma; health; healthy aging

## INTRODUCTION

Chronic respiratory diseases (CRDs) are among major chronic diseases in terms of prevalence and burden.<sup>1</sup> Most cases of asthma and rhinitis occur early in life and persist across the life cycle. A life course is needed to prevent and manage CRDs in old people. Mobile Airways Sentinel Network (MASK)<sup>2,3</sup> was used as a proof-of-concept for chronic disease care across the life cycle for the renewal of the Reference Site of the European Innovation partnership on Active and Healthy Ageing (EIP on AHA) Contre les Maladies Chroniques pour un Vieillessement Actif (MACVIA).<sup>4</sup> MASK involves professionals and patients focusing on EIP on AHA priorities. It proposes real-world integrated care pathways (ICPs) centered around the patient with rhinitis and asthma multimorbidities. MASK is a good practice (GP) of DG Santé in the Digital Transformation of Health and Care presented in Ispra (December 15, 2018)<sup>3</sup> for change management.<sup>5</sup> CRDs, such as asthma and rhinitis, often start early in infancy and can persist throughout life. There are specific problems in old

people associated with a modification of the disease, multimorbidities (allergic and non-allergic) and co-medications (allergic and non-allergic). MASK is devoted to the management of rhinitis and asthma across the life cycle focusing on old adults.

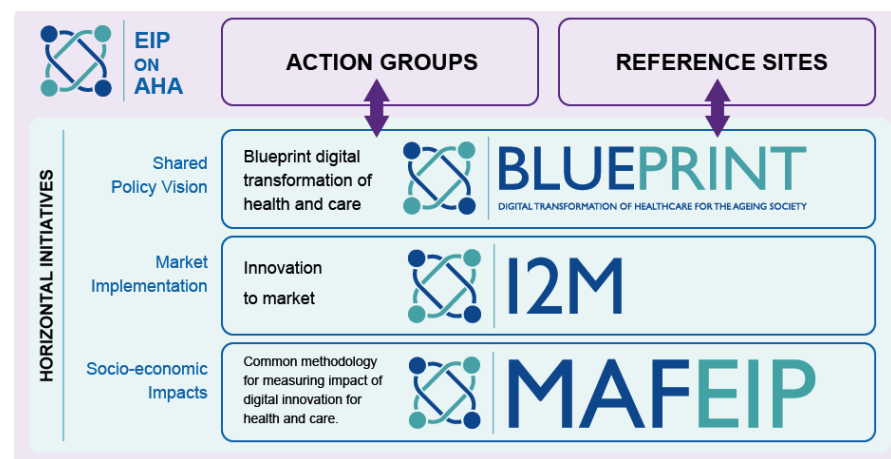
The Widening the support for large scale uptake of Digital Innovation for Active and Healthy Ageing (WE4AHA) coordination and support action (<https://ec.europa.eu/digital-single-market/en/news/we4aha-enabling-large-scale-uptake-digital-innovation-active-and-healthy-ageing>), funded under the H2020 Programme, aims to advance the effective, large-scale uptake and impact of Digital Innovation for Active and Healthy Ageing (AHA), building on a comprehensive set of support and promotion services. Through WE4AHA's centralized administration, coordination and external communication activities, the relevant stakeholders have been called upon to further develop the EIP on AHA and to promote and implement its horizontal initiatives: innovation to market (I2M), Blueprint Digital Transformation of Health and Care for the Ageing Society (Blueprint) and the monitoring and assessment framework (MAFEIP) for the EIP on AHA (Fig. 1).

The present paper summarizes the alignment of MASK to the EIP on AHA objectives.

### THE MOBILE HEALTH (MHEALTH) GOOD PRACTICE MASK

MASK, the phase 3 Allergic Rhinitis and its Impact on Asthma (ARIA) initiative,<sup>6</sup> aims to reduce the global burden of allergic rhinitis (AR) and asthma multimorbidities, giving the patient and the health care professional simple tools to better prevent and manage respiratory allergic diseases in a cost-effective manner. First, it includes a freely available MASK app (MASK-air<sup>®</sup>, formerly the Allergy Diary, Android and iOS).<sup>7</sup> Secondly, there is an interoperable electronic clinical decision support system (e-CDSS).<sup>8</sup> Thirdly, there is an interoperable questionnaire for physicians available online.<sup>9</sup>

MASK is scaled up using the EIP on AHA strategy.<sup>10</sup> It is supported by several EU grants and is a Global Alliance against CRDs (GARD; World Health Organization [WHO])<sup>11</sup> research demonstration project. It is a GP of DG Santé on the digital transformation of health and care.<sup>3,12</sup>



**Fig. 1.** Cross-cutting initiatives of 2017-2019 EIP on AHA. EIP on AHA, European Innovation Partnership on Active and Healthy Ageing; MAFEIP, monitoring and assessment framework.

### MASK-air®

MASK-air® is an information and communication technology (ICT) system centering around the patient<sup>2,3,13,15</sup> operational in 23 countries and 17 languages. It uses a treatment scroll list which includes all of the medications customized for each country, as well as a visual analogue scale (VAS), to assess rhinitis control (global allergy impact, nose, eyes and asthma), sleep and work productivity.<sup>16</sup> MASK-air® is in line with the GDPR,<sup>17</sup> in particular for geolocation.<sup>18</sup> MASK-air® will be combined with prediction on allergen season and pollution exposure (impact of air POLLution on Asthma and Rhinitis, EIT Health [POLLAR] funded project)<sup>15,19</sup> in 2019 (Table).

- App: 30,000 users, 23 countries, 17 languages
- 250,000 days of VAS report
- No missing data due to app structure
- Tested with patients and physicians for acceptability
- GDPR including geolocation
- Follows the recommendations of ICPs for airway diseases (AIRWAYS ICPs)<sup>15</sup>
- From a validated “research” tool (2004-2018) to large scale deployment (2019-)
- Validation with Consensus-based Standards for the selection of health Measurement INstruments guidelines<sup>20</sup>
- Found to be the most relevant app for rhinitis and asthma<sup>21,22</sup>
- Assessment of data quality (Bedard, in preparation)
- Baseline characteristics<sup>23</sup>
- Work productivity<sup>16</sup>
- EuroQOL (EQ-5D) and the work productivity and activity impairment allergy-specific<sup>7</sup>
- Novel phenotypes of allergic diseases<sup>24</sup>
- Adherence to treatment<sup>25,26</sup>
- Novel approaches to inform the efficacy of treatment<sup>25</sup>
- Sleep<sup>23</sup>
- Patient’s organizations and scientific societies involved
- Presented during WHO, EU ministerial meetings and EU parliament meetings<sup>12,27-29</sup>
- Next-generation care pathways meeting (December 3, 2018) with the EIP on AHA, POLLAR and GARD
- Over 70 MASK papers in 16 languages
- Dissemination according to the EIP on AHA<sup>10</sup>

### Electronic clinical decision support system for rhinitis

The interoperable e-CDSS<sup>8</sup> is based on an algorithm designed by the ARIA expert group<sup>30</sup> and is validated using real-world evidence (RWE).<sup>31</sup> This e-CDSS is for use on tablets and is for pharmacists and physicians. The e-CDSS is currently being tested on pharmacists in Portugal and Australia.

**Table.** MASK air®

- GP of the EIP on AHA follows CHRODIS<sup>59</sup>
- GP on digitally enabled, integrated, patient-centred care endorsed by DG Santé<sup>4</sup>
- Based on several EU grants (MeDALL, GA<sup>2</sup>LEN<sup>56</sup>) including—in 2018—POLLAR,<sup>21</sup> DHE Twinning (digital transformation of health).
- Reported in the JRC Science and Policy Reports on Strategic Intelligence Monitor on Personal Health Systems phase 3<sup>7</sup>
- One example of the WHO-ITU “Be He@lthy, Be Mobile” handbook on how to implement mBreatheFreely for asthma and COPD<sup>50</sup>
- GARD (WHO alliance) demonstration project

MASK, Mobile Airways Sentinel Network; GP, good practice; EIP on AHA, European Innovation Partnership on Active and Healthy Ageing; the WHO, World Health Organization; JRC, Joint Research Center; MeDALL, Mechanisms for the Development of ALLergy; POLLAR, impact of air POLLution on Asthma and Rhinitis, EIT Health; ITU, International Telecommunication Union; COPD, chronic obstructive pulmonary disease; GARD, Global Alliance against CRDs.

### **Web-based physician's questionnaire for rhinitis and asthma**

An interoperable questionnaire for physicians is available online on the European Forum for Research and Education in Allergy and Airway Diseases (Euforea) website (<https://www.euforea.eu>). Over 1,000 patients have been enrolled in the 2017 Twinning using the questionnaire. They are then followed up using the app.<sup>9</sup>

## **MANAGEMENT OF CARE PROCESSES**

Protocols and guidelines have been developed by the ARIA expert group since 1999, in collaboration with the WHO (WHO Collaborating Center for Rhinitis and Asthma)<sup>6,32</sup> using the grading of recommendations, assessment, development and evaluations (GRADE) approach<sup>33,34</sup> and including those for severe asthma developed with the WHO.<sup>35</sup> A new approach has been made to develop guidelines tested with RWE.<sup>29,31</sup> IT solutions have been given major focus.<sup>3</sup>

Education and training: The ARIA expert group consists of 600 members in 89 countries with education and training in most countries or clusters.<sup>36</sup> Education is performed in each country by different university members (including all health care professionals<sup>37</sup>) with health care professionals in private practice and with patients' organizations.

Standardization, interoperability and financing: the protocols are standardized and operate in over 40 countries globally. They have been endorsed by several governments and are being used for the registration of treatments (European Medicine Agency; EMA). They have been used by a Twinning in more than 20 countries.<sup>9</sup>

## **BLUEPRINT OF DIGITAL TRANSFORMATION**

The European "Blueprint on Digital Transformation of Health and Care for the Ageing Society" reflects the common policy vision of European policy makers, professional and civil society organizations, and industry. As a shared policy vision, the Blueprint guides the efforts of the EIP on AHA Action Groups and Reference Sites. The Blueprint is essential for mobilizing investments and guaranteeing the commitment of all actors including industrial players, regional authorities, professional and civil society organizations, and multi-stakeholder platforms.

### **Data analytics for predictive risk stratification and prevention**

MASK-air<sup>®</sup> data available for 3,000 users have shown new phenotypes of daily symptoms, including an unrecognized pattern of allergic multimorbidity, which will be very useful for a new stratification of allergic individuals.<sup>24</sup> These results obtained using a big data approach in days were confirmed in canonical epidemiologic studies in patients.<sup>38-41</sup>

### **Pro-active prevention through empowerment, self-management, monitoring and coaching**

The best practices/solutions available for targeting persons' needs. Outcomes and high impact on patients and the health care system. MASK-air<sup>®</sup> results in around 10,000 users show that rhinitis patients are poorly adherent to treatment and that new approaches are needed to monitor the efficacy of the treatments.<sup>26</sup> MASK is a GP of DG Santé on digitally

enabled, patient-centered care and is promoting patients' empowerment in collaboration with patients' organizations to identify strategies for prevention and self-management.<sup>3</sup>

### **Digital solutions for integrated care**

AIRWAYS ICPs have proposed to develop care pathways for airway diseases using mHealth. This was achieved by MASK whereby next-generation care pathways were developed during a POLLAR-GARD meeting (Pasteur Institute, December 3, 2018) including next-generation guidelines that embed RWE.<sup>27,28</sup>

### **Regions with positive experiences willing to provide the necessary knowledge and support to scale up and deploy across Europe**

During the past 20 years, ARIA has had a major implementation strategy: to deploy the existing knowledge globally. The ARIA pocket guide has been translated into 52 languages. The same approach has been applied to MASK which is scaled up using the EIP on AHA procedures.<sup>10</sup> MASK has been published in 17 languages, and the Executive Summary is expected to be published in 25 countries by the end of 2020. MASK has a specific emphasis on the transfer of innovation across centers of the EIP on AHA. A first Twinning based on MASK was found to be the most mature and included 20 countries.<sup>9</sup> A second Twinning with 32 centers has been proposed for severe asthma.

### **Relevant interactions**

The GP directly involves persons interacting with digital solutions and those interacting with other key actors who place a special emphasis on interoperability.<sup>3</sup>

### **Need of other key actors**

General practitioners, nurses, pharmacists, carers, public health authorities and other care providers are all involved in the health and care provision for MASK.

### **High scalability and replication potential**

MASK-air<sup>®</sup> is available in 25 countries (developed and developing) (Fig. 2).

## **EIP ON AHA, I2M**

One of the key challenges in Europe for AHA is the implementation and scaling-up of cross-border innovative solutions. One of the aims is to support the transformation of health and care in the Digital Single Market, thereby reinforcing the links between the development of solutions by companies, start-ups and researchers—the supply side. The other aim is to bridge a gap with the expectation and need of care providers, policy-makers, insurers and other potential buyers of these products and services—the demand side.

The WHO Guide for scaling-up defined the term as “...deliberate efforts to increase the impact of health service innovations successfully tested in pilot or experimental projects so as to benefit more people and to foster policy and program development on a lasting basis.”

<sup>42</sup> This definition stresses the importance of recognizing innovative solutions that are first piloted successfully and then become a mainstream policy.

The purpose of the I2M initiative is to improve the match between the demand and supply sides in AHA, by engaging in a dialog and by organizing a series of activities and services

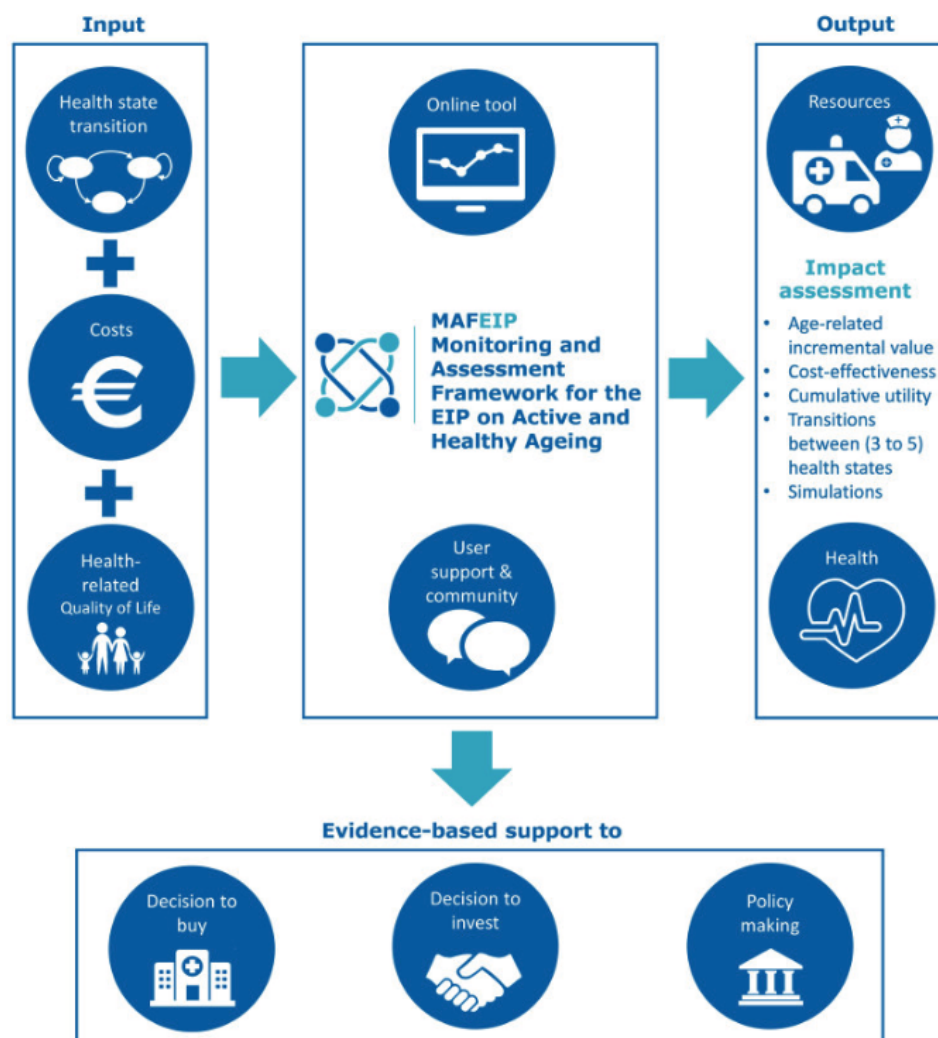


Fig. 2. The ARIACARE digital network.

that involve the 2 sides of the market ([https://ec.europa.eu/eip/ageing/innovation-market-i2m\\_en](https://ec.europa.eu/eip/ageing/innovation-market-i2m_en)). To make concrete progress on a large-scale uptake and impact of Digital Innovation for AHA, a comprehensive set of support and promotion services that are proposed ([https://ec.europa.eu/eip/ageing/library/innovation-market-plan\\_en](https://ec.europa.eu/eip/ageing/library/innovation-market-plan_en)). The Plan is addressed to both organizations delivering AHA services and solution suppliers. It aims to facilitate relationships, mutual understanding and scaling-up, and to increase the impact of innovative technology driven solutions in the reference market.

### Visibility and awareness activities

*Adoption award: MASK has already proposed 2 types of awards*

- An award (platinum, gold or silver) for the members who have had the most important activities in the network (Campania, Piedimonte, Puglia, Lithuania, Mexico and Brazil received the platinum award).
- ARIACare on the model of Ucare (for urticaria),<sup>43</sup> in collaboration with the Global Allergy and Asthma European Network, GA<sup>2</sup>LEN.<sup>44</sup> GA<sup>2</sup>LEN has launched a program for the development, interaction and accreditation of center of reference and excellence in

special areas of allergy embedded in its overall quality management of allergy center of excellence. The first chosen area is urticaria. From September 2019, ARIACare will accredit and award the center in AR and asthma based on the ARIA study group of 600 members. The call preparation and the jury are in place. It is expected that 100 centers will be awarded globally.

#### *Expanding repository of innovative practices*

MASK is an innovative practice in the repository ([https://ec.europa.eu/eip/ageing/repository/macvia-aria-sentinel-network-rhinitis\\_en](https://ec.europa.eu/eip/ageing/repository/macvia-aria-sentinel-network-rhinitis_en)). We will include new practices based on the expertise of MASK.

#### *Needs showcase and solution platforms*

MASK is in the process of creating an online map that provides clear information and encourages interactions among the actors in the sector such as a permanent “marketplace.” This will enable an easier exchange of information between buyers and suppliers, and will facilitate transactions.

### **Knowledge brokerage and matchmaking services**

Matchmaking sessions: MASK has tailored solutions that have been adapted at the regional or national level (Argentina, Austria, Australia, Belgium, Brazil, Canada, Columbia, Czech Republic, Denmark, Finland, France, Germany, Greece, Italy, Japan, Lithuania, Mexico, The Netherlands, Poland, Portugal, Spain, Sweden, Switzerland, Turkey and the UK) in collaboration with the WHO (GARD demonstration project). For all these countries, the language has been translated and adapted. Moreover, Catalan has also been used. This was particularly the case for the Twinning.<sup>9</sup> Training on AHA innovation adoption is in process as part of the POLLAR grant.

Online training for SMEs on private funding, online repository on reimbursement systems and online repository on resources and market insights are not yet envisaged.

### **Transfer activities (Twinning schemes)**

Rhinitis and asthma TWINNING 1,000 patients have been enrolled including over 300 old people. This TWINNING is fully mature (level 4) and is a success story.<sup>57</sup> Analysis is being carried out.

### **Dissemination of MASK**

Dissemination strategy. The dissemination strategy follows the proposed strategy and uses a 5-step framework for developing an individual scaling-up strategy: 1) what to scale up—1-1) databases of GPs, 1-2) assessment of viability of the scaling up of GPs and 1-3) classification of GPs for local replication—and 2) how to scale up—2-1) facilitating partnerships for scaling up, 2-2) implementation of key success factors and lessons learned, including emerging technologies for individualised and predictive medicine. This strategy has already been applied to the CRD action plan of the EIP on AHA.<sup>10</sup>

Networks. The MASK Network includes all countries and regions of the ARIA Network participating in MASK. It comprises over 350 active members in 26 countries. The role of the network was first to translate all MASK documents in 18 languages, then to continue the adaptation of the MASK project and finally to include patients. The members of the network also actively participated in the publications. The network is very strong and reactive.

## COMMUNITY FOR MAFEIP

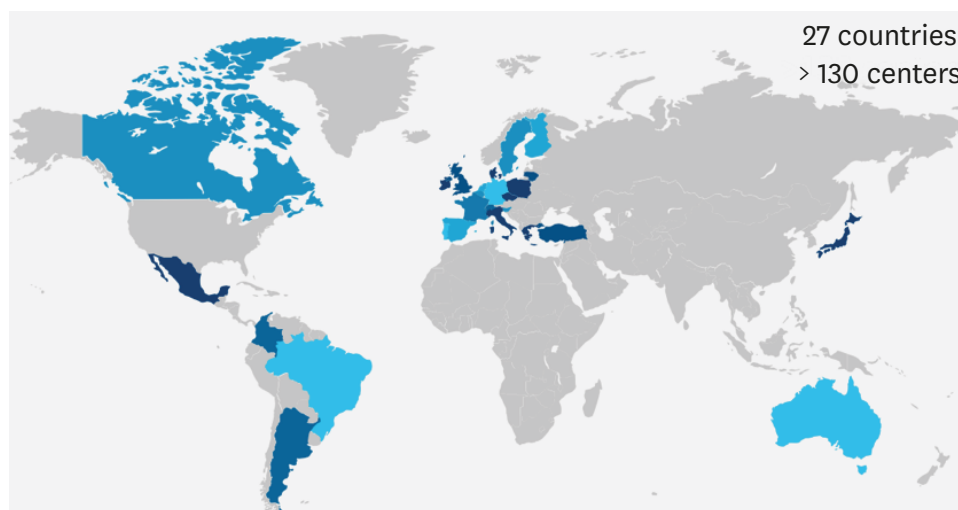
The MAFEIP for the EIP on AHA monitoring framework comprises a web-based tool which rests on the principles of Decision Analytic Modeling (DAM) (<https://www.mafeip.eu/the-tool>). It is based on a traditional Markov model commonly used in health economic evaluations to assess the impact of healthcare innovations in terms of health outcomes and resource use (Fig. 3).

In all the Markov models considered, the baseline health state represents the general health status of the target population. The disease/impairment health state(s) reflect(s) the health status of people who experience the condition of interest (the condition that the intervention aims to prevent, relieve or cure). Each health state is defined by an amount of resource use and quality of life (utility). This represents the average resource use and quality of life of a patient in that health state.

MASK aims to reduce the global burden of AR and asthma multimorbidity in a cost-effective manner, giving the patient and the health care professional simple tools to better prevent and manage respiratory allergic diseases and to inform policy makers.

AR impairs quality-of-life,<sup>45</sup> but NEVER induces death. Thus, the MAFEIP model that has a state of death may be difficult to be used for rhinitis. Prof. A. Briggs designed DAM<sup>46</sup> and is the health economics consultant of the ARIA group.

Discussion is underway with Prof. Briggs to apply the DAM model to MASK and to make it applicable to non-lethal chronic diseases. The model for rhinitis will use EQ-5D weekly<sup>7</sup> and a VAS daily for work and school productivity. There are sufficient data in MASK to perform a pilot study. This information will help guide both clinicians and health policy makers.<sup>47</sup> A pilot study on daily work productivity provides not only proof-of-concept data on the work impairment collected with the app, but also data on the app itself, especially the distribution of responses for VAS. This supports the interpretation that patients with rhinitis report both the presence and the absence of symptoms. We have performed analyses with up to 100,000



**Fig. 3.** The MAFEIP community.  
MAFEIP, monitoring and assessment framework.



days of VAS work. The dissemination plans for MASK include publishing the case studies and evidence based on the MAFEIP website.

Using the rhinitis and asthma Twinning data, MASK will follow 1,000 patients enrolled by their allergist using an interoperable physician's questionnaire. Then, the results of this study will be used to assess all users who have used the app.

## POLITICAL, ORGANIZATIONAL, TECHNOLOGICAL AND FINANCIAL READINESS

### Political

#### *Regional*

- MASK is fully supported by the Région Occitanie.
- In a project on transfer of innovation for severe asthma, the engagement through Salerno local health agency of ProMIS@Campania network<sup>48,49</sup> will ensure that adoption is progressively achieved through a multicentric scale-up pilot. The GP will be adopted by Campania Reference Site through Salerno Health Agency. The involvement of Campania Region Health Directorate through the Unit for Health Innovation will ensure progressive further scale-up to the regional health system through the ProMIS@Campania network. The National ProMIS network will support dissemination and exploitation to other Italian regions.

#### *WHO*

- One example of the WHO-International Telecommunication Union “Be He@lthy, Be Mobile” handbook on how to implement mBreatheFreely for asthma and chronic obstructive pulmonary disease.<sup>50</sup>
- GARD demonstration project.<sup>11</sup>

#### *Political agenda of the EU*

- The EU political agenda is of great importance in supporting the digital transformation of health and care for CRDs. The Polish Presidency of the EU Council (2011) prioritized the early diagnosis, prevention and control of CRDs in children.<sup>51,52</sup> AIRWAYS-ICPs,<sup>53</sup> initiated in 2014 by the EIP on AHA,<sup>54</sup> launched a collaboration to develop multi-sectoral ICPs. It was a GARD demonstration project.<sup>11</sup>
- Euforea proposed a yearly stepwise strategy at the EU or ministerial levels.<sup>55</sup> Euforea organized an EU Summit in Vilnius, Lithuania (March 2018) to propose multisectoral ICPs embedding guided self-management, mHealth and air pollution in CRDs.<sup>15</sup> On May 3, 2019, another Euforea-led meeting (Parliament of Malta) reviewed the results of the Vilnius Declaration.
- POLLAR is focusing on the impact of allergens and air pollution on airway diseases to propose novel ICPs integrating pollution, sleep and patient literacy.<sup>15</sup>
- The next phase of MASK will be the digital transformation of health and care to sustain Planetary health.

### Organizational

- GP of the EIP on AHA follows CHRODIS.<sup>56</sup>
- GP on digitally enabled, integrated, patient-centered care endorsed by DG Santé<sup>3</sup>
- Based on several EU grants (Mechanisms of the Development of ALLergy,<sup>57</sup> GA<sup>2</sup>LEN<sup>44</sup>)

including POLLAR,<sup>15</sup> and the DHE TWINNING on the Digital Single Market.

- Reported in the Joint Research Centre Science and Policy Reports on Strategic Intelligence Monitor on Personal Health Systems phase 3.<sup>58</sup>

### Technology Readiness level (TRL)

- App (MASK-air<sup>®</sup>): TRL9 (ISO 16290:2013 standard<sup>59</sup>).
- e-physician questionnaire deployed in 23 countries (available on the Euforea website): TRL9.
- Electronic clinical decision support system for the tablet (ARIA e-CDSS): TRL7.
- App (MASK-asthma): TRL8 and tested in 23 countries 4-2020 (TRL9).
- Embedding air pollution and pollen data in MASK-air<sup>®</sup> (POLLAR): TRL9.
- Embedding artificial intelligence in MASK-air<sup>®</sup>: TLR3.

### Financial readiness

Over the past 5 years, a total budget of around 4 M€ has been obtained, 2.6 M€ from EU grants and the rest from private sources.

A start-up company (MASK-air) has been set up.

Other EU grants have been submitted for 2018, and private sources allow the sustainability of the project.

A cost business plan has been developed which will allow us to scale up MASK to 50,000 users by 2020. This will help sustain the project in the longer term and allow us to provide further evidence on impact against personal health and well-being, and the economic savings through reduced absenteeism from work, *etc.*

## CONTRIBUTION TO EUROPEAN CO-OPERATION AND TRANSFERABILITY

### Rhinitis and asthma Twinning (2017-2018)

The overarching goal of the EIP on AHA is to enable European citizens to lead healthy, active and independent lives while ageing. The aim of this Twinning was to transfer innovation from an app developed by the MACVIA-France EIP on AHA reference site (Allergy Diary) to other reference sites.<sup>4</sup> The phenotypic characteristics of rhinitis and asthma multimorbidities in adults and the elderly were compared using validated ICT tools (*i.e.*, MASK-air<sup>®</sup> and CARAT: Control of AR and Asthma Test and a physician's questionnaire developed for the Twinning) in 22 Reference Sites or regions across Europe. This improved the understanding, assessment of burden, diagnosis and management of rhinitis in the elderly by comparison with an adult population. Specific objective was: 1) to assess the percentage of adults and the elderly able to use the Allergy Diary, 2) to study the phenotypic characteristics and treatment over a 1-year period of rhinitis and asthma multimorbidities at baseline (cross-sectional study), 3) to follow up using VAS. This part of the study may provide some insight into the differences between the elderly and adults in terms of response to treatment and practice, and finally 4) to examine work productivity in adults.

Over 1,000 patients were enrolled and the analysis is currently ongoing.

During the course of the Twinning, new Reference Sites joined the project.

The rhinitis and asthma Twinning was considered to be the most mature Twinning and one of the 4 success stories of the Digital Health Europe Twinning.

### **MASK website**

The MASK website is available in 15 languages (<https://www.mask-air.com/>).

### **GARD: target on developing countries**

The Twinning is a GARD demonstration project.<sup>11</sup> Developing countries have participated in the Twinning (Brazil)<sup>60</sup> using a strategy for measuring health outcomes and evaluating impacts on interventions.<sup>61</sup>

Two GARD websites exist, one being at the WHO (<https://www.who.int/gard/en/>), and the other (<https://gard-breathefreely.org/>).

### **Euforea**

Euforea proposed a stepwise yearly strategy at the EU or ministerial levels.<sup>62-65</sup> Euforea organized an EU Summit in Vilnius, Lithuania (March 2018) to propose multisectoral ICPs embedding guided self-management, mHealth and air pollution in CRDs.<sup>12</sup> On May 3, 2019, another Euforea-led meeting (Parliament of Malta) reviewed the results of the Vilnius Declaration.

## **DELIVERING EVIDENCE OF IMPACT AGAINST THE TRIPLE WIN APPROACH**

The benefits of the triple win are 1) putting the patient in control, 2) saving on costs and efficiency, and 3) creating huge opportunities for innovative services and start-ups.

### **Quality in care (individual benefit)**

MASK follows mHealth requirements—proposing smart devices for the self-management of diseases and remote monitoring, leading to prevention and management. MASK can help healthcare professionals treat patients more efficiently and can enable citizens to become more involved in the management of their health and diseases.

- MASK ensured that mHealth apps meet citizens' demands for quality and transparency.
- MASK was tested for quality and compared favorably with other mHealth apps for CRDs.
- MASK adheres to strict data protection rules. MASK follows GDPR strictly in particular for geolocation using the k-anonymity method.
- MASK attempts to increase user trust and patient safety in order to boost mHealth's contribution to high-quality healthcare.
- MASK attempts to use novel methods about how we use the data. MASK provided real-world information on rhinitis and asthma.

### **Research and innovation (industrial benefit)**

- MASK has immediately involved SMEs (Kyomed and ASA, Montpellier, and Peercode, NL) to develop the project with a strong business plan for the GP Solution. A new start-up has been established (MASK-air) initially creating 4 job opportunities. MASK-air will develop centers of excellence on digital health for airway diseases (ARIACare-Digital).

- MASK obtained an EIT Health project (POLLAR) to develop an innovative solution in order to predict the pollen season and its interactions with pollution using a business plan and a strong commercial commitment.

### **Supporting the long-term sustainability and efficiency of health and social care systems (institutional and staff benefit)**

In process to be done from the GP, the ARIA group (the initiative from which MASK was developed) has been endorsed by several governments globally<sup>36</sup> and its recommendations are used by the EMA.

## **CONTRIBUTION TO THE EUROPEAN DIGITAL TRANSFORMATION OF HEALTH AND CARE (MASK—A GP OF DG SANTÉ)**

In the context of implementing communication on the digital transformation of health and care, DG Santé (the European Commission's Directorate-General for Health and Food Safety), in collaboration with the newly established EU Commission Expert Group "Steering Group on Health Promotion, Disease Prevention and Management of Non-Communicable Diseases (NCD)" ([https://ec.europa.eu/health/non\\_communicable\\_diseases/steeringgroup\\_promotionprevention\\_en](https://ec.europa.eu/health/non_communicable_diseases/steeringgroup_promotionprevention_en)), has supported the scaling-up and wider implementation of GPs in the field of digitally enabled, integrated, person-centered care. MASK was one of the 9 GPs selected along with chronic disease and Parkinson's disease.<sup>3</sup>

In all societies, the burden and cost of NCD are increasing rapidly.<sup>66</sup> Most economies are struggling to deliver modern health care effectively. The transformation of the health care system into integrated care needs to be supported using organizational health literacy and digital health.

As an example for chronic diseases, ICPs, MASK and POLLAR,<sup>21</sup> in collaboration with professional and patient organizations in the field of allergy and airway diseases, are proposing real-world ICPs centered around the patient with rhinitis and asthma multimorbidity. These next-generation ICPs represent a cornerstone for the digital transformation of health.

There is a need to support the digital transformation of health and care with ICPs. An innovative patient-centered approach for ICPs has been proposed by the ARIA expert group for rhinitis and asthma multimorbidity to be scaled up to chronic diseases. Five aspects of ICPs have been developed in particular:

- 1) Patient participation, health literacy and self-care through technology-assisted "patient activation."<sup>29</sup>
- 2) ICP implementation by pharmacists.<sup>37</sup>
- 3) Next-generation ARIA guidelines have assessed the GRADE recommendations in AR and asthma using RWE that includes not only randomized controlled trials on treatment effects, but also evidence obtained by mHealth tools including MASK in order to confirm the efficiency or refine current recommendations. The MASK results have confirmed the feasibility of the project that will be used for other diseases.
- 4) ARIA ICPs for allergen immunotherapy,<sup>67</sup> including an innovative symptom-medication

score, based on the real-world data of MASK and the results of POLLAR for the prediction of the pollen season and pollutants.

- 5) Embedding air pollution, aerobiology and novel approaches in ICPs during a meeting organized by the Finnish Institute of Health and Welfare (Presidency of the EU council, December 3-4, 2019).

**MASK STUDY GROUP:** J Bousquet,<sup>1,2,3,4,5,6,7\*</sup> J Farrell,<sup>8</sup> GL Onorato,<sup>2</sup> A Bedbrook,<sup>2</sup> W Czarlewski,<sup>9</sup> Y Micheli,<sup>10</sup> S Arnavielhe,<sup>10</sup> M Illario,<sup>11</sup> IJ Ansoategui,<sup>12</sup> JM Anto,<sup>13,14,15,16</sup> C Bachert,<sup>17</sup> X Basagaña,<sup>13</sup> A Bédard,<sup>13</sup> S Benveniste,<sup>18,19</sup> KC Bergmann,<sup>6,7</sup> M Bewick,<sup>20</sup> C Bindsvlev-Jensen,<sup>21</sup> L Bjermer,<sup>22</sup> H Blain,<sup>23,24</sup> S Bosnic-Anticevich,<sup>25</sup> I Bosse,<sup>26</sup> F Braido,<sup>27</sup> L Brussino,<sup>28</sup> T Camuzat,<sup>29</sup> GW Canonica,<sup>30</sup> V Cardona,<sup>31</sup> P Carreiro Martins,<sup>32,33</sup> L Cecchi,<sup>34</sup> NH Chavannes,<sup>35</sup> DK Chu,<sup>36,37</sup> J Correia da Sousa,<sup>38,39</sup> DJ Costa,<sup>40</sup> E Costa,<sup>41</sup> AA Cruz,<sup>42,43</sup> J da Silva,<sup>44</sup> P Devillier,<sup>45</sup> G De Feo,<sup>46</sup> G De Vries,<sup>47</sup> G Dray,<sup>48</sup> M Ebisawa,<sup>49</sup> M Erhola,<sup>50</sup> JL Fauquert,<sup>51</sup> WJ Fokkens,<sup>5,52</sup> J Fonseca,<sup>53,54</sup> JM Fontaine,<sup>55</sup> B Gemicioglu,<sup>56</sup> T Haahtela,<sup>57</sup> E Heffler,<sup>30</sup> PW Hellings,<sup>5,58,59</sup> JC Ivancevich,<sup>60</sup> E Jassem,<sup>61</sup> M Jutel,<sup>62</sup> I Kaidashev,<sup>63</sup> O Kalayci,<sup>64</sup> L Klimek,<sup>65</sup> ML Kowalski,<sup>66</sup> I Kull,<sup>67,68</sup> P Kuna,<sup>69</sup> V Kvedariene,<sup>70</sup> S La Grutta,<sup>71</sup> D Laune,<sup>10</sup> D Larenas-Linnemann,<sup>72</sup> D Ierodiakonou,<sup>73,74</sup> LTT Le,<sup>75</sup> O Lourenço,<sup>76</sup> M Makris,<sup>77</sup> E Menditto,<sup>78</sup> R Monti,<sup>28</sup> M Morais-Almeida,<sup>79</sup> L Münter,<sup>80</sup> A Muraro,<sup>81</sup> R Murray,<sup>82,83</sup> M Maurer,<sup>6,7</sup> E Melén,<sup>66,84</sup> R Mösges,<sup>85</sup> J Mullol,<sup>86,87</sup> M Niedoszytko,<sup>59</sup> RE O'Hehir,<sup>88,89</sup> Y Okamoto,<sup>90</sup> NG Papadopoulos,<sup>91,92</sup> G Passalacqua,<sup>93</sup> V Patella,<sup>94</sup> AM Pereira,<sup>51,95</sup> O Pfaar,<sup>96</sup> N Pham-Thi,<sup>97</sup> F Portejoie,<sup>2</sup> D Price,<sup>98</sup> EP Prokopakis,<sup>99</sup> F Psarros,<sup>100</sup> F Raciborski,<sup>101</sup> F Regateiro,<sup>102</sup> S Reitsma,<sup>5,50</sup> N Roche,<sup>103</sup> C Rolland,<sup>104</sup> D Ryan,<sup>105</sup> B Samolinski,<sup>102</sup> J Sastre,<sup>106</sup> GK Scadding,<sup>107</sup> P Schmid-Grendelmeier,<sup>108</sup> HJ Schünemann,<sup>34,35</sup> M Shamji,<sup>109</sup> A Sheikh,<sup>110</sup> C Stellato,<sup>44</sup> C Suppli-Ulrik,<sup>111</sup> D Somekh,<sup>112</sup> M Sova,<sup>113</sup> A Todo Bom,<sup>114</sup> PV Tomazic,<sup>115</sup> S Toppila-Salmi,<sup>55</sup> M Triggiani,<sup>44</sup> I Tsiligianni,<sup>71,72</sup> A Valero,<sup>87</sup> A Valiulis,<sup>116,117</sup> E Valovirta,<sup>118</sup> M van Eerd,<sup>45</sup> T Vasankari,<sup>119</sup> MT Ventura,<sup>120</sup> D Wallace,<sup>121</sup> S Wasserman,<sup>35</sup> A Yorgancioglu,<sup>122</sup> M Zidarn,<sup>123</sup> T Zuberbier,<sup>6,7</sup> and the MASK study group.

<sup>1</sup>CHU Arnaud de Villeneuve, Montpellier, France

<sup>2</sup>MACVIA-France, Montpellier, France

<sup>3</sup>INSERM U 1168, VIMA: Ageing and Chronic Diseases Epidemiological and Public Health Approaches, Villejuif, France

<sup>4</sup>UMR-S 1168, Université Versailles St-Quentin-en-Yvelines, Montigny le Bretonneux, France

<sup>5</sup>Euforea, Brussels, Belgium

<sup>6</sup>Charité - Universitätsmedizin Berlin, Humboldt-Universität zu Berlin, Berlin, Germany

<sup>7</sup>Department of Dermatology and Allergy, Berlin Institute of Health, Comprehensive Allergy Center, Berlin, Germany

<sup>8</sup>LANUA International Healthcare Consultancy, Belfast, Northern Ireland, UK

<sup>9</sup>Medical Consulting Czarlewski, Levallois, France

<sup>10</sup>KYomed INNOV, Montpellier, France

<sup>11</sup>Division for Health Innovation, Campania Region and Federico II University Hospital Naples (R&D Unit and Department of Public Health), Naples, Italy

<sup>12</sup>Department of Allergy and Immunology, Hospital Quirónsalud Bizkaia, Erandio, Spain

<sup>13</sup>ISGlobAL, Centre for Research in Environmental Epidemiology (CREAL), Barcelona, Spain

<sup>14</sup>Hospital del Mar Research Institute (IMIM), Barcelona, Spain

<sup>15</sup>CIBER Epidemiología y Salud Pública (CIBERESP), Barcelona, Spain

<sup>16</sup>Universitat Pompeu Fabra (UPF), Barcelona, Spain

<sup>17</sup>Upper Airways Research Laboratory, Department of ENT, Ghent University Hospital, Ghent, Belgium

<sup>18</sup>National Center of Expertise in Cognitive Stimulation (CEN STIMCO), Broca Hospital, Paris, France

- <sup>19</sup>Mines ParisTech CRI - PSL Research University, Fontainebleau, France
- <sup>20</sup>iQ4U Consultants Ltd, London, UK
- <sup>21</sup>Department of Dermatology and Allergy Centre, Odense University Hospital, Odense Research Center for Anaphylaxis (ORCA), Odense, Denmark
- <sup>22</sup>Department of Respiratory Medicine and Allergology, Lund University, Lund, Sweden
- <sup>23</sup>Department of Geriatrics, Montpellier University Hospital, Montpellier, France
- <sup>24</sup>EA 2991, Euromov, University Montpellier, France
- <sup>25</sup>Woolcock Institute of Medical Research, University of Sydney and Woolcock Emphysema Centre and Sydney Local Health District, Glebe, Australia
- <sup>26</sup>Allergologist, La Rochelle, France
- <sup>27</sup>University of Genoa, Department of Internal Medicine, DiMI) and IRCCS Ospedale Policlinico San Martino, Genova, Italy
- <sup>28</sup>Department of Medical Sciences, Allergy and Clinical Immunology Unit, University of Torino & Mauriziano Hospital, Torino, Italy
- <sup>29</sup>Assitant Director General, Montpellier, Région Occitanie, Montpellier, France
- <sup>30</sup>Personalized Medicine Clinic Asthma & Allergy, Humanitas Clinical and Research Center IRCCS, Rozzano (MI), Italy
- <sup>31</sup>Allergy Section, Department of Internal Medicine, Hospital Vall d'Hebron & ARADyAL Research Network, Barcelona, Spain
- <sup>32</sup>Serviço de Imunoalergologia, Hospital de Dona Estefânia, Centro Hospitalar de Lisboa Central, Lisbon, Portugal
- <sup>33</sup>CEDOC-CHRC, Faculdade de Ciências Médicas (FCM), Universidade Nova de Lisboa, Lisbon, Portugal
- <sup>34</sup>SOS Allergology and Clinical Immunology, USL Toscana Centro, Prato, Italy
- <sup>35</sup>Department of Public Health and Primary Care, Leiden University Medical Center, Leiden, The Netherlands
- <sup>36</sup>Department of Health Research Methods, Evidence, and Impact, McMaster University, Hamilton, Canada
- <sup>37</sup>Division of Clinical Immunology and Allergy, Department of Medicine, McMaster University, Hamilton, Canada
- <sup>38</sup>Life and Health Sciences Research Institute (ICVS), School of Medicine, University of Minho, Braga, Portugal
- <sup>39</sup>ICVS/3B's, PT Government Associate Laboratory, Braga/Guimarães, Portugal
- <sup>40</sup>General Practice, Nîmes, France
- <sup>41</sup>UCIBIO, REQUIMTE, Faculty of Pharmacy, and Competence Center on Active and Healthy Ageing of University of Porto (AgeUPNetWork), University of Porto, Porto, Portugal
- <sup>42</sup>ProAR – Nucleo de Excelencia em Asma, Federal University of Bahia, Salvador, Brasil
- <sup>43</sup>WHO GARD Planning Group, Salvador, Brazil
- <sup>44</sup>Allergy Service, University Hospital of Federal University of Santa Catarina (HU-UFSC), Florianópolis, Brazil
- <sup>45</sup>UPRES EA220, Pôle des Maladies des Voies Respiratoires, Hôpital Foch, Université Paris-Saclay, Suresnes, France
- <sup>46</sup>Department of Medicine, Surgery and Dentistry “Scuola Medica Salernitana”, University of Salerno, Salerno, Italy
- <sup>47</sup>Peercode BV, Geldermalsen, The Netherlands
- <sup>48</sup>IMT Mines Alès, Université Montpellier, France
- <sup>49</sup>Clinical Reserch Center for Allergy and Rheumatology, Sagamihara National Hospital, Sagamihara, Japan
- <sup>50</sup>National Insitute for Health and Welfare, Helsinki, Finland

- <sup>51</sup>CHU Clermont-Ferrand, Unité d'allergologie de l'enfant, Pôle pédiatrique, Hôpital Estaing, Clermont-Ferrand, France
- <sup>52</sup>Department of Otorhinolaryngology, Amsterdam University Medical Centres, AMC, Amsterdam, The Netherlands
- <sup>53</sup>CINTESIS, Center for Research in Health Technology and Information Systems, Faculdade de Medicina da Universidade do Porto, Porto, Portugal
- <sup>54</sup>Medida, Lda, Porto, Portugal
- <sup>55</sup>Allergologist, Reims, France
- <sup>56</sup>Department of Pulmonary Diseases, Istanbul University-Cerrahpasa, Cerrahpasa Faculty of Medicine, Istanbul, Turkey
- <sup>57</sup>Skin and Allergy Hospital, Helsinki University Hospital, and University of Helsinki, Helsinki, Finland
- <sup>58</sup>Department of Otorhinolaryngology, University Hospitals Leuven, Leuven, Belgium
- <sup>59</sup>Academic Medical Center, University of Amsterdam, Amsterdam, The Netherlands
- <sup>60</sup>Servicio de Alergia e Immunologia, Clinica Santa Isabel, Buenos Aires, Argentina
- <sup>61</sup>Department of Allergology, Medical University of Gdańsk, Gdańsk, Poland
- <sup>62</sup>Department of Clinical Immunology, Wrocław Medical University, Poland
- <sup>63</sup>Ukrainina Medical Stomatological Academy, Poltava, Ukraine
- <sup>64</sup>Pediatric Allergy and Asthma Unit, Hacettepe University School of Medicine, Ankara, Turkey
- <sup>65</sup>Center for Rhinology and Allergology, Wiesbaden, Germany
- <sup>66</sup>Department of Immunology and Allergy, Healthy Ageing Research Center, Medical University of Lodz, Poland
- <sup>67</sup>Department of Clinical Science and Education Södersjukhuset, Karolinska Institutet, Stockholm, Sweden
- <sup>68</sup>Sach's Children and Youth Hospital, Södersjukhuset, Stockholm, Sweden
- <sup>69</sup>Division of Internal Medicine, Asthma and Allergy, Barlicki University Hospital, Medical University of Lodz, Poland
- <sup>70</sup>Institute of Biomedical Sciences, Department of Pathology, Faculty of Medicine, Vilnius University, and Institute of Clinical Medicine, Clinic of Chest diseases and Allergology, Faculty of Medicine, Vilnius, Lithuania
- <sup>71</sup>Institute for Research and Biomedical Innovation (IRIB), National Research Council (CNR), Palermo, Italy
- <sup>72</sup>Center of Excellence in Asthma and Allergy, Médica Sur Clinical Foundation and Hospital, México City, Mexico
- <sup>73</sup>Department of Social Medicine, Faculty of Medicine, University of Crete and International Primary Care Respiratory Group, Crete, Greece
- <sup>74</sup>International Primary Care Respiratory Group IPCRG, Aberdeen, Scotland
- <sup>75</sup>University of Medicine and Pharmacy, Ho Chi Minh City, Vietnam
- <sup>76</sup>Faculty of Health Sciences and CICS – UBI, Health Sciences Research Centre, University of Beira Interior, Covilhã, Portugal
- <sup>77</sup>Allergy Unit “D Kalogeromitros”, 2nd Department of Dermatology and Venereology, National & Kapodistrian University of Athens, Attikon University Hospital, Athens, Greece
- <sup>78</sup>CIRFF, Center of Pharmacoconomics, University of Naples Federico II, Naples, Italy
- <sup>79</sup>Allergy Center, CUF Descobertas Hospital, Lisbon, Portugal
- <sup>80</sup>Danish Committee for Health Education, Copenhagen East, Denmark
- <sup>81</sup>Food Allergy Referral Centre Veneto Region, Department of Women and Child Health, Padua General University Hospital, Padua, Italy
- <sup>82</sup>Director, MedScript, Paraparaumu, New Zealand.
- <sup>83</sup>Research Fellow, Optimum Patient Care, Cambridge, UK

- <sup>84</sup>Institute of Environmental Medicine, Karolinska Institutet, Stockholm, Sweden
- <sup>85</sup>Institute of Medical Statistics, and Computational Biology, Medical Faculty, University of Cologne, Germany and CRI-Clinical Research International-Ltd, Hamburg, Germany
- <sup>86</sup>Rhinology Unit & Smell Clinic, Department of ENT, Hospital Clínic, Barcelona, Spain
- <sup>87</sup>Clinical & Experimental Respiratory Immunoallergy, IDIBAPS, CIBERES, University of Barcelona, Barcelona, Spain
- <sup>88</sup>Department of Allergy, Immunology and Respiratory Medicine, Alfred Hospital and Central Clinical School, Monash University, Melbourne, Australia
- <sup>89</sup>Department of Immunology, Monash University, Melbourne, Australia
- <sup>90</sup>Department of Otorhinolaryngology, Chiba University Hospital, Chiba, Japan
- <sup>91</sup>Division of Infection, Immunity & Respiratory Medicine, Royal Manchester Children's Hospital, University of Manchester, Manchester, UK
- <sup>92</sup>Department of Allergy, 2nd Pediatric Clinic, Athens General Children's Hospital "P&A Kyriakou," University of Athens, Athens, Greece
- <sup>93</sup>Allergy and Respiratory Diseases, Ospedale Policlinico San Martino, University of Genoa, Italy
- <sup>94</sup>Division of Allergy and Clinical Immunology, Department of Medicine, Agency of Health ASL Salerno, Santa Maria della Speranza Hospital, Salerno, Italy
- <sup>95</sup>Allergy Unit, CUF-Porto Hospital and Institute, Porto, Portugal
- <sup>96</sup>Department of Otorhinolaryngology, Head and Neck Surgery Section of Rhinology and Allergy, University Hospital Marburg, Philipps-Universität Marburg, Germany
- <sup>97</sup>Department of Allergy, Pasteur Institute, Paris, France
- <sup>98</sup>Observational and Pragmatic Research Institute, Singapore, Singapore
- <sup>99</sup>Department of Otorhinolaryngology University of Crete School of Medicine, Heraklion, Greece
- <sup>100</sup>Allergy Department, Athens Naval Hospital, Athens, Greece
- <sup>101</sup>Department of Prevention of Environmental Hazards and Allergology, Medical University of Warsaw, Warsaw, Poland
- <sup>102</sup>Imunoalergologia, Centro Hospitalar Universitário de Coimbra and Faculty of Medicine, University of Coimbra, Portugal
- <sup>103</sup>Pneumologie et Soins Intensifs Respiratoires, Hôpitaux Universitaires Paris, Centre Hôpital Cochin, Paris, France
- <sup>104</sup>Association Asthme et Allergie, Paris, France
- <sup>105</sup>Allergy and Respiratory Research Group, The University of Edinburgh, Edinburgh, UK
- <sup>106</sup>Faculty of Medicine, Autonomous University of Madrid, Spain
- <sup>107</sup>The Royal National TNE Hospital, University College London, London, UK
- <sup>108</sup>Allergy Unit, Department of Dermatology, University Hospital of Zurich, Zürich, Switzerland
- <sup>109</sup>Immunomodulation and Tolerance Group, Allergy and Clinical Immunology, Imperial College London, London, UK
- <sup>110</sup>The Usher Institute of Population Health Sciences and Informatics, The University of Edinburgh, Edinburgh, UK
- <sup>111</sup>Department of Respiratory Medicine, Hvidovre Hospital, University of Copenhagen, Copenhagen, Denmark
- <sup>112</sup>European Health Futures Forum (EHFF), Dromahair, UK
- <sup>113</sup>Department of Respiratory Medicine, University Hospital Olomouc, Olomouc, Czechia
- <sup>114</sup>Imunoalergologia, Centro Hospitalar Universitário de Coimbra and Faculty of Medicine, University of Coimbra, Coimbra, Portugal
- <sup>115</sup>Department of General ORL, H1NS, Medical University of Graz, Graz, Austria
- <sup>116</sup>Vilnius University Faculty of Medicine, Institute of Clinical Medicine & Institute of Health Sciences, Vilnius, Lithuania
- <sup>117</sup>European Academy of Paediatrics (EAP/UEMS-SP), Brussels, Belgium



- <sup>118</sup>Department of Lung Diseases and Clinical Immunology, University of Turku and Terveystalo Allergy Clinic, Turku, Finland
- <sup>119</sup>FILHA, Finnish Lung Association, Helsinki, Finland
- <sup>120</sup>University of Bari Medical School, Unit of Geriatric Immunoallergology, Bari, Italy
- <sup>121</sup>Nova Southeastern University, Fort Lauderdale, Florida, USA
- <sup>122</sup>Department of Pulmonary Diseases, Celal Bayar University, Faculty of Medicine, Manisa, Turkey
- <sup>123</sup>University Clinic of Respiratory and Allergic Diseases, Golnik, Slovenia

## REFERENCES

1. Bousquet J, Anto JM, Sterk PJ, Adcock IM, Chung KF, Roca J, et al. Systems medicine and integrated care to combat chronic noncommunicable diseases. *Genome Med* 2011;3:43.  
[PUBMED](#) | [CROSSREF](#)
2. Bousquet J, Arnavielhe S, Bedbrook A, Bewick M, Laune D, Mathieu-Dupas E, et al. MASK 2017: ARIA digitally-enabled, integrated, person-centred care for rhinitis and asthma multimorbidity using real-world-evidence. *Clin Transl Allergy* 2018;8:45.  
[PUBMED](#) | [CROSSREF](#)
3. Bousquet J, Bedbrook A, Czarlewski W, Onorato GL, Arnavielhe S, Laune D, et al. Guidance to 2018 good practice: ARIA digitally-enabled, integrated, person-centred care for rhinitis and asthma. *Clin Transl Allergy* 2019;9:16.  
[PUBMED](#) | [CROSSREF](#)
4. Bousquet J, Bourret R, Camuzat T, Augé P, Bringer J, Noguès M, et al. MACVIA-LR (fighting chronic diseases for active and healthy ageing in Languedoc-Roussillon): a success story of the European Innovation Partnership on Active and Healthy Ageing. *J Frailty Aging* 2016;5:233-41.  
[PUBMED](#)
5. Bousquet J, Hellings PW, Agache I, Amat F, Annesi-Maesano I, Ansotegui IJ, et al. Allergic Rhinitis and its Impact on Asthma (ARIA) phase 4 (2018): change management in allergic rhinitis and asthma multimorbidity using mobile technology. *J Allergy Clin Immunol* 2019;143:864-79.  
[PUBMED](#) | [CROSSREF](#)
6. Bousquet J, Khaltaev N, Cruz AA, Denburg J, Fokkens WJ, Togias A, et al. Allergic Rhinitis and its Impact on Asthma (ARIA) 2008 update (in collaboration with the World Health Organization, GA(2)LEN and AllerGen). *Allergy* 2008;63 Suppl 86:8-160.  
[PUBMED](#) | [CROSSREF](#)
7. Bousquet J, Arnavielhe S, Bedbrook A, Fonseca J, Morais Almeida M, Todo Bom A, et al. The Allergic Rhinitis and its Impact on Asthma (ARIA) score of allergic rhinitis using mobile technology correlates with quality of life: the MASK study. *Allergy* 2018;73:505-10.  
[PUBMED](#) | [CROSSREF](#)
8. Courbis AL, Murray RB, Arnavielhe S, Caimmi D, Bedbrook A, Van Eerd M, et al. Electronic clinical decision support system for allergic rhinitis management: MASK e-CDSS. *Clin Exp Allergy* 2018;48:1640-53.  
[PUBMED](#) | [CROSSREF](#)
9. Bousquet J, Agache I, Aliberti MR, Angles R, Annesi-Maesano I, Anto JM, et al. Transfer of innovation on allergic rhinitis and asthma multimorbidity in the elderly (MACVIA-ARIA) - EIP on AHA Twinning reference site (GARD research demonstration project). *Allergy* 2018;73:77-92.  
[PUBMED](#) | [CROSSREF](#)
10. Bousquet J, Farrell J, Crooks G, Hellings P, Bel EH, Bewick M, et al. Scaling up strategies of the chronic respiratory disease programme of the European Innovation Partnership on Active and Healthy Ageing (action plan B3: area 5). *Clin Transl Allergy* 2016;6:29.  
[PUBMED](#) | [CROSSREF](#)
11. Bousquet J, Mohammad Y, Bedbrook A, To T, McGihon R, Bárbara C, et al. Country activities of Global Alliance against Chronic Respiratory Diseases (GARD): focus presentations at the 11th GARD general meeting, Brussels. *J Thorac Dis* 2018;10:7064-72.  
[PUBMED](#) | [CROSSREF](#)
12. Valiulis A, Bousquet J, Veryga A, Suprun U, Sergeenko D, Cebotari S, et al. Vilnius declaration on chronic respiratory diseases: multisectoral care pathways embedding guided self-management, mHealth and air pollution in chronic respiratory diseases. *Clin Transl Allergy* 2019;9:7.  
[PUBMED](#) | [CROSSREF](#)

13. Bédard A, Basagaña X, Anto JM, Garcia-Aymerich J, Devillier P, Arnavielhe S, et al. Mobile technology offers novel insights into the control and treatment of allergic rhinitis: the MASK study. *J Allergy Clin Immunol* 2019;144:135-143.e6.  
[PUBMED](#) | [CROSSREF](#)
14. Bousquet J, Ansotegui JJ, Anto JM, Arnavielhe S, Bachert C, Basagaña X, et al. Mobile technology in allergic rhinitis: evolution in management or revolution in health and care? *J Allergy Clin Immunol Pract* 2019;7:2511-23.  
[PUBMED](#) | [CROSSREF](#)
15. Bousquet J, Anto JM, Annesi-Maesano I, Dedeu T, Dupas E, Pépin JL, et al. POLLAR: impact of air POLLution on Asthma and Rhinitis; a European Institute of Innovation and Technology Health (EIT Health) project. *Clin Transl Allergy* 2018;8:36.  
[PUBMED](#) | [CROSSREF](#)
16. Bousquet J, Bewick M, Arnavielhe S, Mathieu-Dupas E, Murray R, Bedbrook A, et al. Work productivity in rhinitis using cell phones: the MASK pilot study. *Allergy* 2017;72:1475-84.  
[PUBMED](#) | [CROSSREF](#)
17. Laune D, Arnavielhe S, Viart F, Bedbrook A, Mercier J, Lun San, et al. Adaptation of the General Data Protection Regulation (GDPR) to a smartphone app for rhinitis and asthma (MASK-air®). *Rev Mal Respir* 2019;36:1019-31.  
[PUBMED](#) | [CROSSREF](#)
18. Samreth D, Arnavielhe S, Ingenrieth F, Bedbrook A, Onorato GL, Murray R, et al. Geolocation with respect to personal privacy for the allergy diary app - a MASK study. *World Allergy Organ J* 2018;11:15.  
[PUBMED](#) | [CROSSREF](#)
19. Bédard A, Sofiev M, Arnavielhe S, Antó JM, Garcia-Aymerich J, Thibaudon M, et al. Interactions between air pollution and pollen season for rhinitis using mobile technology: a MASK-POLLAR study. *J Allergy Clin Immunol Pract*. Forthcoming 2019.  
[PUBMED](#) | [CROSSREF](#)
20. Caimmi D, Baiz N, Tanno LK, Demoly P, Arnavielhe S, Murray R, et al. Validation of the MASK-rhinitis visual analogue scale on smartphone screens to assess allergic rhinitis control. *Clin Exp Allergy* 2017;47:1526-33.  
[PUBMED](#) | [CROSSREF](#)
21. Sleurs K, Seys SF, Bousquet J, Fokkens WJ, Gorris S, Pugin B, et al. Mobile health tools for the management of chronic respiratory diseases. *Allergy* 2019;74:1292-306.  
[PUBMED](#) | [CROSSREF](#)
22. Tan R, Cvetkovski B, Kritikos V, O'Hehir RE, Lourenço O, Bousquet J, et al. Identifying an effective mobile health application for the self-management of allergic rhinitis and asthma in Australia. *J Asthma* 2019;1:12.  
[PUBMED](#) | [CROSSREF](#)
23. Bousquet J, Caimmi DP, Bedbrook A, Bewick M, Hellings PW, Devillier P, et al. Pilot study of mobile phone technology in allergic rhinitis in European countries: the MASK-rhinitis study. *Allergy* 2017;72:857-65.  
[PUBMED](#) | [CROSSREF](#)
24. Bousquet J, Devillier P, Anto JM, Bewick M, Haahtela T, Arnavielhe S, et al. Daily allergic multimorbidity in rhinitis using mobile technology: a novel concept of the MASK study. *Allergy* 2018;73:1622-31.  
[PUBMED](#) | [CROSSREF](#)
25. Bousquet J, Devillier P, Arnavielhe S, Bedbrook A, Alexis-Alexandre G, van Eerd M, et al. Treatment of allergic rhinitis using mobile technology with real-world data: the MASK observational pilot study. *Allergy* 2018;73:1763-74.  
[PUBMED](#) | [CROSSREF](#)
26. Menditto E, Costa E, Midão L, Bosnic-Anticevich S, Novellino E, Bialek S, et al. Adherence to treatment in allergic rhinitis using mobile technology. The MASK study. *Clin Exp Allergy* 2019;49:442-60.  
[PUBMED](#) | [CROSSREF](#)
27. Bousquet J, Pham-Thi N, Bedbrook A, Agache I, Annesi-Maesano I, Ansotegui I, et al. Next-generation care pathways for allergic rhinitis and asthma multimorbidity: a model for multimorbid non-communicable diseases-Meeting Report (Part 1). *J Thorac Dis* 2019;11:3633-82.  
[PUBMED](#) | [CROSSREF](#)
28. Bousquet J, Pham-Thi N, Bedbrook A, Agache I, Annesi-Maesano I, Ansotegui I, et al. Next-generation care pathways for allergic rhinitis and asthma multimorbidity: a model for multimorbid non-communicable diseases-meeting report (Part 2). *J Thorac Dis* 2019;11:4072-84.  
[PUBMED](#) | [CROSSREF](#)
29. Bousquet JJ, Schünemann HJ, Togias A, Erhola M, Hellings PW, Zuberbier T, et al. Next-generation ARIA care pathways for rhinitis and asthma: a model for multimorbid chronic diseases. *Clin Transl Allergy* 2019;9:44.  
[PUBMED](#) | [CROSSREF](#)

30. Bousquet J, Schünemann HJ, Togias A, Bachert C, Erhola M, Hellings PW, et al. MACVIA clinical decision algorithm in adolescents and adults with allergic rhinitis. *J Allergy Clin Immunol* 2016;138:367-374.e2.  
[PUBMED](#) | [CROSSREF](#)
31. Bousquet J, Schünemann HJ, Togias A, Bachert C, Erhola M, Hellings PW, et al. Next-generation Allergic Rhinitis and Its Impact on Asthma (ARIA) guidelines for allergic rhinitis based on grading of recommendations assessment, development and evaluation (GRADE) and real-world evidence. *J Allergy Clin Immunol* 2020;145:70-80.e3.  
[PUBMED](#) | [CROSSREF](#)
32. Bousquet J, Van Cauwenberge P, Khaltaev N; Aria Workshop Group; World Health Organization. Allergic rhinitis and its impact on asthma. *J Allergy Clin Immunol* 2001;108:S147-334.  
[PUBMED](#) | [CROSSREF](#)
33. Brozek JL, Bousquet J, Baena-Cagnani CE, Bonini S, Canonica GW, Casale TB, et al. Allergic Rhinitis and its Impact on Asthma (ARIA) guidelines: 2010 revision. *J Allergy Clin Immunol* 2010;126:466-76.  
[PUBMED](#) | [CROSSREF](#)
34. Brożek JL, Bousquet J, Agache I, Agarwal A, Bachert C, Bosnic-Anticevich S, et al. Allergic Rhinitis and its Impact on Asthma (ARIA) guidelines-2016 revision. *J Allergy Clin Immunol* 2017;140:950-8.  
[PUBMED](#) | [CROSSREF](#)
35. Bousquet J, Mantzouranis E, Cruz AA, Ait-Khaled N, Baena-Cagnani CE, Bleecker ER, et al. Uniform definition of asthma severity, control, and exacerbations: document presented for the World Health Organization consultation on severe asthma. *J Allergy Clin Immunol* 2010;126:926-38.  
[PUBMED](#) | [CROSSREF](#)
36. Bousquet J, Schünemann HJ, Samolinski B, Demoly P, Baena-Cagnani CE, Bachert C, et al. Allergic Rhinitis and its Impact on Asthma (ARIA): achievements in 10 years and future needs. *J Allergy Clin Immunol* 2012;130:1049-62.  
[PUBMED](#) | [CROSSREF](#)
37. Bosnic-Anticevich S, Costa E, Menditto E, Lourenço O, Novellino E, Bialek S, et al. ARIA pharmacy 2018 “Allergic rhinitis care pathways for community pharmacy”: AIRWAYS ICPs initiative (European Innovation Partnership on Active and Healthy Ageing, DG CONNECT and DG Santé) POLLAR (impact of air POLLution on Asthma and Rhinitis) GARD Demonstration project. *Allergy* 2019;74:1219-36.  
[PUBMED](#)
38. Amaral R, Bousquet J, Pereira AM, Araújo LM, Sá-Sousa A, Jacinto T, et al. Disentangling the heterogeneity of allergic respiratory diseases by latent class analysis reveals novel phenotypes. *Allergy* 2019;74:698-708.  
[PUBMED](#) | [CROSSREF](#)
39. Raciborski F, Bousquet J, Namyslowski A, Krzych-Falta E, Tomaszewska A, Piekarska B, et al. Correction to: dissociating polysensitization and multimorbidity in children and adults from a Polish general population cohort. *Clin Transl Allergy* 2019;9:23.  
[PUBMED](#) | [CROSSREF](#)
40. Siroux V, Boudier A, Nadif R, Lupinek C, Valenta R, Bousquet J. Association between asthma, rhinitis, and conjunctivitis multimorbidities with molecular IgE sensitization in adults. *Allergy* 2019;74:824-7.  
[PUBMED](#) | [CROSSREF](#)
41. Toppila-Salmi S, Chanoine S, Karjalainen J, Pekkanen J, Bousquet J, Siroux V. Risk of adult-onset asthma increases with the number of allergic multimorbidities and decreases with age. *Allergy* 2019;74:2406-16.  
[PUBMED](#) | [CROSSREF](#)
42. World Health Organization (WHO). Practical guidance for scaling up health service innovations [Internet]. Geneva: World Health Organization; 2009 [cited year month day]. Available from: [http://whqlibdoc.who.int/publications/2009/9789241598521\\_eng.pdf](http://whqlibdoc.who.int/publications/2009/9789241598521_eng.pdf).
43. Maurer M, Metz M, Bindslev-Jensen C, Bousquet J, Canonica GW, Church MK, et al. Definition, aims, and implementation of GA(2) LEN urticaria centers of reference and excellence. *Allergy* 2016;71:1210-8.  
[PUBMED](#) | [CROSSREF](#)
44. Bousquet J, Burney PG, Zuberbier T, Cauwenberge PV, Akdis CA, Bindslev-Jensen C, et al. GA2LEN (Global Allergy and Asthma European Network) addresses the allergy and asthma ‘epidemic’. *Allergy* 2009;64:969-77.  
[PUBMED](#) | [CROSSREF](#)
45. Leynaert B, Neukirch C, Liard R, Bousquet J, Neukirch F. Quality of life in allergic rhinitis and asthma. A population-based study of young adults. *Am J Respir Crit Care Med* 2000;162:1391-6.  
[PUBMED](#) | [CROSSREF](#)
46. Briggs A, Claxton K, Sculpher M. Decision modelling for health economic evaluation. Oxford: Oxford University Press; 2006.

47. Vandenas O, Vinnikov D, Blanc PD, Agache I, Bachert C, Bewick M, et al. Impact of rhinitis on work productivity: a systematic review. *J Allergy Clin Immunol Pract* 2018;6:1274-1286.e9.  
[PUBMED](#) | [CROSSREF](#)
48. Bousquet J, Illario M, Farrell J, Batey N, Carriazo AM, Malva J, et al. The reference site collaborative network of the European Innovation Partnership on Active and Healthy Ageing. *Transl Med UniSa* 2019;19:66-81.  
[PUBMED](#)
49. Patella V, Florio G, Magliacane D, Giuliano A, Russo LF, D'Amato V, et al. Public prevention plans to manage climate change and respiratory allergic diseases. innovative models used in Campania region (Italy): the Twinning Aria implementation and the allergy safe tree decalogue. *Transl Med UniSa* 2019;19:95-102.  
[PUBMED](#)
50. World Health Organization, International Telecommunication Union. A handbook on how to implement mBreatheFreely, mHealth for COPD and asthma. Geneva: World Health Organization; 2017.
51. Samoliński B, Fronczak A, Kuna P, Akdis CA, Anto JM, Białoszewski AZ, et al. Prevention and control of childhood asthma and allergy in the EU from the public health point of view: Polish Presidency of the European Union. *Allergy* 2012;67:726-31.  
[PUBMED](#) | [CROSSREF](#)
52. Samoliński B, Fronczak A, Włodarczyk A, Bousquet J. Council of the European Union conclusions on chronic respiratory diseases in children. *Lancet* 2012;379:e45-6.  
[PUBMED](#) | [CROSSREF](#)
53. European Innovation Partnership on Active and Healthy Ageing, Action Plan B3; Mechanisms of the Development of Allergy, WP 10; Global Alliance against Chronic Respiratory Diseases, Bousquet J, Addis A, Adcock I, et al. Integrated care pathways for airway diseases (AIRWAYS-ICPs). *Eur Respir J* 2014;44:304-23.  
[PUBMED](#) | [CROSSREF](#)
54. Bousquet J, Michel J, Standberg T, Crooks G, Iakovidis I, Gomez M. The European Innovation Partnership on Active and Healthy Ageing: the European geriatric medicine introduces the EIP on AHA column. *Eur Geriatr Med* 2014;5:361-2.  
[CROSSREF](#)
55. Hellings PW, Borrelli D, Pietikainen S, Agache I, Akdis C, Bachert C, et al. European summit on the prevention and self-management of chronic respiratory diseases: report of the European Union Parliament Summit (29 March 2017). *Clin Transl Allergy* 2017;7:49.  
[PUBMED](#) | [CROSSREF](#)
56. Bousquet J, Onorato GL, Bachert C, Barbolini M, Bedbrook A, Bjermer L, et al. CHRODIS criteria applied to the MASK (MACVIA-ARIA Sentinel Network) Good Practice in allergic rhinitis: a SUNFRIL report. *Clin Transl Allergy* 2017;7:37.  
[PUBMED](#) | [CROSSREF](#)
57. Anto JM, Bousquet J, Akdis M, Auffray C, Keil T, Momas I, et al. Mechanisms of the Development of Allergy (MeDALL): Introducing novel concepts in allergy phenotypes. *J Allergy Clin Immunol* 2017;139:388-99.  
[PUBMED](#) | [CROSSREF](#)
58. Bousquet J, Mercier J, Avignon A, Bourret R, Camuzat T. MACVIA-LR (France) case study. Report EUR 27150 EN. In: Abadie F, editor. Strategic intelligence monitor on personal health systems phase 3 (SIMP3S3). JRC94487. Luxembourg: Publications Office of the European Union; 2015.
59. ISO/TC 20/SC 14 Space systems and operations. ISO 16290:2013. Space systems — Definition of the Technology Readiness Levels (TRLs) and their criteria of assessment [Internet]. Geneva: ISO; 2013 [cited 2019]. Available from: <https://www.iso.org/standard/56064.html>.
60. Cruz AA, Camargos PA, Urrutia-Pereira M, Stelmach R. Global Alliance against Chronic Respiratory Diseases (GARD) Brazil success case: overcoming barriers. *J Thorac Dis* 2018;10:534-8.  
[PUBMED](#) | [CROSSREF](#)
61. To T, Cruz AA, Viegi G, McGihon R, Khaltayev N, Yorgancioglu A, et al. A strategy for measuring health outcomes and evaluating impacts of interventions on asthma and COPD-common chronic respiratory diseases in Global Alliance against Chronic Respiratory Diseases (GARD) countries. *J Thorac Dis* 2018;10:5170-7.  
[PUBMED](#) | [CROSSREF](#)
62. Hellings PW, Akdis CA, Bachert C, Bousquet J, Pugin B, Adriaensen G, et al. EUFOREA Rhinology Research Forum 2016: report of the brainstorming sessions on needs and priorities in rhinitis and rhinosinusitis. *Rhinology* 2017;55:202-10.  
[PUBMED](#) | [CROSSREF](#)

63. Hellings PW, Fokkens WJ, Bachert C, Akdis CA, Bieber T, Agache I, et al. Positioning the principles of precision medicine in care pathways for allergic rhinitis and chronic rhinosinusitis - a EUFOREA-ARIA-EPOS-AIRWAYS ICP statement. *Allergy* 2017;72:1297-305.  
[PUBMED](#) | [CROSSREF](#)
64. Hellings PW, Pugin B, Mariën G, Bachert C, Breynaert C, Bullens DM, et al. Stepwise approach towards adoption of allergen immunotherapy for allergic rhinitis and asthma patients in daily practice in Belgium: a BelSACI-Abeforcal-EUFOREA statement. *Clin Transl Allergy* 2019;9:1.  
[PUBMED](#) | [CROSSREF](#)
65. Scadding G, Bousquet J, Bachert C, Fokkens WJ, Hellings PW, Prokopakis E, et al. Rhinology future trends: 2017 EUFOREA debate on allergic rhinitis. *Rhinology* 2019;57:49-56.  
[PUBMED](#) | [CROSSREF](#)
66. Vandenberghe D, Albrecht J. The financial burden of non-communicable diseases in the European Union: a systematic review. *Eur J Public Health*. Forthcoming 2019.  
[PUBMED](#) | [CROSSREF](#)
67. Bousquet J, Pfaar O, Togias A, Schünemann HJ, Ansotegui I, Papadopoulos NG, et al. 2019 ARIA care pathways for allergen immunotherapy. *Allergy* 2019;74:2087-102.  
[PUBMED](#) | [CROSSREF](#)