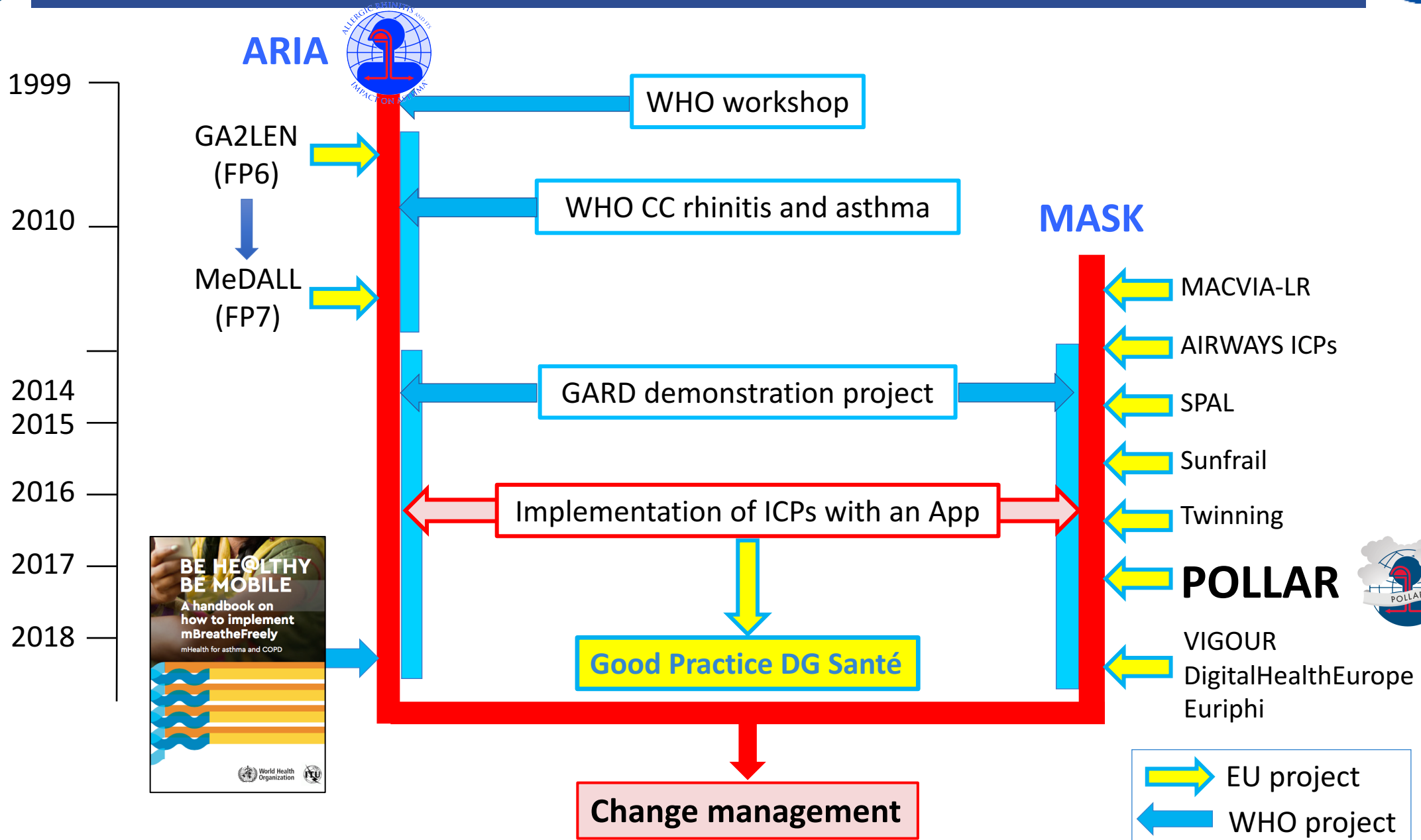




Intertwined links between ARIA, MASK & POLLAR



MASK (Mobile Airways Sentinel Network)

1- The goals

2- The cell phone (The Allergy Diary)

3- Innovation in epidemiology

4- Innovation in management

5- Next-generation care pathways

ARIA 2016: Care pathways implementing emerging technologies for predictive medicine in rhinitis and asthma across the life cycle



Bousquet et al. *Clin Transl Allergy* (2016) 6:47

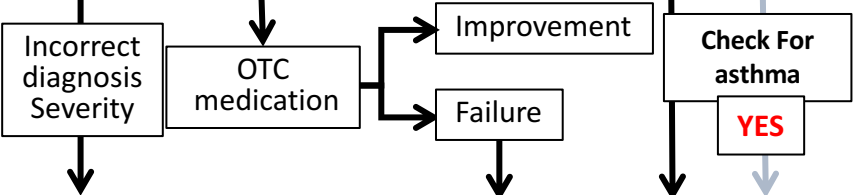
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Stepwise care pathways

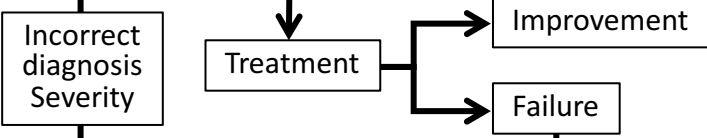
Patient with rhinitis symptoms

Self-care

Pharmacist



General practitioner



Specialist

Emergency care (asthma)

Goals

1. Develop for each step a document with a 4-pages pocket-guide
2. Include mHealth for each step
3. From one step to the next one
4. When to go to the next step
5. Stepwise approach for management
6. Develop machine learning to optimize ICPs

Integrated care pathways for airway diseases (AIRWAYS-ICPs)

European Innovation Partnership on Active and Healthy Ageing, Action Plan B3 Mechanisms of the Development of Allergy (MeDALL, WP10)
GARD (Global Alliance against Chronic Respiratory Diseases, WHO) research demonstration project

J. Bousquet^{1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,21,22,23,24,25,26,27,28,29,30,31,32,33,34,35,36,37,38,39,40,41,42,43,44,45,46,47,48,49,50,51,52,53,54,55,56,57,58,59,60,61,62,63,64,65,66,67,68,69,70,71,72,73,74,75,76,77,78,79,80,81,82,83,84,85,86,87,88,89,90,91,92,93,94,95,96,97,98,99,100,101,102,103,104,105,106,107,108,109,110,111,112,113,114,115,116,117,118,119,120,121,122,123,124,125,126,127,128,129,130,131,132,133,134,135,136,137,138,139,140,141,142,143,144,145,146,147,148,149,150,151,152,153,154,155,156,157,158,159,160,161,162,163,164,165,166,167,168,169,170,171,172,173,174,175,176,177,178,179,180,181,182,183,184,185,186,187,188,189,190,191,192,193,194,195,196,197,198,199,200,201,202,203,204,205,206,207,208,209,210,211,212,213,214,215,216,217,218,219,220,221,222,223,224,225,226,227,228,229,230,231,232,233,234,235,236,237,238,239,240,241,242,243,244,245,246,247,248,249,250,251,252,253,254,255,256,257,258,259,260,261,262,263,264,265,266,267,268,269,270,271,272,273,274,275,276,277,278,279,280,281,282,283,284,285,286,287,288,289,290,291,292,293,294,295,296,297,298,299,300,301,302,303,304,305,306,307,308,309,310,311,312,313,314,315,316,317,318,319,320,321,322,323,324,325,326,327,328,329,330,331,332,333,334,335,336,337,338,339,340,341,342,343,344,345,346,347,348,349,350,351,352,353,354,355,356,357,358,359,360,361,362,363,364,365,366,367,368,369,370,371,372,373,374,375,376,377,378,379,380,381,382,383,384,385,386,387,388,389,390,391,392,393,394,395,396,397,398,399,400,401,402,403,404,405,406,407,408,409,410,411,412,413,414,415,416,417,418,419,420,421,422,423,424,425,426,427,428,429,430,431,432,433,434,435,436,437,438,439,440,441,442,443,444,445,446,447,448,449,450,451,452,453,454,455,456,457,458,459,460,461,462,463,464,465,466,467,468,469,470,471,472,473,474,475,476,477,478,479,480,481,482,483,484,485,486,487,488,489,490,491,492,493,494,495,496,497,498,499,500,501,502,503,504,505,506,507,508,509,510,511,512,513,514,515,516,517,518,519,520,521,522,523,524,525,526,527,528,529,530,531,532,533,534,535,536,537,538,539,540,541,542,543,544,545,546,547,548,549,550,551,552,553,554,555,556,557,558,559,560,561,562,563,564,565,566,567,568,569,570,571,572,573,574,575,576,577,578,579,580,581,582,583,584,585,586,587,588,589,590,591,592,593,594,595,596,597,598,599,600,601,602,603,604,605,606,607,608,609,610,611,612,613,614,615,616,617,618,619,620,621,622,623,624,625,626,627,628,629,630,631,632,633,634,635,636,637,638,639,640,641,642,643,644,645,646,647,648,649,650,651,652,653,654,655,656,657,658,659,660,661,662,663,664,665,666,667,668,669,670,671,672,673,674,675,676,677,678,679,680,681,682,683,684,685,686,687,688,689,690,691,692,693,694,695,696,697,698,699,700,701,702,703,704,705,706,707,708,709,710,711,712,713,714,715,716,717,718,719,720,721,722,723,724,725,726,727,728,729,730,731,732,733,734,735,736,737,738,739,740,741,742,743,744,745,746,747,748,749,750,751,752,753,754,755,756,757,758,759,760,761,762,763,764,765,766,767,768,769,770,771,772,773,774,775,776,777,778,779,780,781,782,783,784,785,786,787,788,789,790,791,792,793,794,795,796,797,798,799,800,801,802,803,804,805,806,807,808,809,810,811,812,813,814,815,816,817,818,819,820,821,822,823,824,825,826,827,828,829,830,831,832,833,834,835,836,837,838,839,840,841,842,843,844,845,846,847,848,849,850,851,852,853,854,855,856,857,858,859,860,861,862,863,864,865,866,867,868,869,870,871,872,873,874,875,876,877,878,879,880,881,882,883,884,885,886,887,888,889,890,891,892,893,894,895,896,897,898,899,900,901,902,903,904,905,906,907,908,909,910,911,912,913,914,915,916,917,918,919,920,921,922,923,924,925,926,927,928,929,930,931,932,933,934,935,936,937,938,939,940,941,942,943,944,945,946,947,948,949,950,951,952,953,954,955,956,957,958,959,960,961,962,963,964,965,966,967,968,969,970,971,972,973,974,975,976,977,978,979,980,981,982,983,984,985,986,987,988,989,990,991,992,993,994,995,996,997,998,999,1000,1001,1002,1003,1004,1005,1006,1007,1008,1009,1010,1011,1012,1013,1014,1015,1016,1017,1018,1019,1020,1021,1022,1023,1024,1025,1026,1027,1028,1029,1030,1031,1032,1033,1034,1035,1036,1037,1038,1039,1040,1041,1042,1043,1044,1045,1046,1047,1048,1049,1050,1051,1052,1053,1054,1055,1056,1057,1058,1059,1060,1061,1062,1063,1064,1065,1066,1067,1068,1069,1070,1071,1072,1073,1074,1075,1076,1077,1078,1079,1080,1081,1082,1083,1084,1085,1086,1087,1088,1089,1090,1091,1092,1093,1094,1095,1096,1097,1098,1099,1100,1101,1102,1103,1104,1105,1106,1107,1108,1109,1110,1111,1112,1113,1114,1115,1116,1117,1118,1119,1120,1121,1122,1123,1124,1125,1126,1127,1128,1129,1130,1131,1132,1133,1134,1135,1136,1137,1138,1139,1140,1141,1142,1143,1144,1145,1146,1147,1148,1149,1150,1151,1152,1153,1154,1155,1156,1157,1158,1159,1160,1161,1162,1163,1164,1165,1166,1167,1168,1169,1170,1171,1172,1173,1174,1175,1176,1177,1178,1179,1180,1181,1182,1183,1184,1185,1186,1187,1188,1189,1190,1191,1192,1193,1194,1195,1196,1197,1198,1199,1200,1201,1202,1203,1204,1205,1206,1207,1208,1209,1210,1211,1212,1213,1214,1215,1216,1217,1218,1219,12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MASK mHealth approach for ICPs

Patient with allergic rhinitis symptoms

Self-care

Pharmacist


General practitioner

Specialist

Emergency care (asthma)

Goals

1. Develop for each step an mHealth tool
2. cell phone for self-care
3. interoperable tablet for pharmacists and physicians
4. Physicians's questionnaire
5. Patient's personal data with maintained privacy (GDPR)

 **USERS**

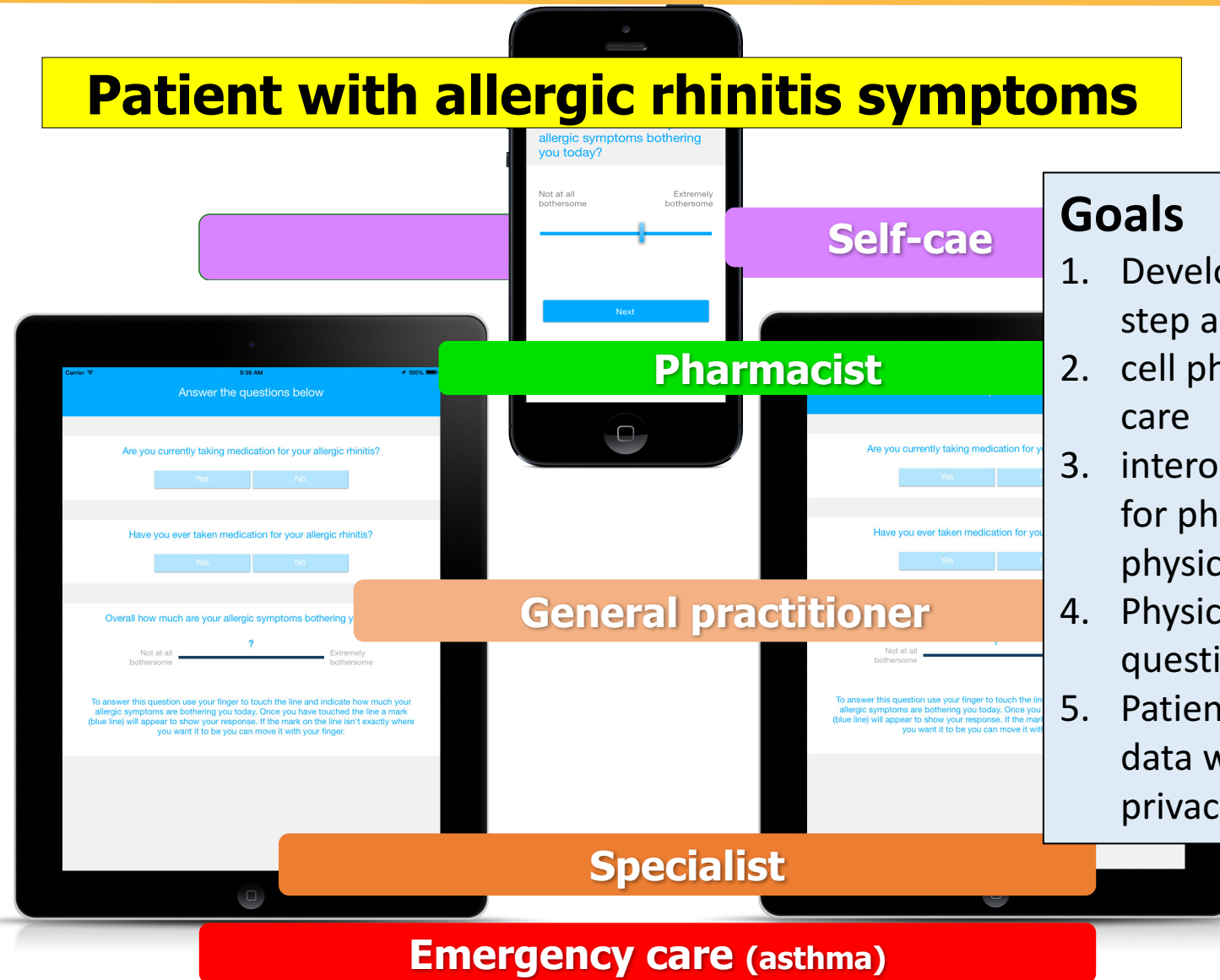
Add User

Name * **First name ***

Mail *

Language **Country** **Region ***

Specialty *



MASK (Mobile Airways Sentinel Network)

1- The goals

2- The cell phone (The Allergy Diary)



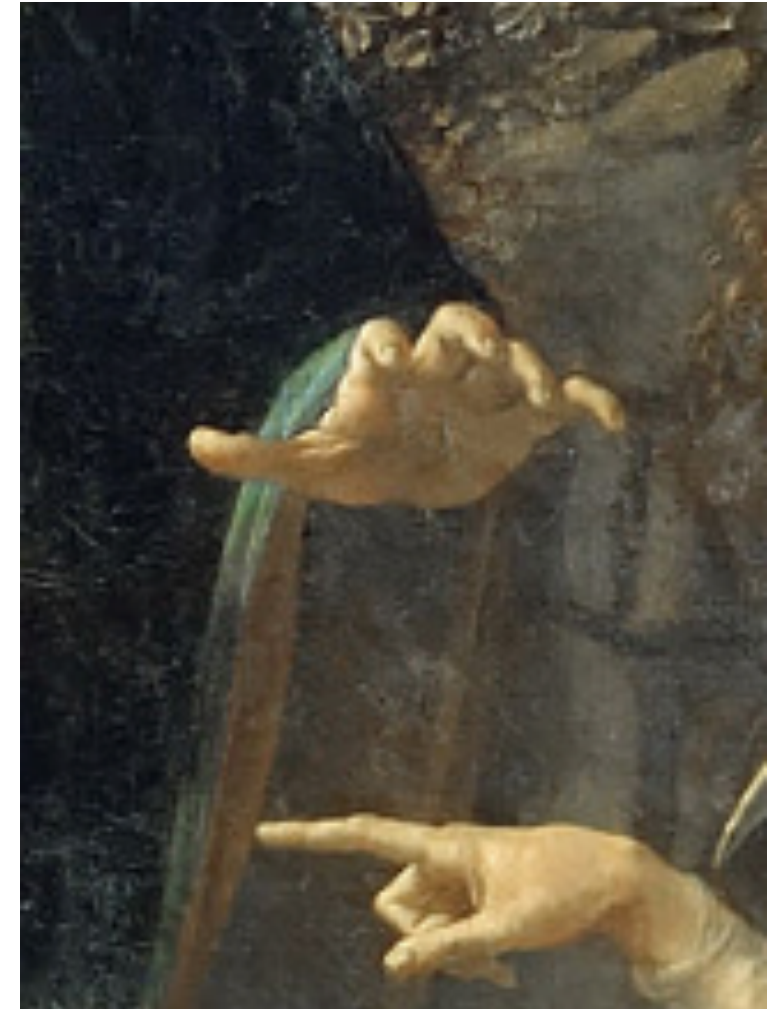
The finger approach to manage allergic rhinitis



Not at all bothersome

VAS

Extremely bothersome





The Allergy Diary

Carrier 12:32

Menu About us

The Allergy Diary was developed in collaboration between MACVIA-LR and ARIA.

MACVIA*LR

MACVIA-LR (Contre les Maladies Chroniques pour un Vieillissement Actif en Languedoc-Roussillon, France) is a reference site of the European Innovation Partnership on Active and Healthy Ageing aimed at fighting chronic disease.




The ARIA (Allergic Rhinitis and its Impact on Asthma) initiative aims to educate and implement evidenced-based management of allergic rhinitis in conjunction with asthma

Carrier 12:34

Menu My symptoms

Overall how much are your allergic symptoms bothering you today?

Not at all bothersome Extremely bothersome



Next

How much are your nose symptoms bothering you today?

How much are your eye symptoms bothering you today?

How much are your asthma symptoms bothering you today?


23 countries (+3)
17 languages
23,500 users
160,000 VAS days
GPDR (May 25, 2018)

Carrier 12:26

Medication Nasal Done

QUICK SEARCH

- Avamys (Fluticasone furoate)
- Beclo aqua (Beclometasone)
- Beclometasone (Beclometasone)
- Beconase (Beclometasone)

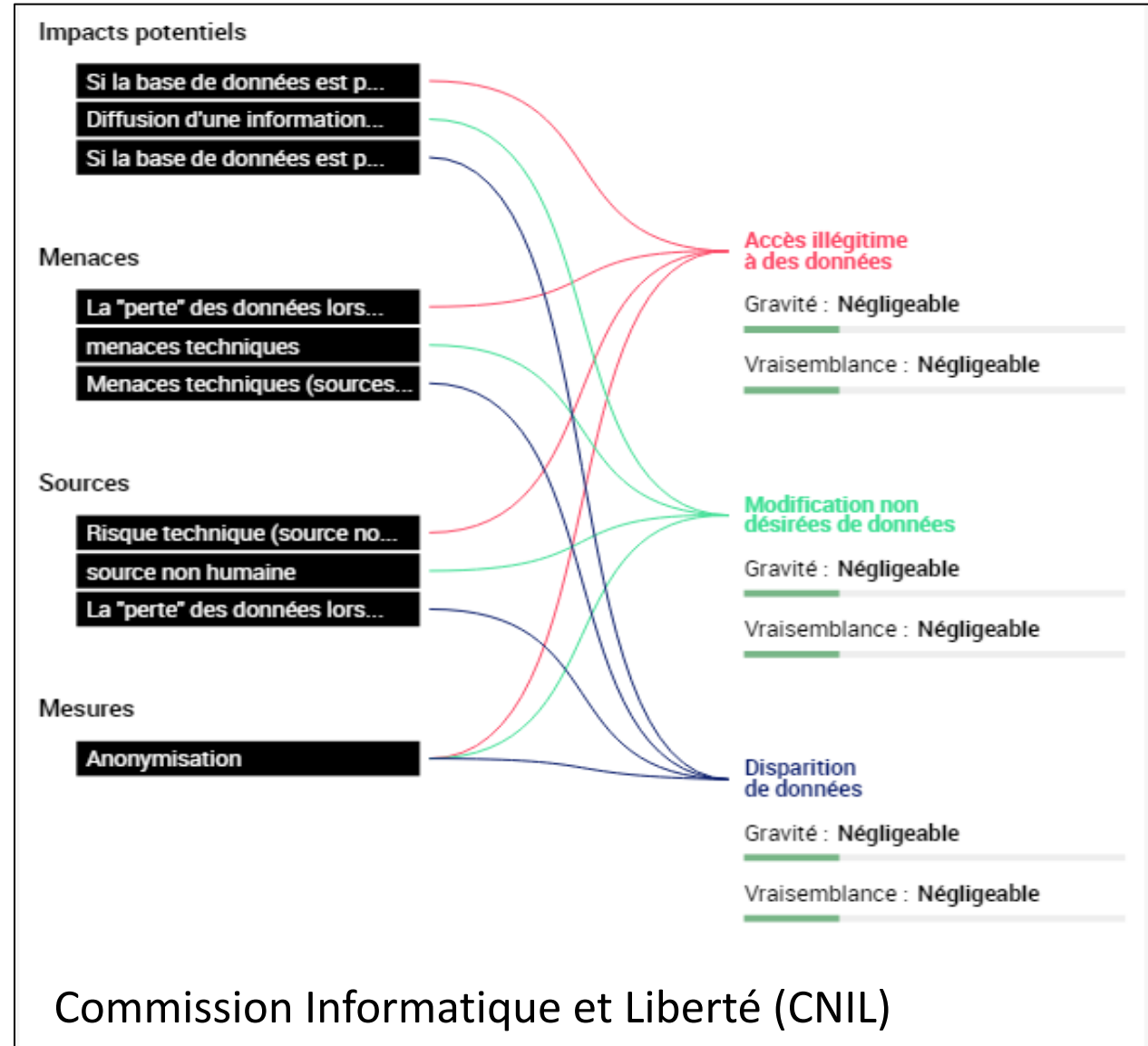


Free on Android and IOS

Data protection in the EU

Data protection in the EU

The General Data Protection Regulation (GDPR), the Data Protection Law Enforcement Directive and other rules concerning the protection of personal data



REVIEW

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CHRODIS criteria applied to the MASK (MACVIA-ARIA Sentinel Network) Good Practice in allergic rhinitis: a SUNFRAIL report

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1- Data storage

- Crypted transfer of data from user's smartphone to data base
- Secure database –with restricted access- to store data in E.U. (no transfer outside EU)

2- Data transfer

- Post treatment of geolocation data to follow GDPR in respect of users' privacy
- Transfer of data only when protocol detailing analyses is signed
- Data freely available for MASK participants (per country), fee for others

3- Data analysis

- Epidemiologic data
- Assessment of treatment efficacy and adherence
- Pharmaco-economic impact of allergic diseases (including EQ-5D and work)

4- Integration of data

- Integrated print process from user's smartphone to user or physician's PC
- Interoperability of data exported into medical databases: linking to patient's record
- Possible integration to contextual data (e.g.: pollution data)

Completion of the m-health tool

- ❑ Profile complement (tobacco)
- ❑ Complement of daily survey-sleep and sleepiness questions added
- ❑ Complement questionnaires (Epworth)



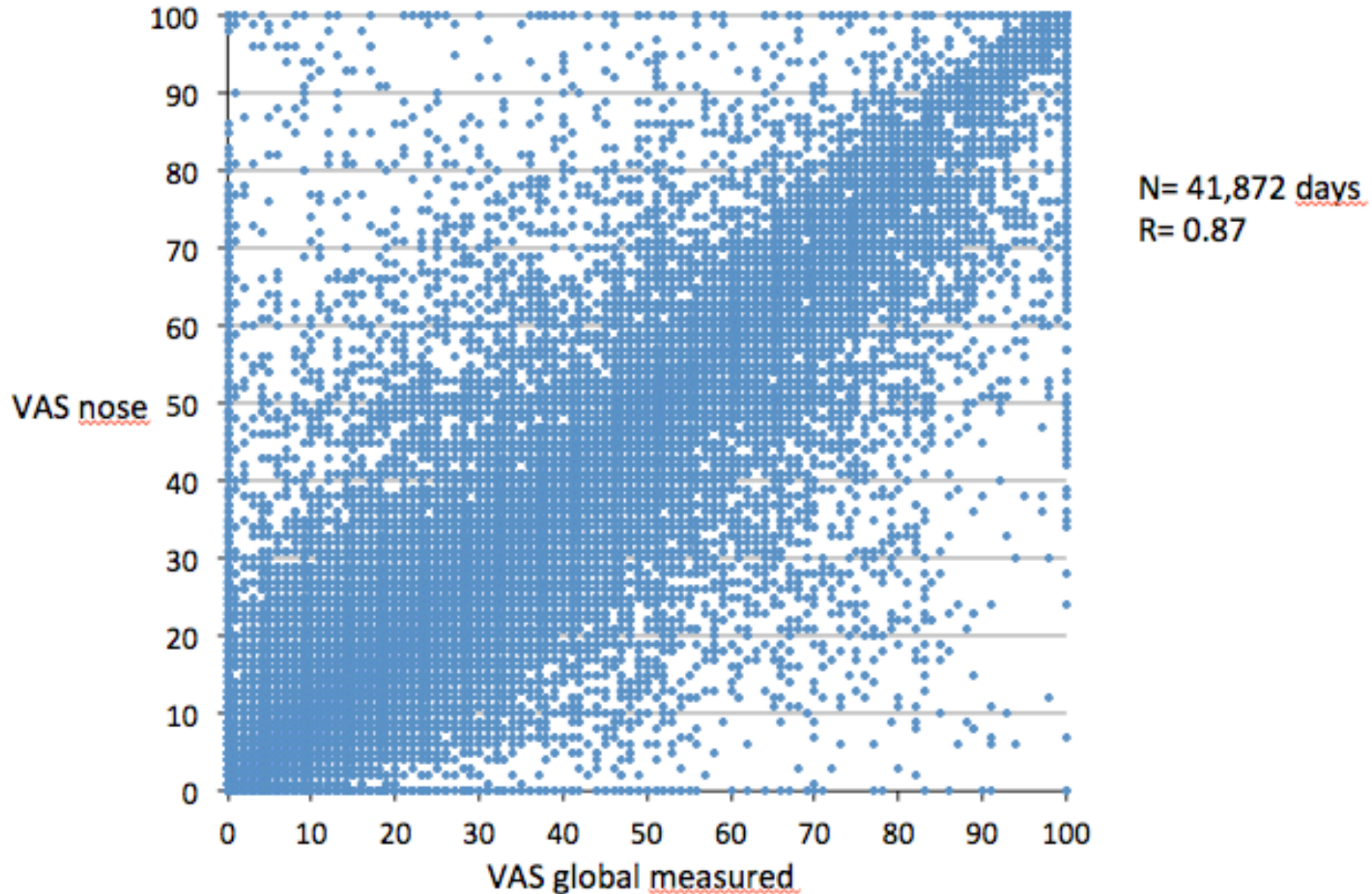
MASK (Mobile Airways Sentinel Network)

1- The goals

2- The cell phone

3- Innovation in epidemiology (research)

Correlation between global and nasal VAS





VAS work

Carrier 12:10

< Asthma My symptoms

Are you working today?

Yes No

Next

Carrier 12:10

< Back My symptoms

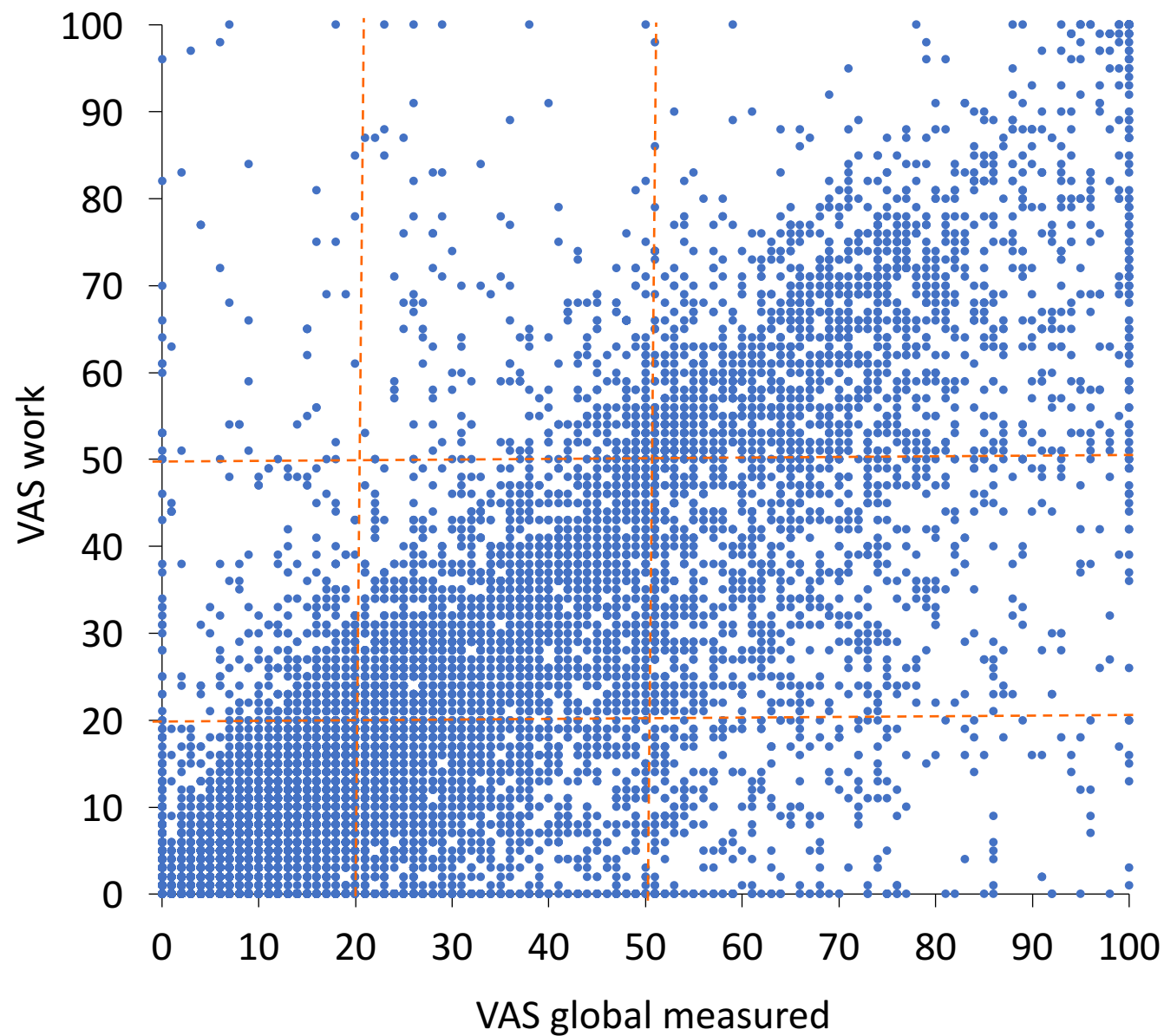
How much are your allergic symptoms affecting your work today?

Not at all bothersome No work possible

Next

N = 16,925 days
20 countries
15 languages

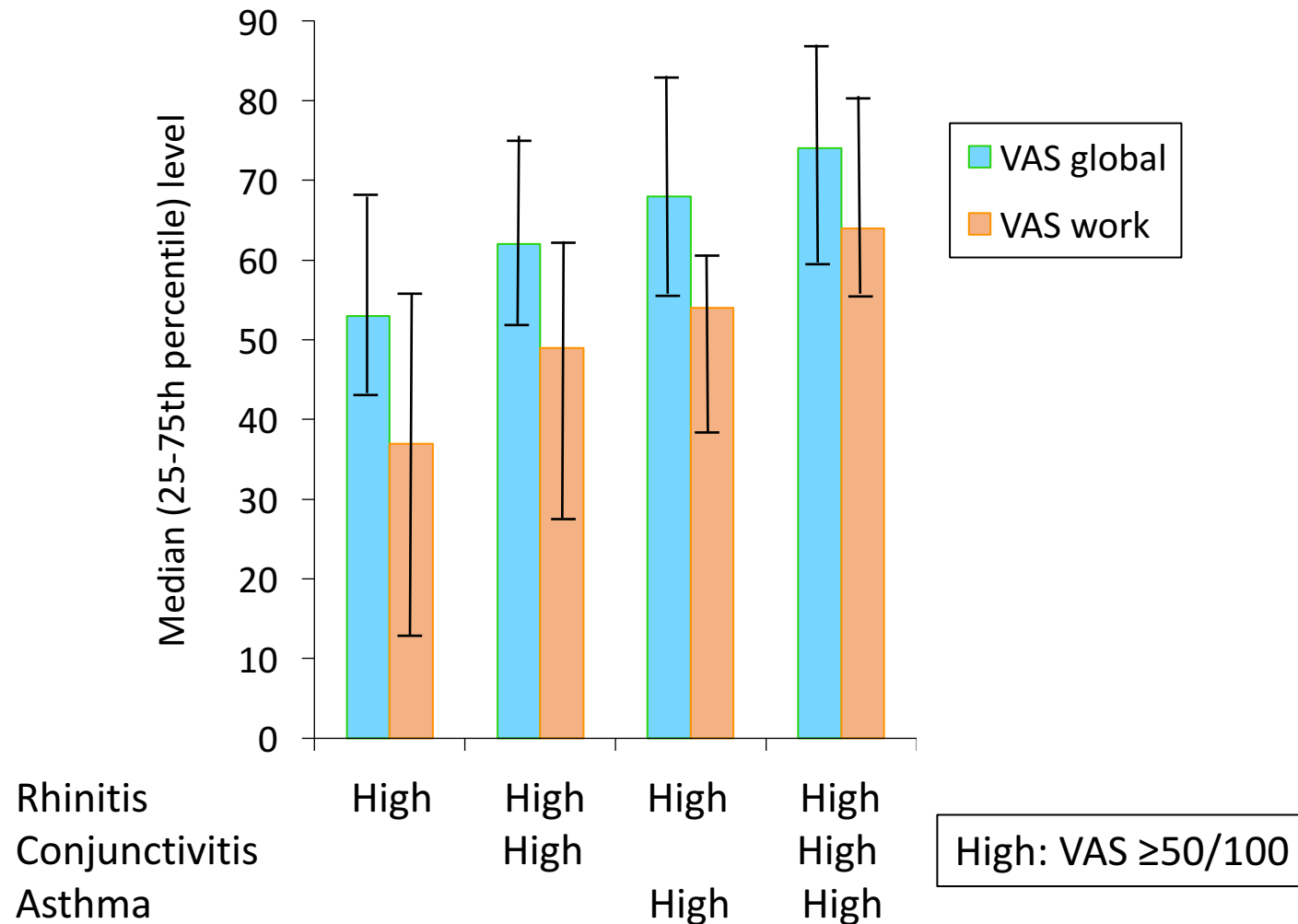
Global VAS: $r=0.82$
Rhinitis: $r=0.77$
Conjunctivitis: $r=0.69$
Asthma: $r=0.60$





Novel patterns of multimorbidity (days)

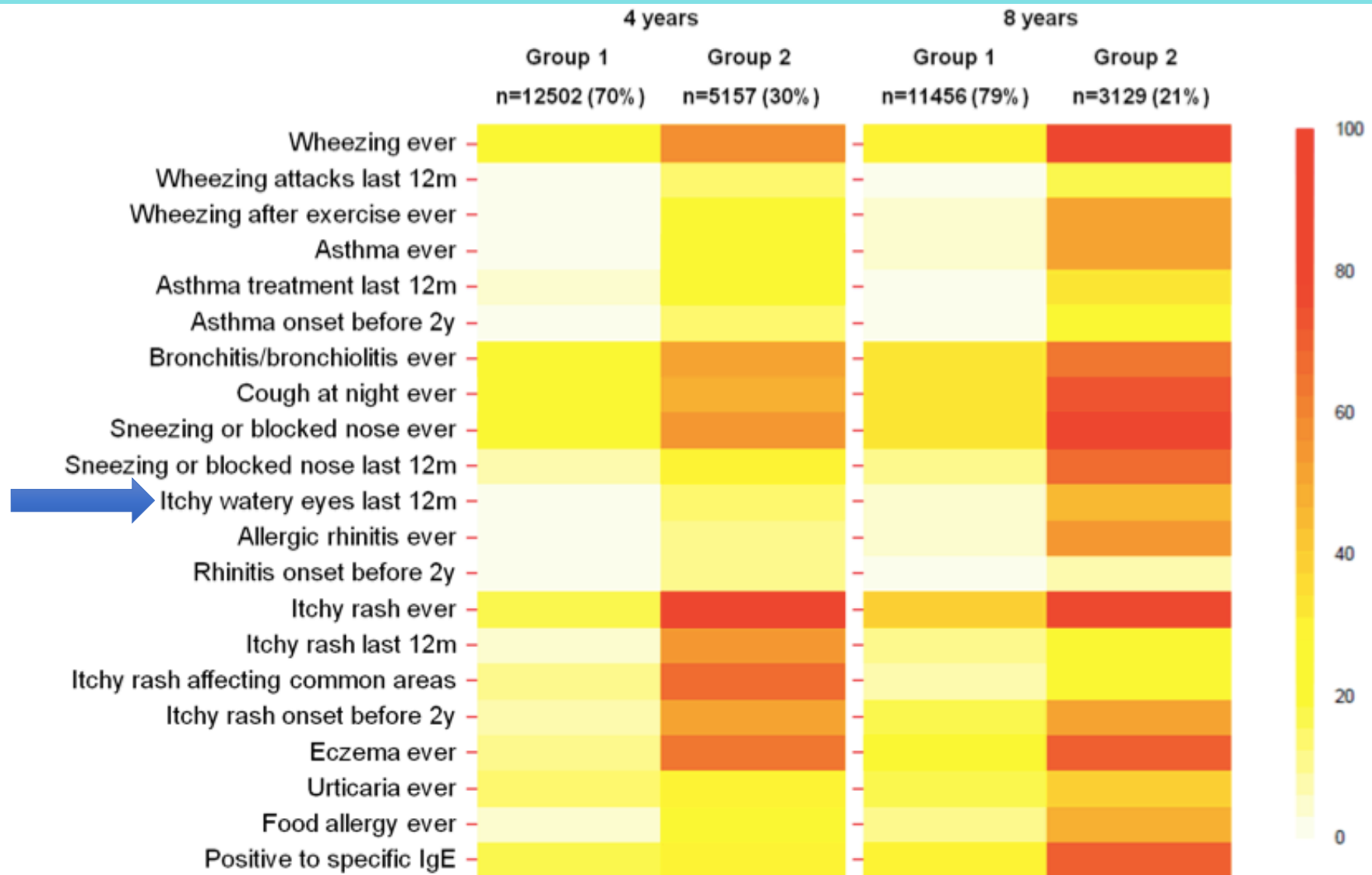
Visual Analogue Scale levels depending on allergic multimorbidities



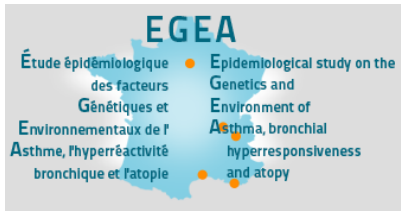


MeDALL novel phenotypes

Garcia-Aymeric et al, Allergy 2015



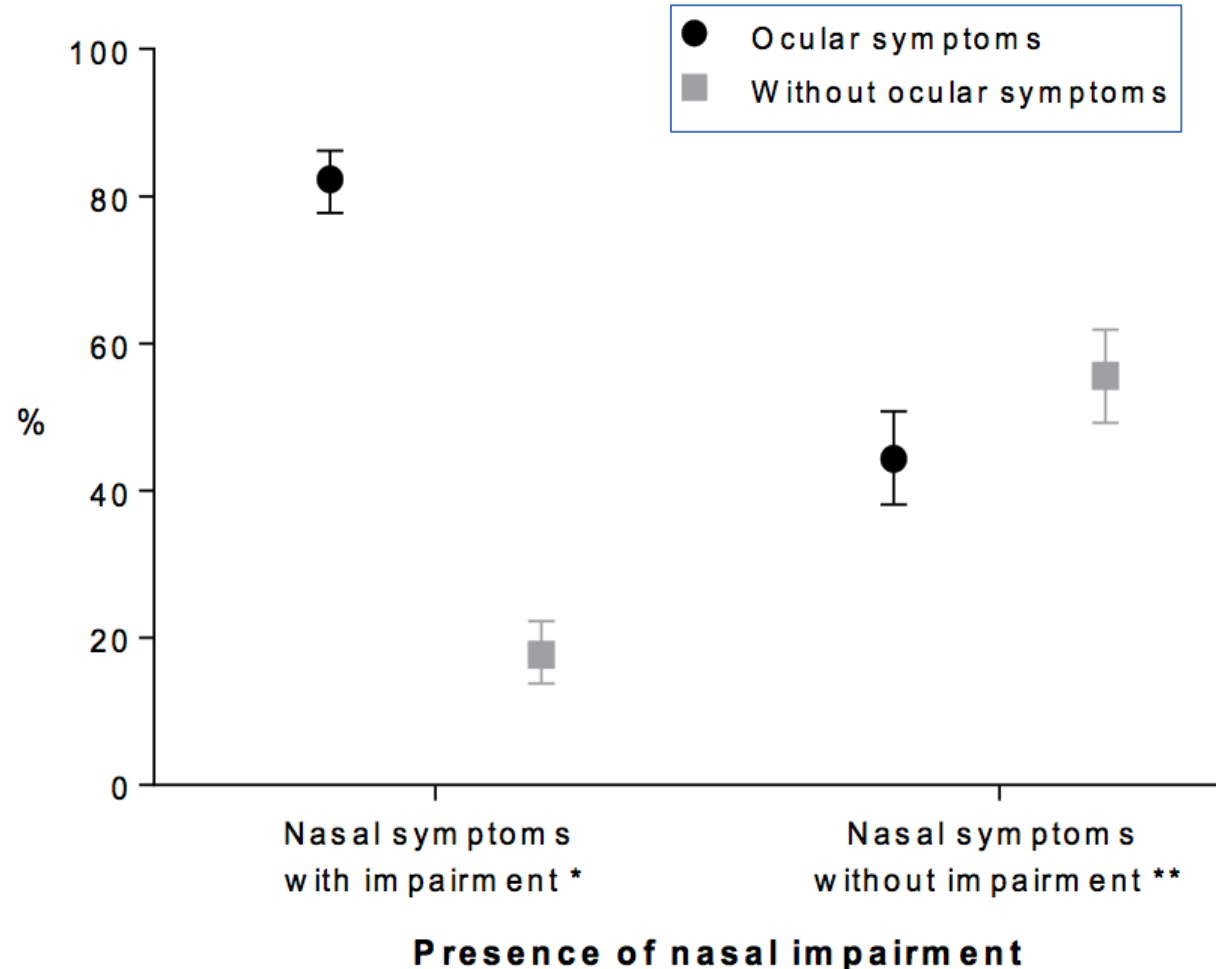
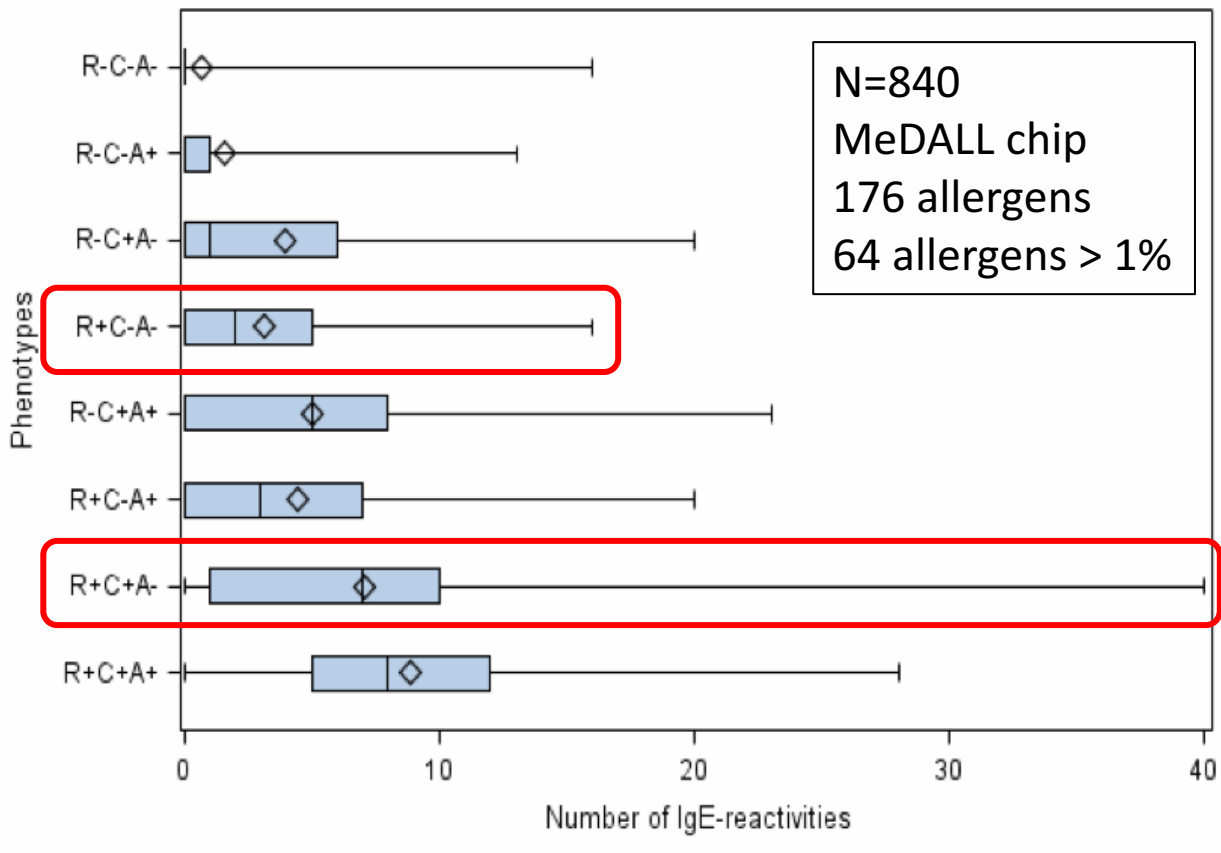
Phenotypes in epidemiologic studies



Boudier, Siroux, Bousquet

Portuguese national cohort Amaral et al

Distribution of sensib_respi by Phenotypes



Phenotypic epidemiologic studies

An App without any information on patient characteristics suggested to **re-classify allergic diseases (hypothesis-generating)**

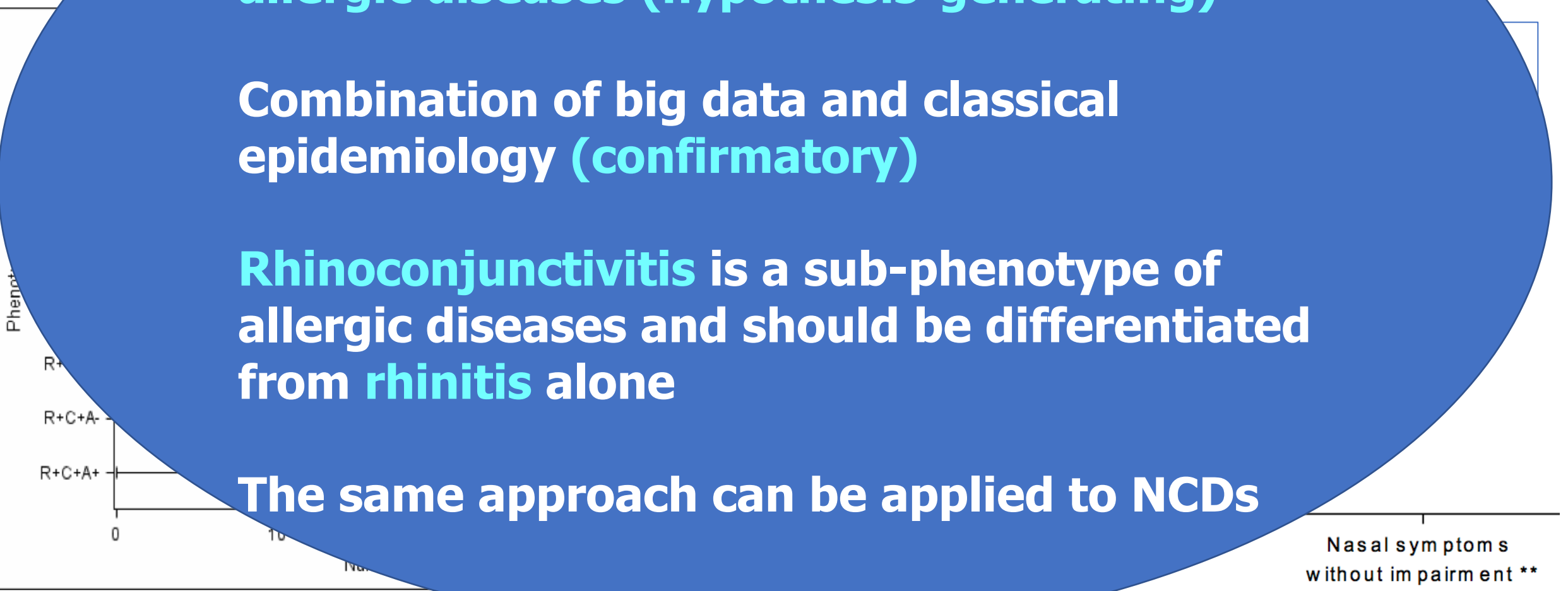
Combination of big data and classical epidemiology (**confirmatory**)

Rhinoconjunctivitis is a sub-phenotype of allergic diseases and should be differentiated from **rhinitis** alone

The same approach can be applied to NCDs

EGEA
Étude épidémiologique
des facteurs
Génétiques et
Environnementaux
Asthme, Hypertension
bronchique

Paral et al



Presence of nasal impairment

Linking pollution, pollen and allergy symptoms Xavier Basagaña, Annabelle Bedard

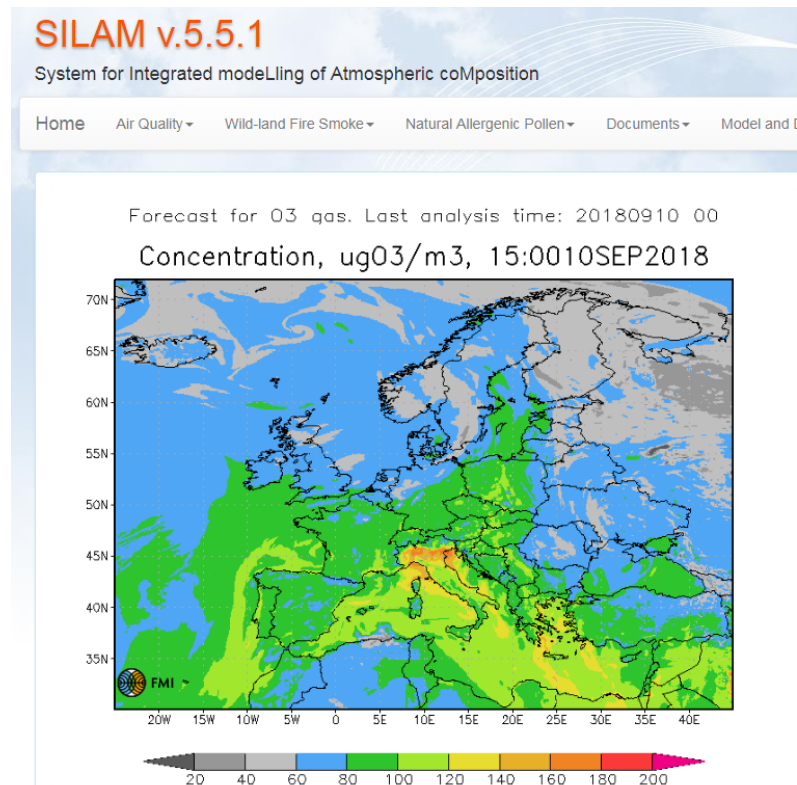
Allergy Diary

1- Establishment of “severe rhinitis” and “asthma” for 2016 and 2017

Bedard, submitted

2- Analysis of 28,300 days reported by Allergy Diary in 2017

Air pollution



Pollen season (GTs)



MASK (Mobile Airways Sentinel Network)

1- The goals

2- The cell phone

3- Innovation in epidemiology

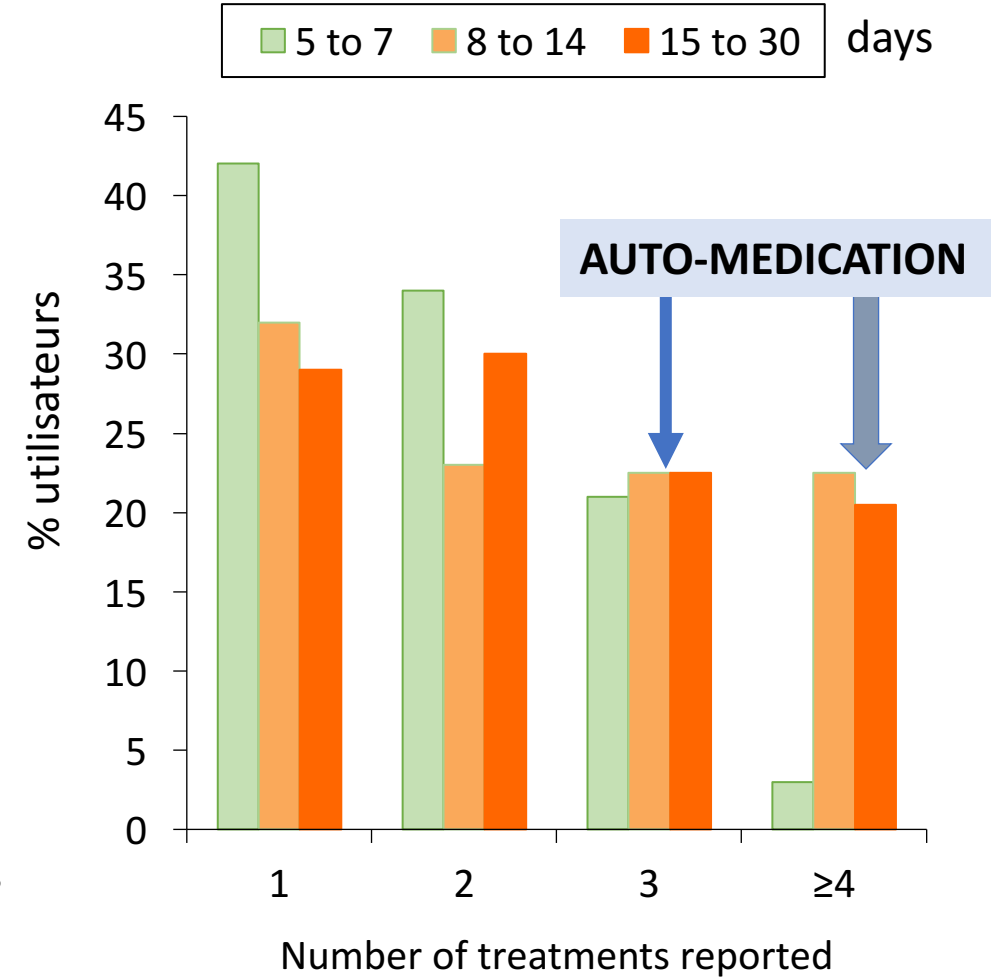
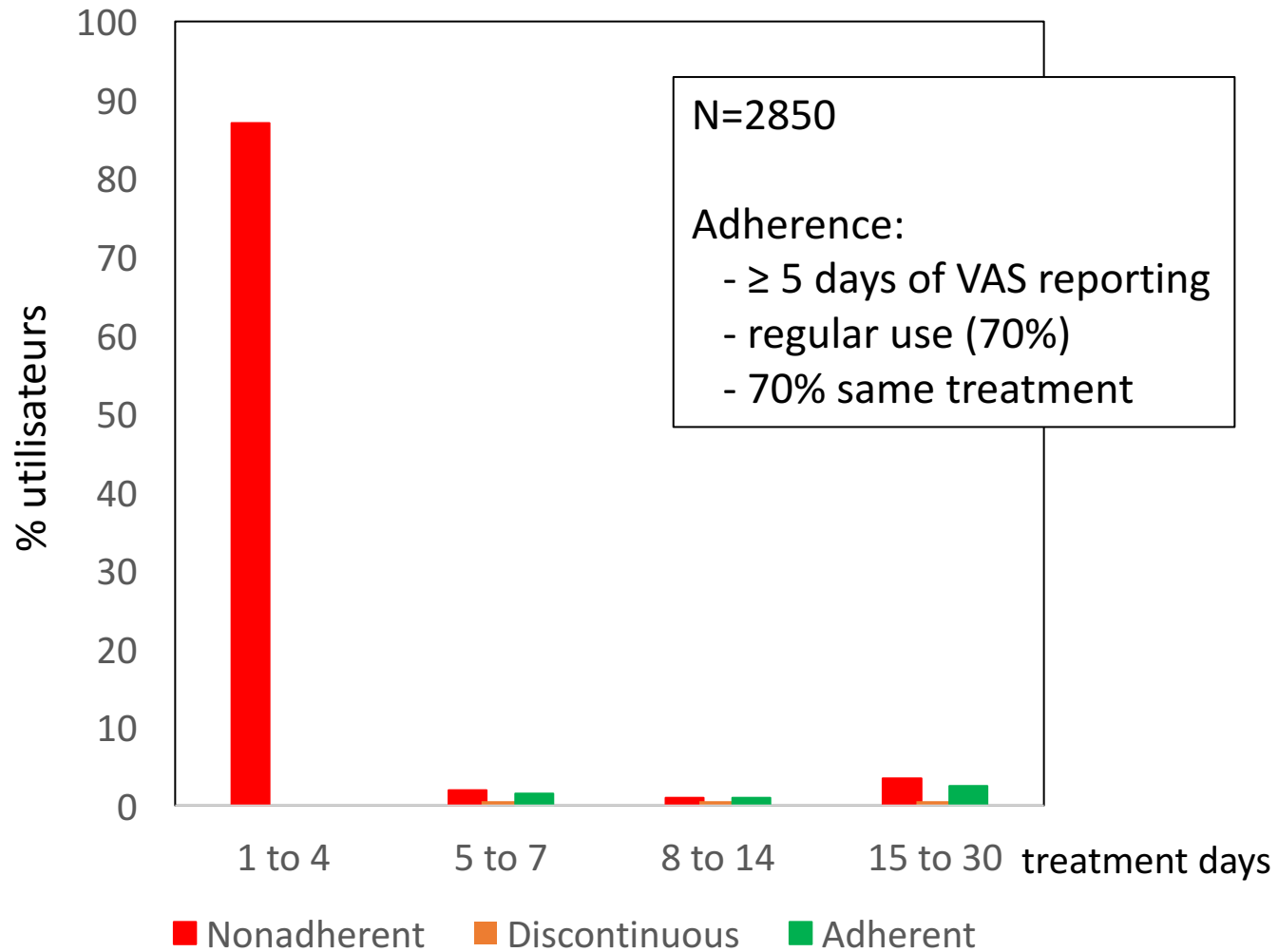
4- Innovation in management

- Users self-identified as having AR without confirmation of diagnosis
- No information except age, sex, country, location (Privacy)
- Mobile app users are not representative of the general population
- Adherence is difficult to analyze,
- Users may not report all medications used
- Longitudinal data capture is very challenging:
 - Treatment trajectories are specific for almost each user
 - Most users have gaps in treatment days when they are well-controlled
 - Cross-sectional analysis of days may be performed instead



Adherence to treatment

Bousquet J et al, 2018





Medical prescriptions (ARIA members)

**There is a major disconnection
between physicians' prescriptions
and patients' behavior**

N = 201

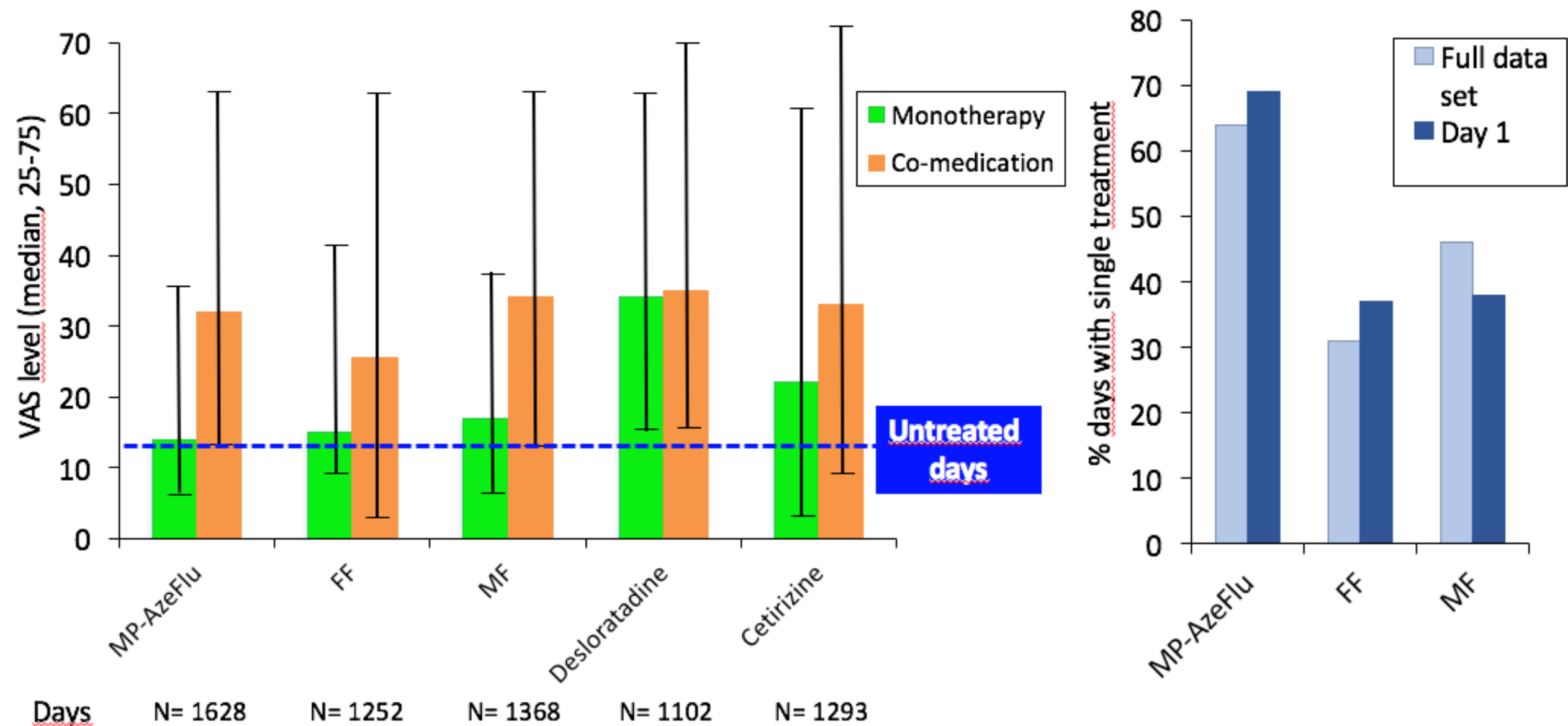
Guidelines are not used by patients

**Allergic physicians behave like
patients**

Indoor

Treatments received in MASK

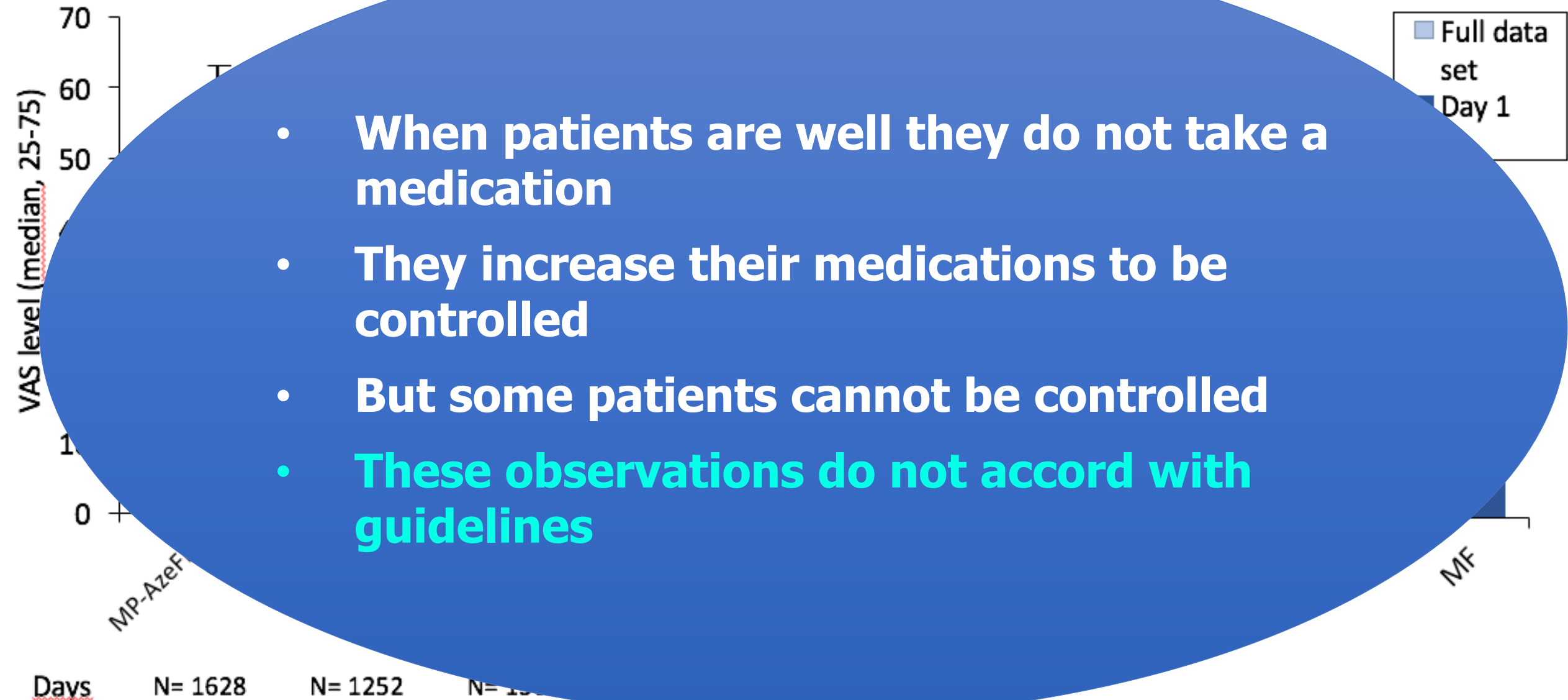
Bousquet J et al, Allergy 2018





Treatments received in MASK

Bousquet J et al, Allergy 2018



- When patients are well they do not take a medication
- They increase their medications to be controlled
- But some patients cannot be controlled
- These observations do not accord with guidelines

MASK (Mobile Airways Sentinel Network)

1- The goals

2- The cell phone

3- Innovation in epidemiology

4- Innovation in management

5- Next-generation care pathways

Next-generation integrated care pathways for allergic rhinitis and asthma multi-morbidity

A model for non-communicable diseases

POLLAR (eit Health)

GARD demonstration project (WHO Alliance)

ARIA-Euforea-Ga2len 2019

ACAAI

EAACI

EFA

ERS

ERS (Rhinology)

IPCRG

POLLAR

EHH

RNSA and MedUni Vienna

RSCN of the European Innovation Partnership on Active and Healthy Ageing az

WAO

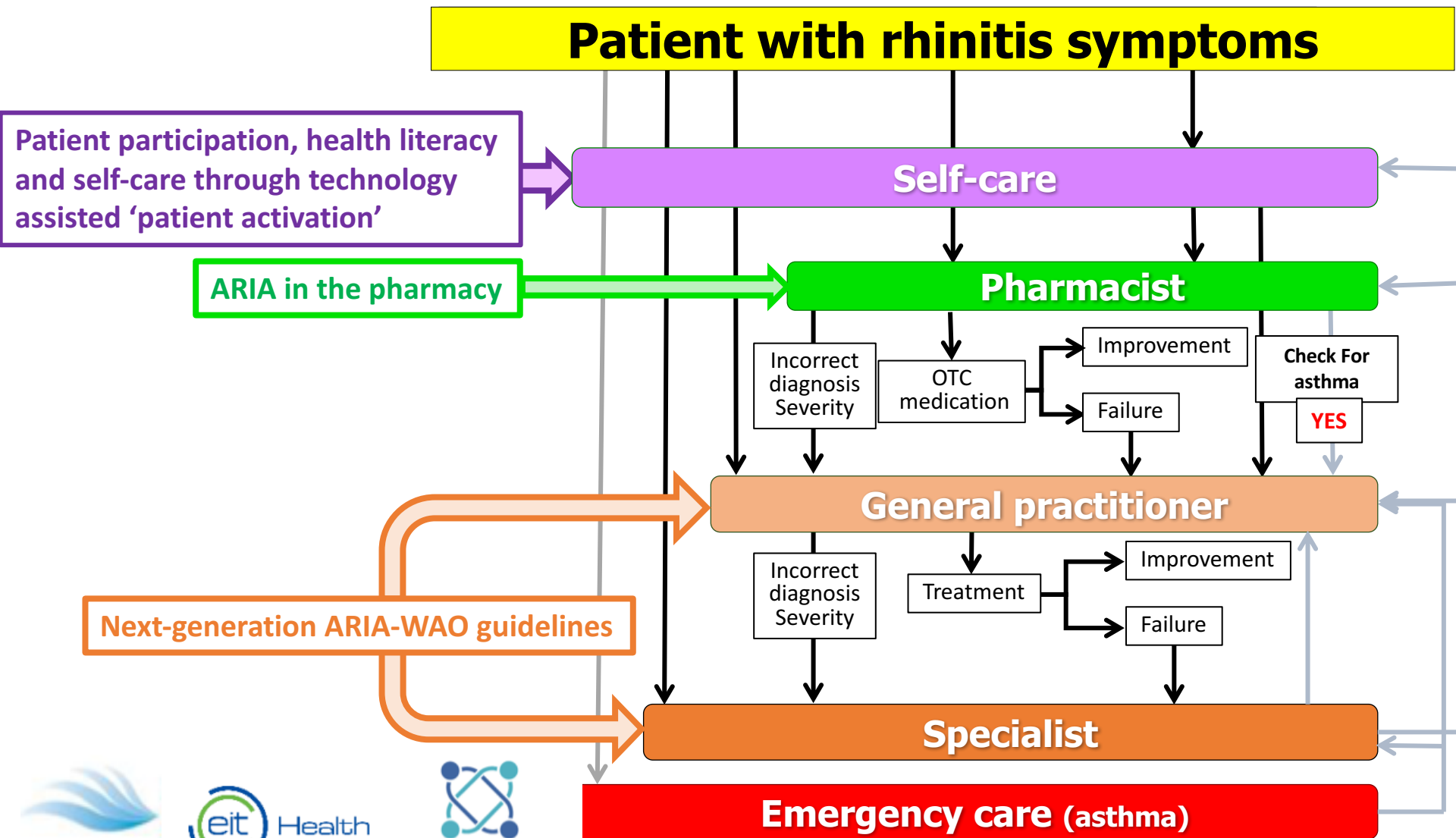


European Innovation
Partnership on Active
and Healthy Ageing

REFERENCE SITE



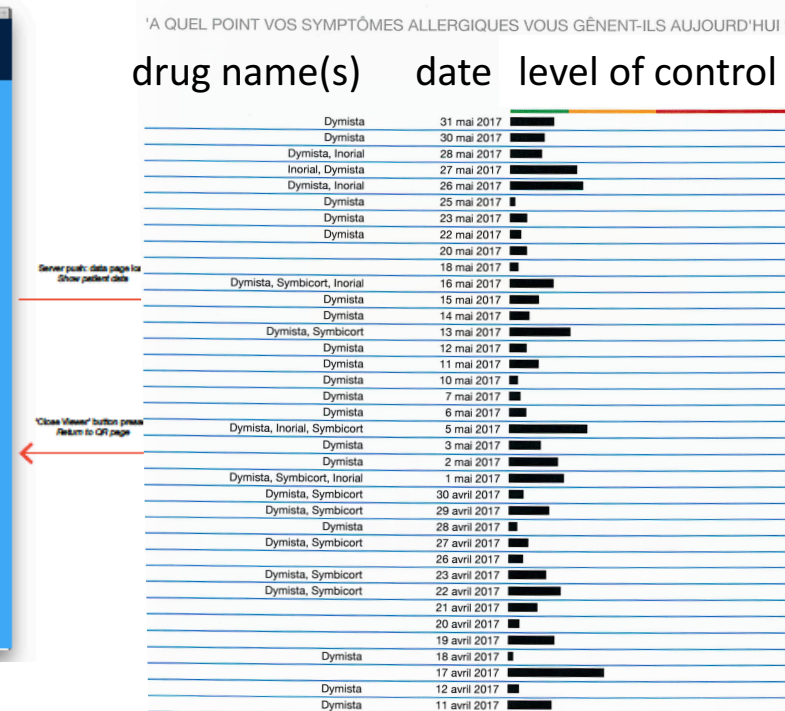
Next-generation care pathways



Goals

1. Develop for each step a document with a 4-pages pocket-guide
2. Include mHealth for each step
3. From one step to the next one
4. When to go to the next step
5. Stepwise approach for management
6. Develop machine learning to optimize ICPs

Transfer of data to HCP

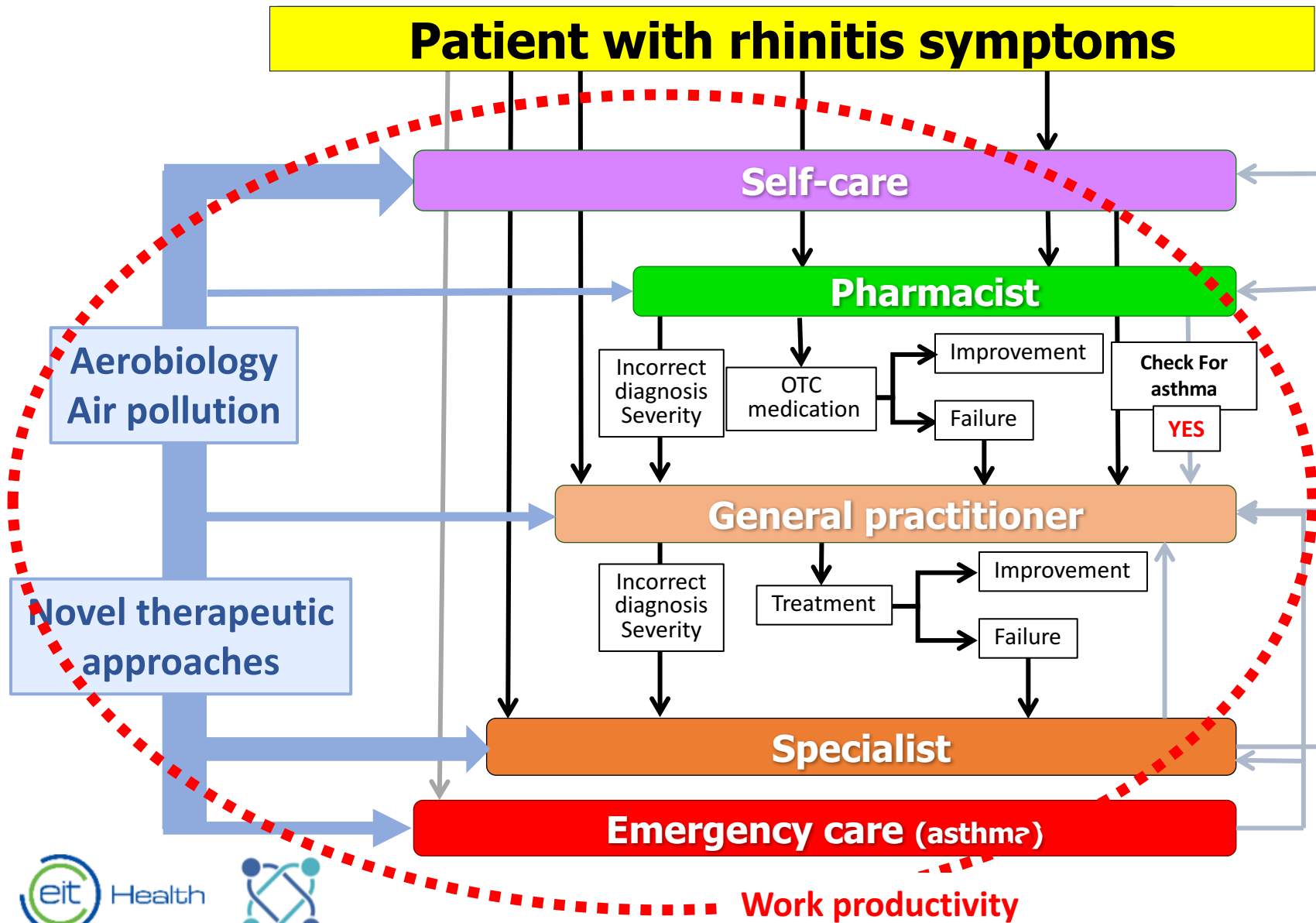


Goals

1. Patient's personal data with privacy
2. The patient cannot send to the HCP any electronic form
3. The patient can show his(her) data



Embedding environment in next-generation ICPs



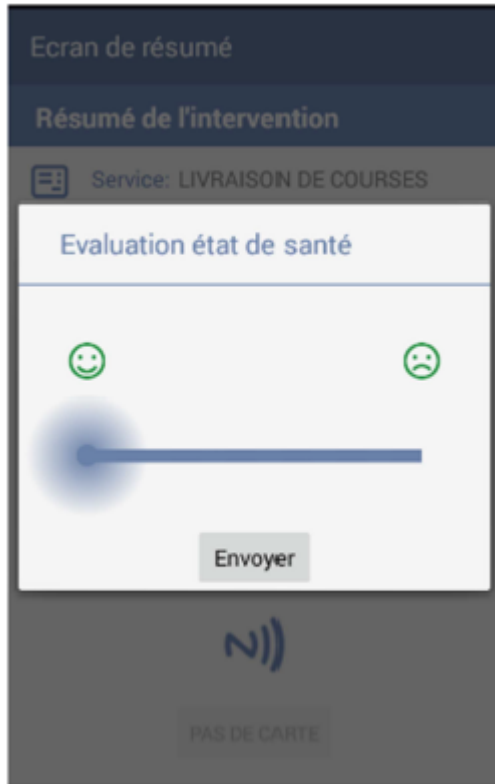
- ### Goals
1. Embedding environmental data
 2. Prevention of symptoms and asthma (self-care)
 3. Assess if severity of symptoms is associated with allergens or pollution
 4. Predict emergency care visits
 5. Develop machine learning to optimize ICPs



Pilot study
in 500 patients
completed

The Airways Diary (with COPD)

- IPAG questionnaire
- Daily evaluation
 - VAS Dyspnea
 - VAS Exercise
 - Pulmonary function



Home services

- Alert system
- Pilot study completed
- Major clinical alerts
- Clinical alerts
- Social alerts

Multimorbidity App

- For diagnosed disease NOT for screening
- Based on *The Airways Diary*
- Diseases: those commonly associated with COPD
- User with a diagnosis of the disease
- Simple questionnaire for the diagnosis of the disease
- Risk factors
- Daily evaluation
 - Most important symptom
 - Objective measurements