Severe exacerbation and its association with specific phenotype in asthma

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Definition of severe asthma exacerbation

ATS/ERS Task Force

- ✓ Asthma-related hospital admissions
- ✓ Accident and emergency attendances
- ✓ Prescription for acute courses of oral corticosteroids

An important risk factor for exacerbation

악화관련 조절 가능 위험인자

- ✓ 조절되지 않는 천식증상
- ✓ 과도한 SABA 사용 (한 달에 한 통 이상 사용)
- ✓ 부정확한 흡입스테로이드 사용; 처방이 안되거나, 순응도가 낮거나 잘못된 방법의 흡입제 사용
- ✓ 낮은 FEV_1, 특히 FEV_1<60%
- ✓ 정신적, 사회적인 문제
- ✓ 흡연, 알레르기항원 노출
- ✓ 동반질환: 비만, 부비동염, 확인된 음식물 알레르기
- ✓ 객담, 혈중 호산구 증가증, 임신

또 다른 주요 악화관련 위험인자

- ✓ 천식관련 중환자실 치료 혹은 기도 삽관 과거력
- ✓ 지난 12개월 이내에 1회 이상 중증 악화

Factors that increase the risk of asthma-related death

- ✓ A history of near-fatal asthma requiring intubation and mechanical ventilation
- ✓ Hospitalization or ER visit for asthma in the past year
- ✓ Currently using or having recently stopped using oral corticosteroids
- ✓ Not currently using ICS
- ✓ Over-use of SABA (한달에 한 개 이상)
- ✓ A history of psychiatric disease or psychosocial problems
- ✓ Poor adherence with asthma medication
- ✓ Food allergy in a patient with asthma

To prevent severe asthma exacerbations

- ✓ Recognition of patients who are at a greater risk for near-fatal or fatal asthma
- ✓ Education of patients to recognize deterioration
- ✓ Provision of an individual action plan and to know when to seek professional help
- ✓ Management of comorbidities

  : rhinosinusitis, obesity, GERD, obstructive sleep apnea, COPD, vocal cord dysfunction, atopic dermatitis

Contents

- T2 Inflammation biomarker
  (Blood eosinophil, FENO..)
- History of exacerbation
- Infection

- Multivariable prediction model

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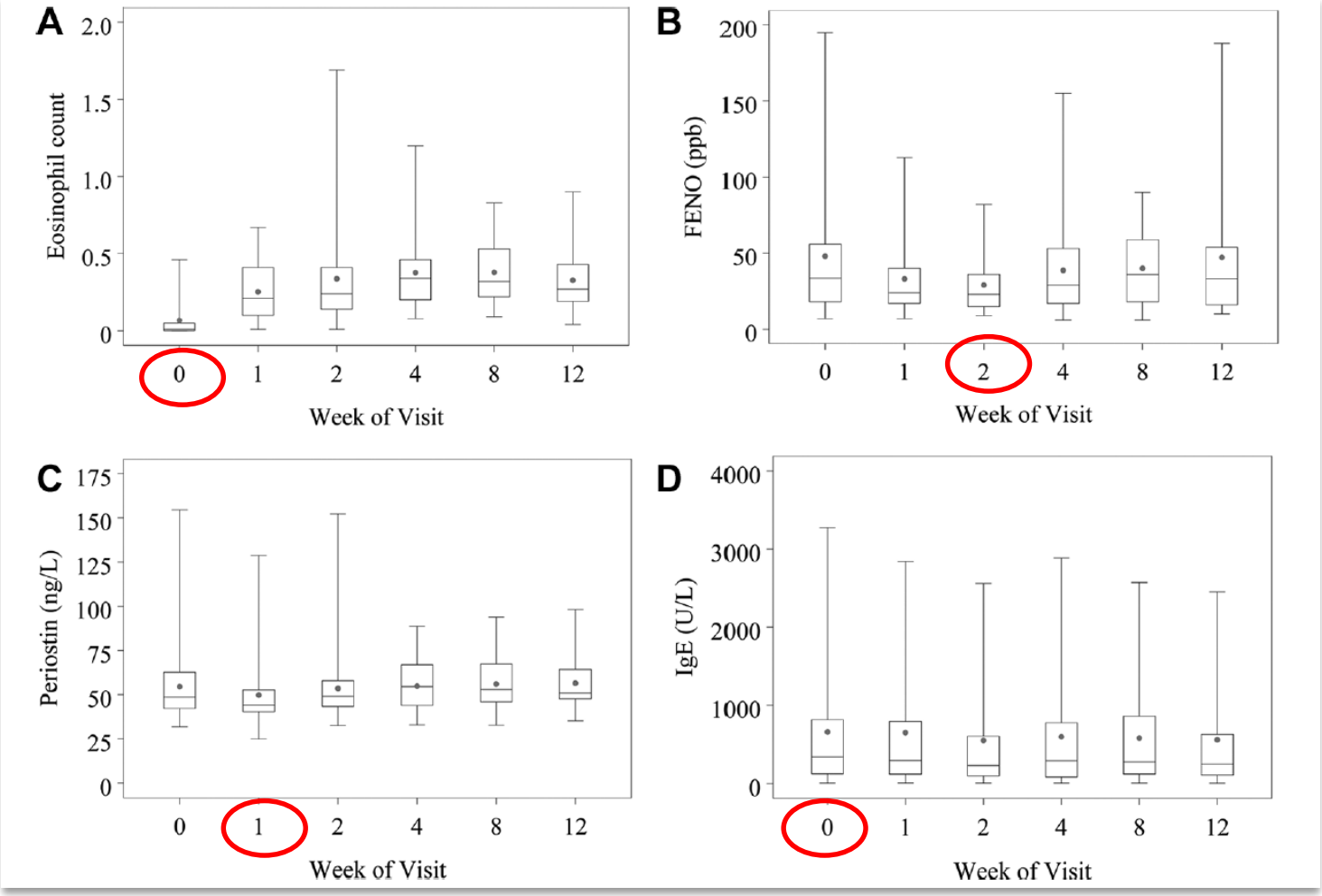
Change in biomarkers of type-2 inflammation following severe exacerbations of asthma

Semprini R, et al. Thorax 2018;**0**:1–4. doi:10.1136/thoraxjnl-2018-211657



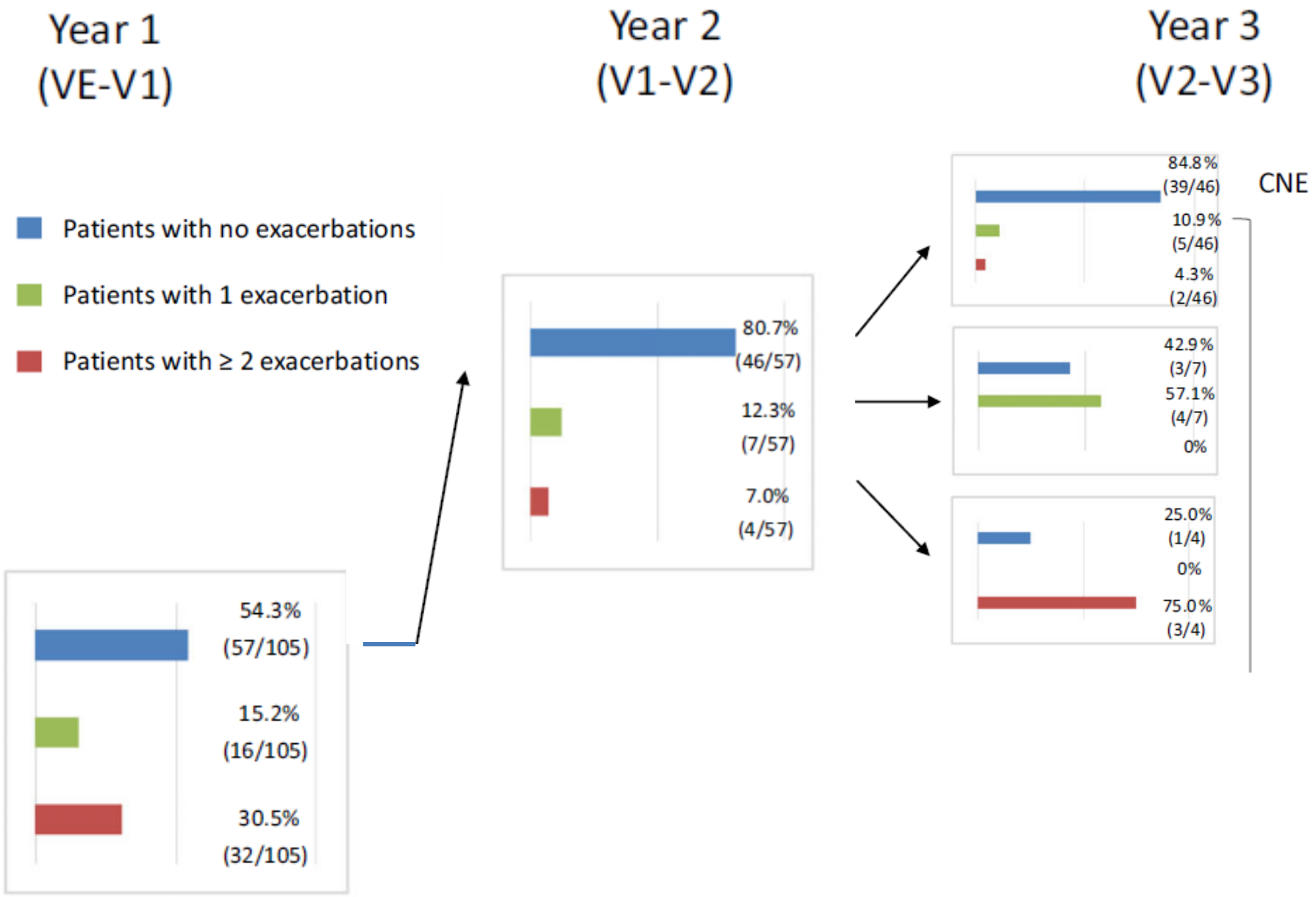
A delay of 4–8 weeks following a severe exacerbation is required if these biomarkers are used to guide the ongoing management of patients with asthma.

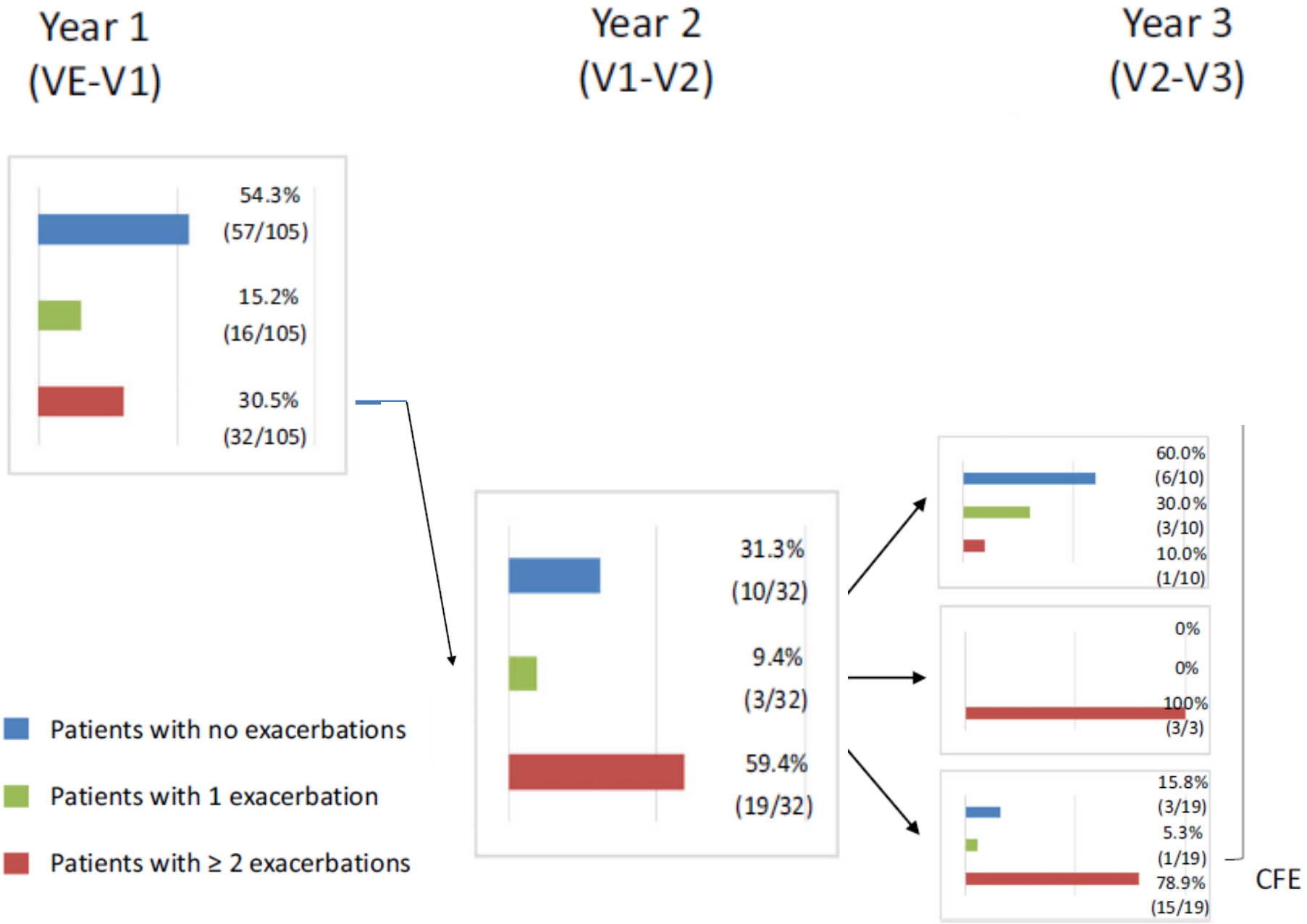
Prospective predictors of exacerbation status in severe asthma over a 3-year follow-up

105 severe asthmatics yearly for 3 years, as well as their exacerbation status
Hokkaido Severe Asthma Cohort Study

(i) consistent non-exacerbators (CNE, subjects who did not experience any exacerbation over the 3-year period)
(ii) consistent frequent exacerbators (CFE,, defined as those who had 2 or more exacerbations within 1 year, throughout the 3-year period)
(iii) intermittent exacerbators (IE)

S. Konno. Clin Exp Allergy. 2018;1–10.


Year 1
(VE-V1)
Year 2
(V1-V2)
Year 3
(V2-V3)
Patients with no exacerbations
Patients with 1 exacerbation
Patients with ≥ 2 exacerbations
54.3%
(57/105)
15.2%
(16/105)
30.5%
(32/105)
80.7%
(46/57)
12.3%
(7/57)
7.0%
(4/57)
84.8%
(39/46)
10.9%
(5/46)
4.3%
(2/46)
42.9%
(3/7)
57.1%
(4/7)
0%
25.0%
(1/4)
0%
75.0%
(3/4)
CNE


Year 1
(VE-V1)
Year 2
(V1-V2)
Year 3
(V2-V3)
54.3%
(57/105)
15.2%
(16/105)
30.5%
(32/105)
31.3%
(10/32)
9.4%
(3/32)
59.4%
(19/32)
60.0%
(6/10)
30.0%
(3/10)
10.0%
(1/10)
0%
0%
100%
(3/3)
15.8%
(3/19)
5.3%
(1/19)
78.9%
(15/19)
CFE
Patients with no exacerbations
Patients with 1 exacerbation
Patients with ≥ 2 exacerbations

Comorbidity characteristics of the subjects at study entry according to the exacerbation status groups in 3-y follow-up

		Type of exacerbation				
	All (N = 105)	CNE (N = 39)	IE (N = 51)	CFE (N = 15)	*P*-value	*P* for trend*
Biomarkers						
Blood eosinophil, cells/μL	197.0 (0.52)	149.7 (0.52)	211.0 (0.52)	318.1 (0.45)	.095	.032
Blood neutrophil, cells/μL	4528.2 (0.18)	4453.2 (0.19)	4568.3 (0.16)	4589.6 (0.23)	.952	.862
Total serum IgE, IU/mL	138.5 (0.70)	163.9 (0.74)	127.4 (0.70)	118.8 (0.60)	.709	.301
Sputum eosinophil, %[a]	8.0 (0.8-30.6)	5.1 (0.7-26.3)	4.8 (0.8-31.1)	20.0 (9.2-41.6)	.349	.670
FeNO, ppb	30.2 (0.36)	23.1 (0.35)	34.3 (0.34)	39.0 (0.39)	.033	.013
Serum periostin, ng/mL	80.3 (0.21)	77.4 (0.22)	82.8 (0.20)	79.3 (0.21)	.806	.462
Pulmonary function						
FEV_1, % predicted (maximum)[b]	91.4 ± 18.9	93.7 ± 18.0	89.9 ± 19.7	90.5 ± 19.5	.627	.529
FEV_1/FVC, %[c]	66.3 ± 12.7	67.9 ± 12.3	64.9 ± 12.8	67.1 ± 13.8	.526	.599
Co-morbidity						
AERD (%)	15 (14.3)	4 (10.3)	6 (11.8)	5 (33.3)	.073	.069
Allergic rhinitis (%)	85 (81.0)	32 (82.1)	40 (78.4)	13 (86.7)	.756	.875
COPD[d] (%)	64 (61.0)	23 (59.0)	31 (60.8)	10 (66.7)	.873	.632
LMS[e]	3.0 (0-9.3)	3.0 (0-8.0)	4.0 (1.0-12.0)	4.0 (1.3-7.5)	.446	.427
Nasal polyp[e], N (%)	28 (26.7)	9 (23.1)	15 (29.4)	4 (26.7)	.797	.649
GERD, F-scale	8.0 (3.0-13.3)	7.0 (2.0-13.0)	8.0 (3.0-13.8)	10.0 (6.3-13.8)	.758	.488
SDS	38.0 (32.0-46.0)	37.0 (31.0-46.0)	39.0 (33.0-45.0)	39.0 (31.3-45.8)	.683	.484

TABLE 3 Comparison of the blood eosinophil count and FeNO among exacerbation status groups in 3-y follow-up (Analysis 1)

	Type of exacerbation				
	CNE (N = 39)	IE (N = 51)	CFE (N = 15)	*P*-value crude	*P*-value adjusted*
Blood eosinophil, cells/μL[a]	149.7 (0.52)	211.0 (0.52)	318.1 (0.45)	.095	.063
FeNO, ppb[a]	23.1 (0.35)	34.3 (0.34)	39.0 (0.39)	.033	.013

CFE, consistent frequent exacerbators; CNE, consistent non-exacerbators; FeNO, fractional exhaled nitric oxide; IE, intermittent exacerbators.

Data are shown as the geometric mean ($\log_{10}$ SD).

P-values were obtained using a 1-way analysis of variance (ANOVA).

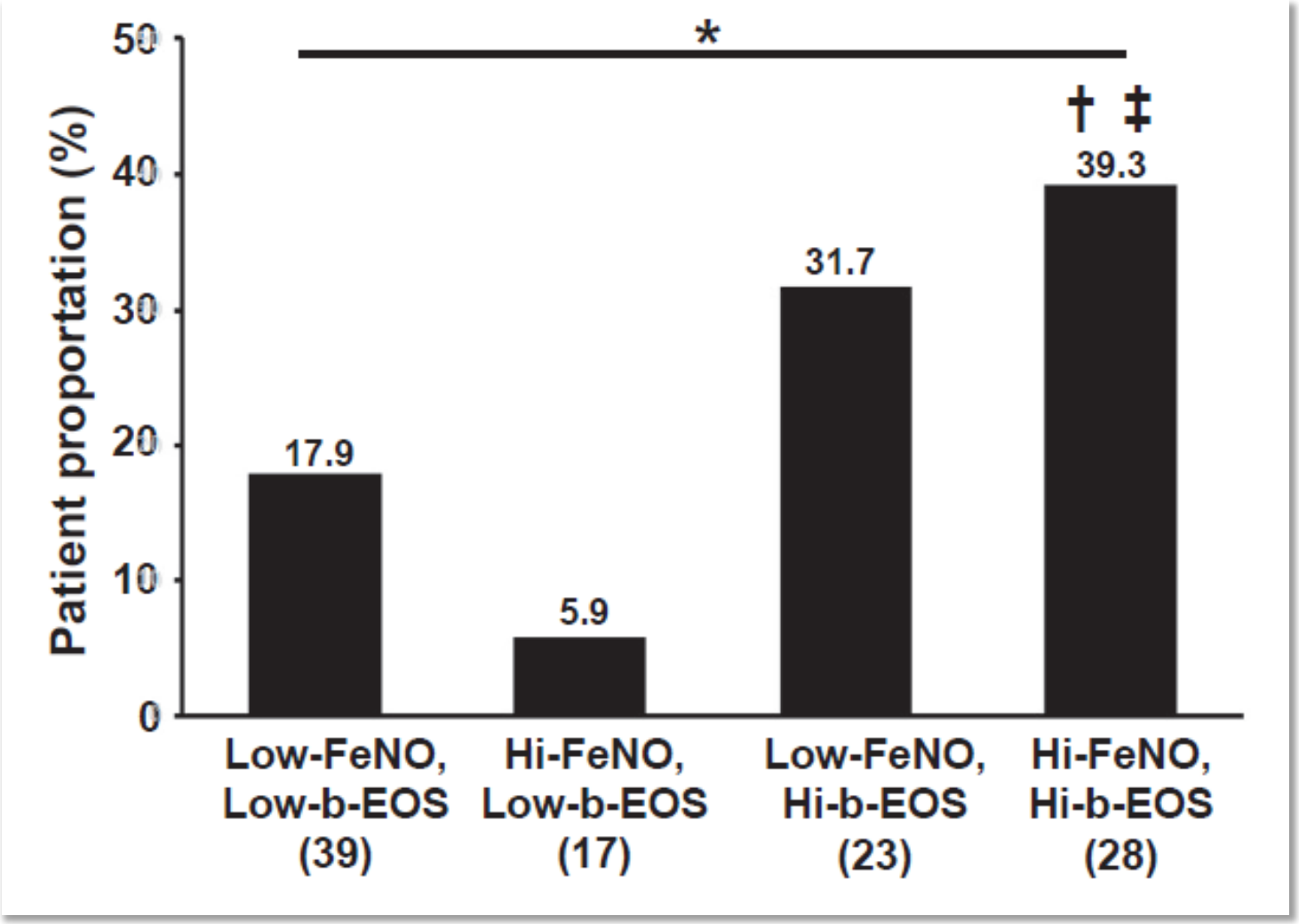
[a]Log-transformed.

*Model 1 (see Figure 1) Adjusted for age, asthma duration, sex, body mass index, atopic status, smoking status (PY ≥ 10), oral corticosteroid use, and aspirin-exacerbated respiratory disease.

Frequent exacerbation phenotype of severe asthma appeared to be relatively stable over the 3-year study period.

In addition, **measurement of FeNO** could be a valuable co-predictor for the management of severe asthma when combined with "past exacerbation status."

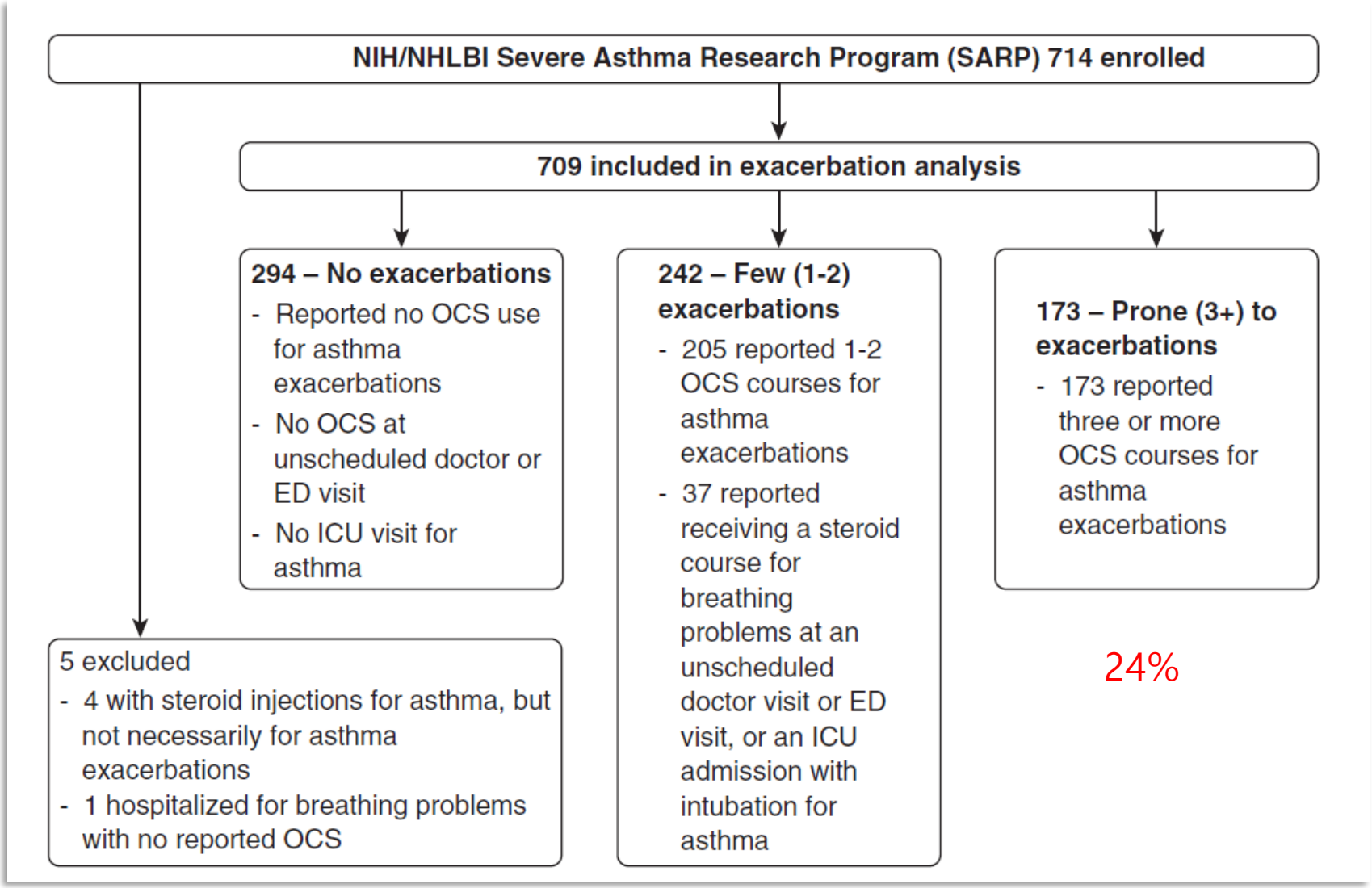
Implication of fraction of exhaled nitric oxide and blood eosinophil count in severe asthma



Proportion of patients with 3 episodes of severe asthma exacerbation

T. Soma et al. Allergology International xxx (2018) 1-9

Inflammatory and Comorbid Features of Patients with Severe Asthma and Frequent Exacerbations



Loren C. Denlinger. Am J Respir Crit Care Med. 2017 Feb 1;195(3):302-313

Table 6. Replication Analysis with the SARP-1 + 2 Cohort

	SARP-3 (*n* = 709)		SARP-1 + 2 (*n* = 1,199)	
	Risk Ratio (95% CI)	*P* Value	Risk Ratio (95% CI)	*P* Value
White	1.2 (0.9–1.6)	0.231	0.8 (0.6–1.0)	0.093
Female sex	0.9 (0.7–1.3)	0.712	1.4 (1.1–1.8)	0.005
Sinusitis	1.7 (1.2–2.2)	<0.001	1.3 (1.1–1.7)	0.019
GERD	1.8 (1.3–2.4)	<0.001	2.3 (1.9–3.0)	<0.001
Age	1.0 (0.9–1.2)	0.477	1.1 (1.0–1.2)	0.033
Maximum postalbuterol reversibility	1.1 (1.0–1.3)	0.046	1.1 (1.0–1.2)	0.067
BMI	1.3 (1.1–1.5)	0.005	1.2 (1.1–1.4)	0.006
IgE (log)	0.8 (0.7–1.0)	0.045	1.1 (1.0–1.3)	0.123
Blood eosinophils (log)	1.8 (1.2–2.7)	0.009	1.7 (1.2–2.4)	0.009

Am J Respir Crit Care Med. 2017 Feb 1;195(3):302-313

Type 2 Biomarkers and Prediction of Future Exacerbations and Lung Function Decline in Adult Asthma

RCT of mAb therapies directed against type 2 asthma
: higher levels of blood eosinophils, FENO, and serum periostin are associated with higher exacerbation rates in populations with severe asthma.

We aimed to assess whether the risk of severe exacerbation was greater in those with high levels of type 2 biomarkers in a relatively nonspecific group of adults with asthma with a range of severity.

The first cohort was a sample of 235 adults with asthma, who had predominantly intermittent asthma of mild or moderate severity

The second smaller cohort consisted of 60 adults with stable moderate to severe asthma on a regular regimen of ICS/LABA, who had participated in a study of the longitudinal variation of serum periostin levels

Irene Braithwaite. J Allergy Clin Immunol Pract. 2018. 2198(18)30137-5

TABLE I. Characteristics of participants enrolled in the study

Continuous variable	Mean ± SD		
	Baseline	Follow-up	Difference* (SD)
Age (y)	50.5 ± 13.2		
BMI (kg/m^2)	29 ± 6.1		
ACQ-5 score	0.91 ± 0.74	0.73 ± 0.76	−0.17 (0.71)
AQLQ-S score	6.13 ± 0.92	6.23 ± 0.81	0.09 (0.75)
FEV_1 (L)	2.90 ± 0.91	2.77 ± 0.87	−0.14 (0.34)
FEV_1 % predicted (%)	88.9 ± 19.8	87.3 ± 18.7	−1.6 (10.2)
Blood eosinophils (× 10^9/L)	0.25 ± 0.19	0.24 ± 0.18	−0.01 (0.15)
FENO (ppb)†	22.5 (13.6 to 44.4)	22 (15 to 33)	−0.4 (−9.5 to 5)
Serum periostin (ng/mL)†	52.8 (45 to 65.5)	52.6 (43.7 to 61.7)	−2.24 (−8.1 to 4.4)
Serum IgE (IU/L)†	123 (32 to 262.5)	103 (23 to 243)	−8 (−74.8 to 8)

Categorical variables	N/212 (%)		
	Baseline	Follow-up	Difference (N)
Female	109 (51.4)	109 (51.4)	
Current smoker	13 (6.1)	13 (6.1)	0
No inhalers	41 (19.3)	38 (17.9)	−3
SABA inhaler only	16 (7.5)	37 (17.5)	21
ICS use	155 (74.1)	137 (64.1)	−18
ICS/LABA	92 (43.4)	101 (47.6)	9

Irene Braithwaite. J Allergy Clin Immunol Pract. 2018. 2198(18)30137-5

TABLE II. The associations between type 2 biomarkers and time to exacerbation

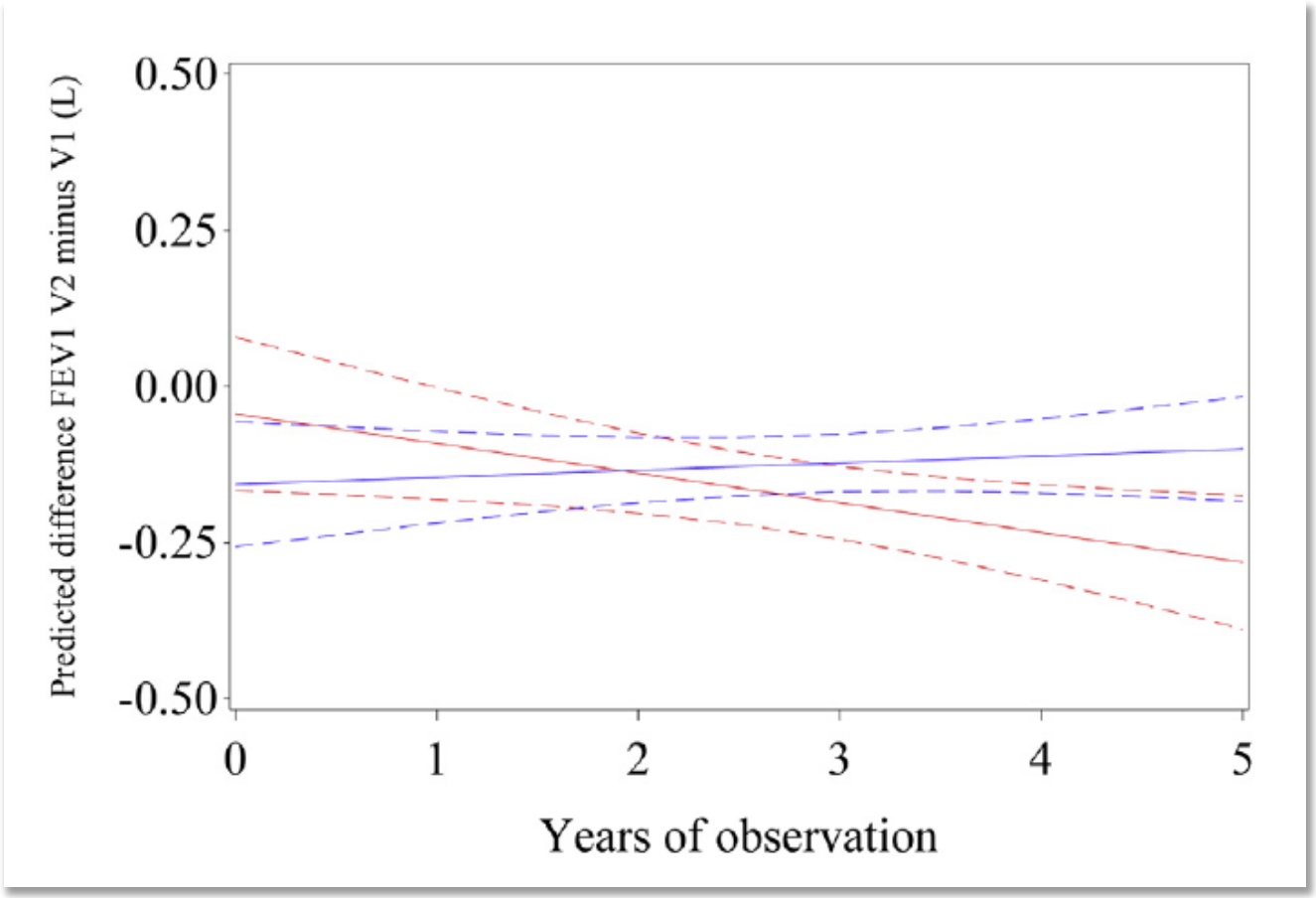
	Univariate		Multivariate	
Type 2 biomarkers	Hazard ratio (95% CI)	*P* value	Hazard ratio (95% CI)	*P* value
Per 0.1 unit increase in blood eosinophils	0.92 (0.79-1.07)	.28	0.89 (0.76-1.05)	.17
Per 0.693 unit increase in log FENO	0.64 (0.52-0.79)	<.001	0.65 (0.52-0.81)	<.001
Per 0.693 unit increase in log serum periostin	0.59 (0.33-1.07)	.08	0.62 (0.35-1.09)	.10
Per 0.693 unit increase in log serum IgE	0.93 (0.83-1.04)	0.20	0.89 (0.80-1.00)	.05

The multivariate associations are adjusted for which recruitment cohort the participants were from and for use of ICSs or not.

Significant association between high baseline FENO and serum IgE levels and a lower risk of a severe exacerbation in adults with predominantly intermittent asthma of mild to moderate severity

Irene Braithwaite. J Allergy Clin Immunol Pract. 2018. 2198(18)30137-5

Change in FEV1 with time associated with baseline eosinophil count.



eosinophil count of 0.3 at baseline

eosinophil count of 0.1 at baseline

Irene Braithwaite. J Allergy Clin Immunol Pract. 2018. 2198(18)30137-5

Contents

- T2 Inflammation biomarker
  (Blood eosinophil, FENO..)
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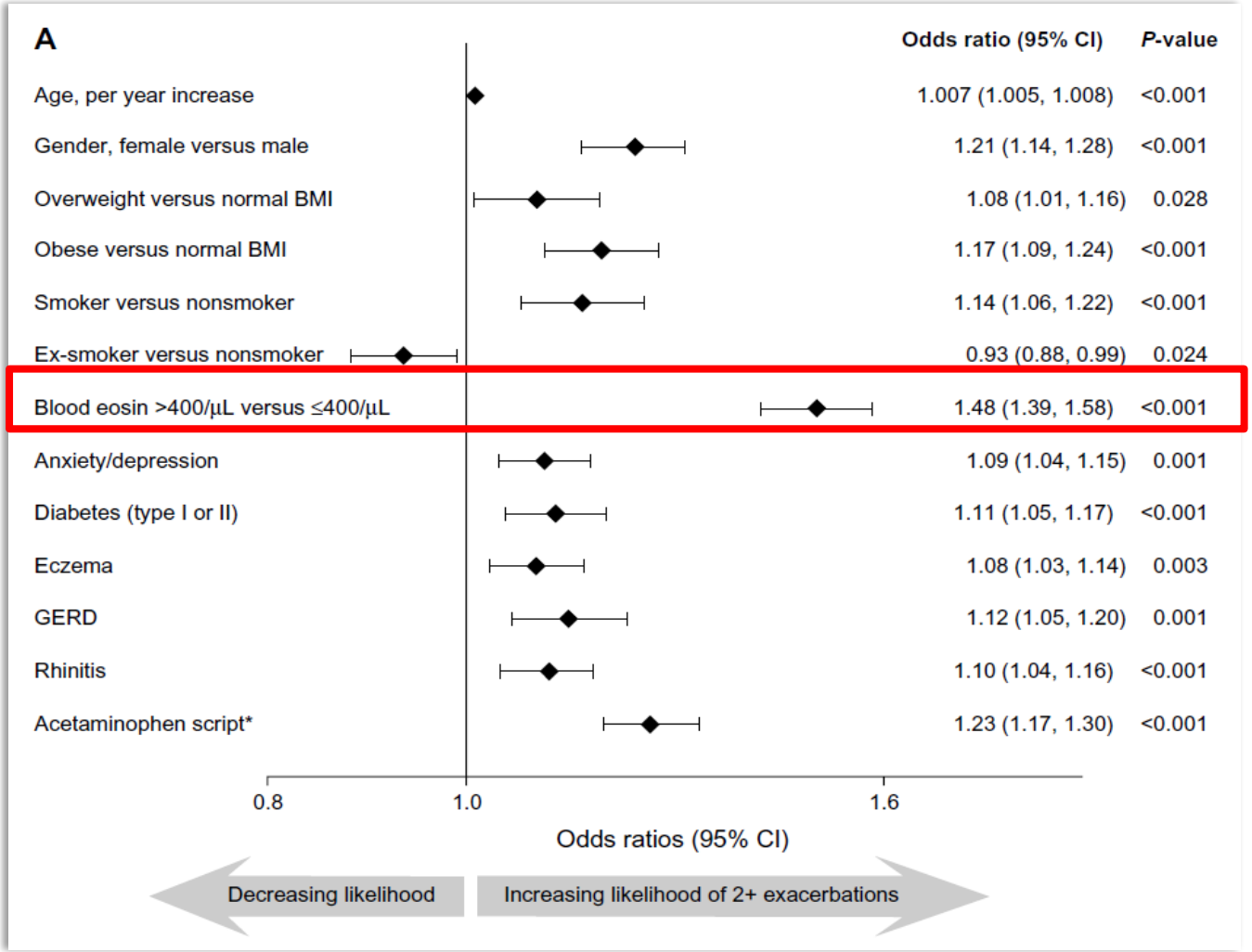
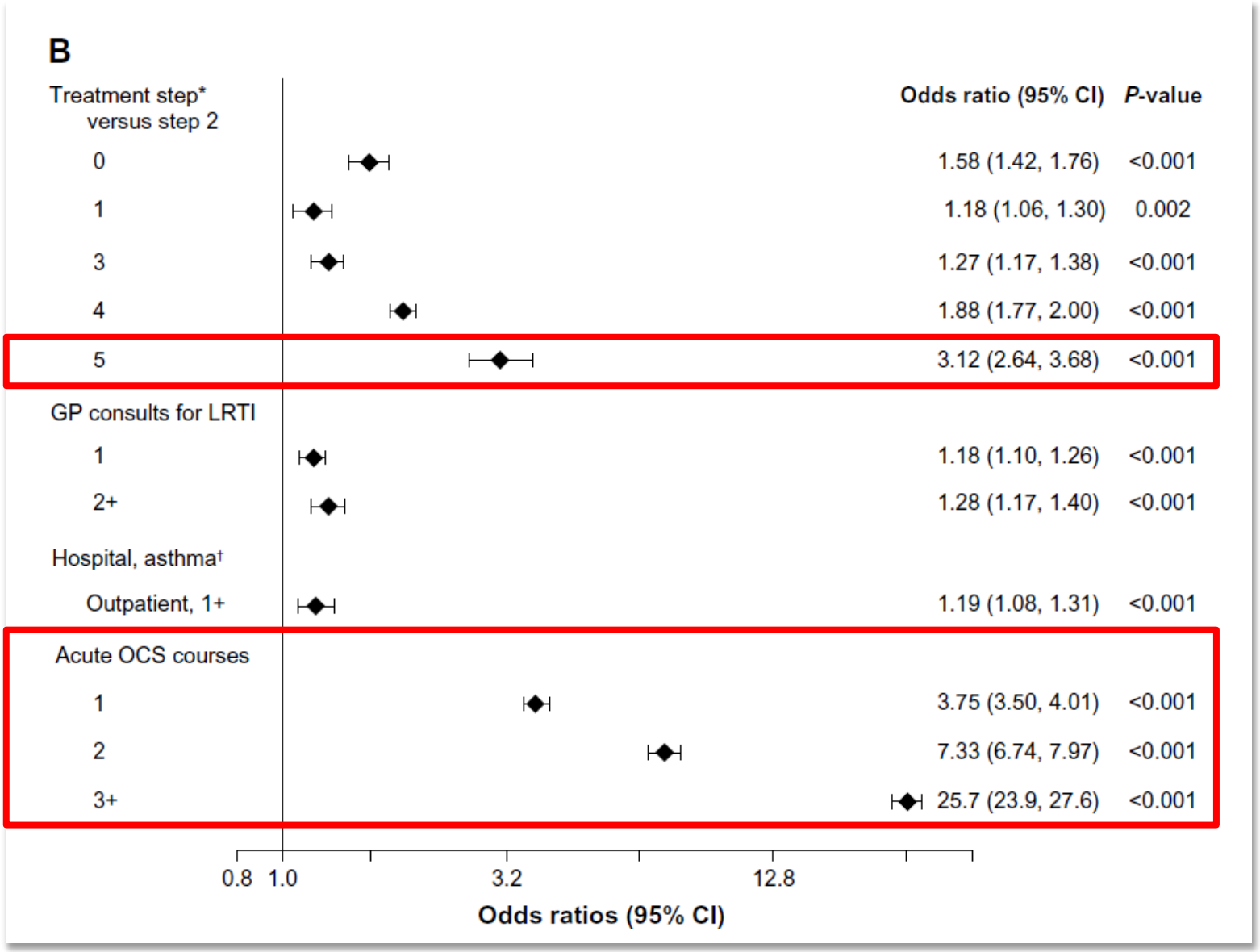
Predicting frequent asthma exacerbations using blood eosinophil count and other patient data routinely available in clinical practice

Medical records of 130,547 asthma patients aged 12–80 years from the UK Optimum Patient Care Research Database and Clinical Practice Research Datalink, 1990–2013,

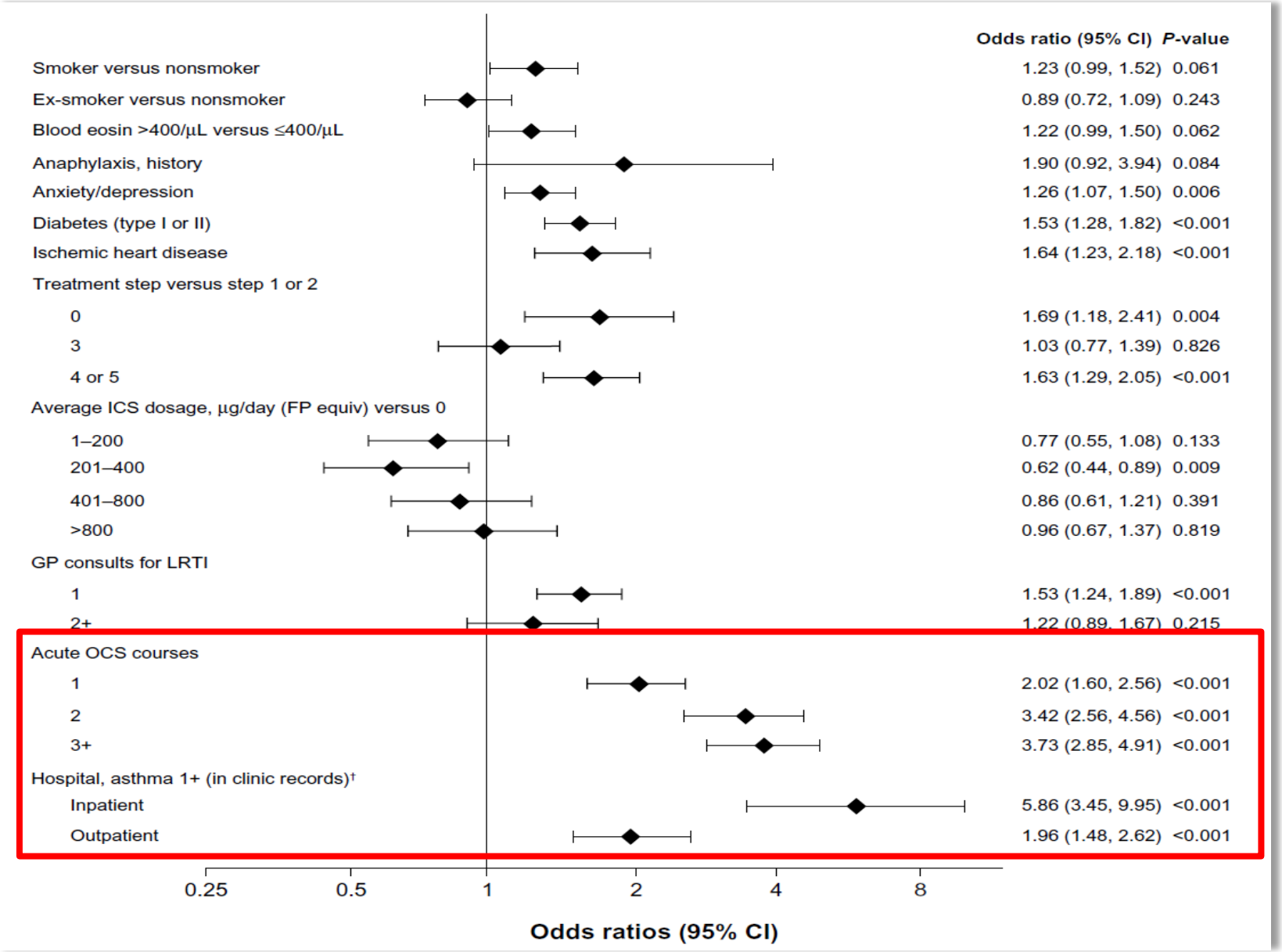


David Price. J Asthma Allergy. 2016 Jan 7;9:1-12

Odds of two or more exacerbations (versus 0 or 1) in the next year



Hospital Episode Statistics (HES) subset: odds of at least one inpatient admission for asthma (versus 0) in the next year.



Regular follow-up visits reduce the risk for asthma exacerbation requiring admission in Korean adults with asthma

Hye Jung Park[1], Min Kwang Byun[1*], Hyung Jung Kim[1], Chul Min Ahn[1], Chin Kook Rhee[2], Kyungjoo Kim[2], Bo Yeon Kim[3], Hye Won Bae[4] and Kwang-Ha Yoo[5]

Table 5 Univariate and multivariate analyses for asthma exacerbation requiring admission

Parameters	Univariate analysis		Multivariate analysis	
	OR (95% CI)	*P* value	OR (95% CI)	*P* value
General ward admission with exacerbated asthma				
Age	1.04 (1.04–1.04)	< 0.001	1.02 (1.02–1.02)	< 0.001
Male	1.08 (1.06–1.11)	< 0.001	0.79 (0.77–0.81)	< 0.001
Medical aid insurance	0.43 (0.42–0.44)	< 0.001	0.81 (0.78–0.85)	< 0.001
Hospital type				
Primary	0.19 (0.19–0.20)	< 0.001	1.44 (1.39–1.48)	< 0.001
Secondary	7.75 (7.56–7.95)	< 0.001	15.97 (15.40–16.56)	< 0.001
Tertiary	12.25 (11.93–12.58)	< 0.001	20.14 (19.44–20.88)	< 0.001
Charlson's comorbidity index	2.11 (2.09–2.13)	< 0.001	1.62 (1.60–1.64)	< 0.001
Admission with exacerbated asthma in previous year	14.16 (13.70–14.63)	< 0.001	4.39 (4.22–4.56)	< 0.001
Frequent visitor	1.44 (1.40–1.48)	< 0.001	0.48 (0.47–0.50)	< 0.001

Allergy Asthma Clin Immunol (2018) 14:29

Blood Eosinophil Count and Outcomes in Severe Uncontrolled Asthma: A Prospective Study

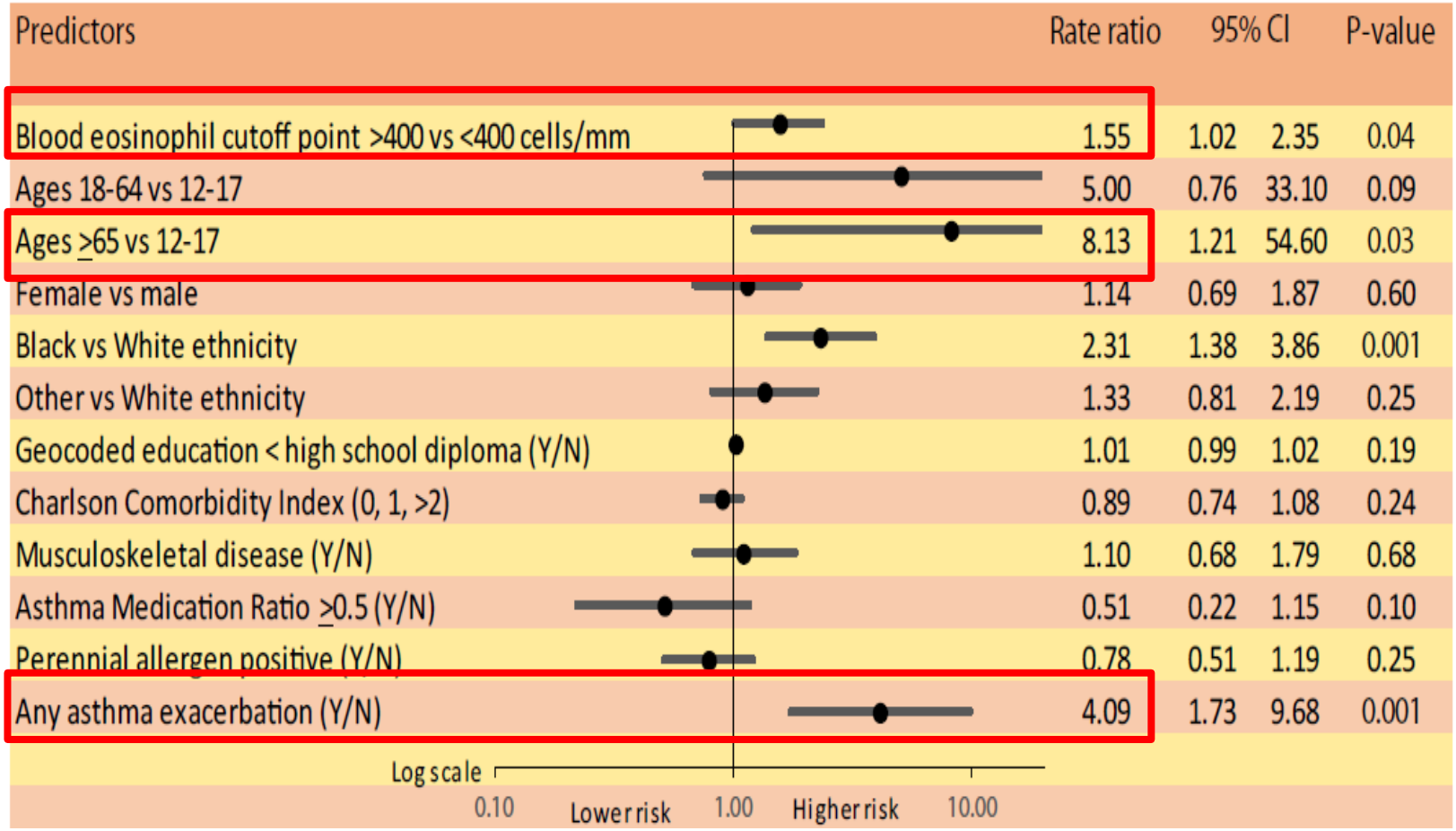
(1) 2 or more asthma exacerbations;
(2) 6 or more medium- or high-dose dispensed canisters of ICS as monotherapy or with LABA;
(3) 3 or more dispensed non-ICS controllers.

TABLE II. Unadjusted rate or risk ratio of asthma exacerbations in outcome year in patients with SUA at blood eosinophil cutoff point of ≥400 cells/mm^3 vs <400 cells/mm^3

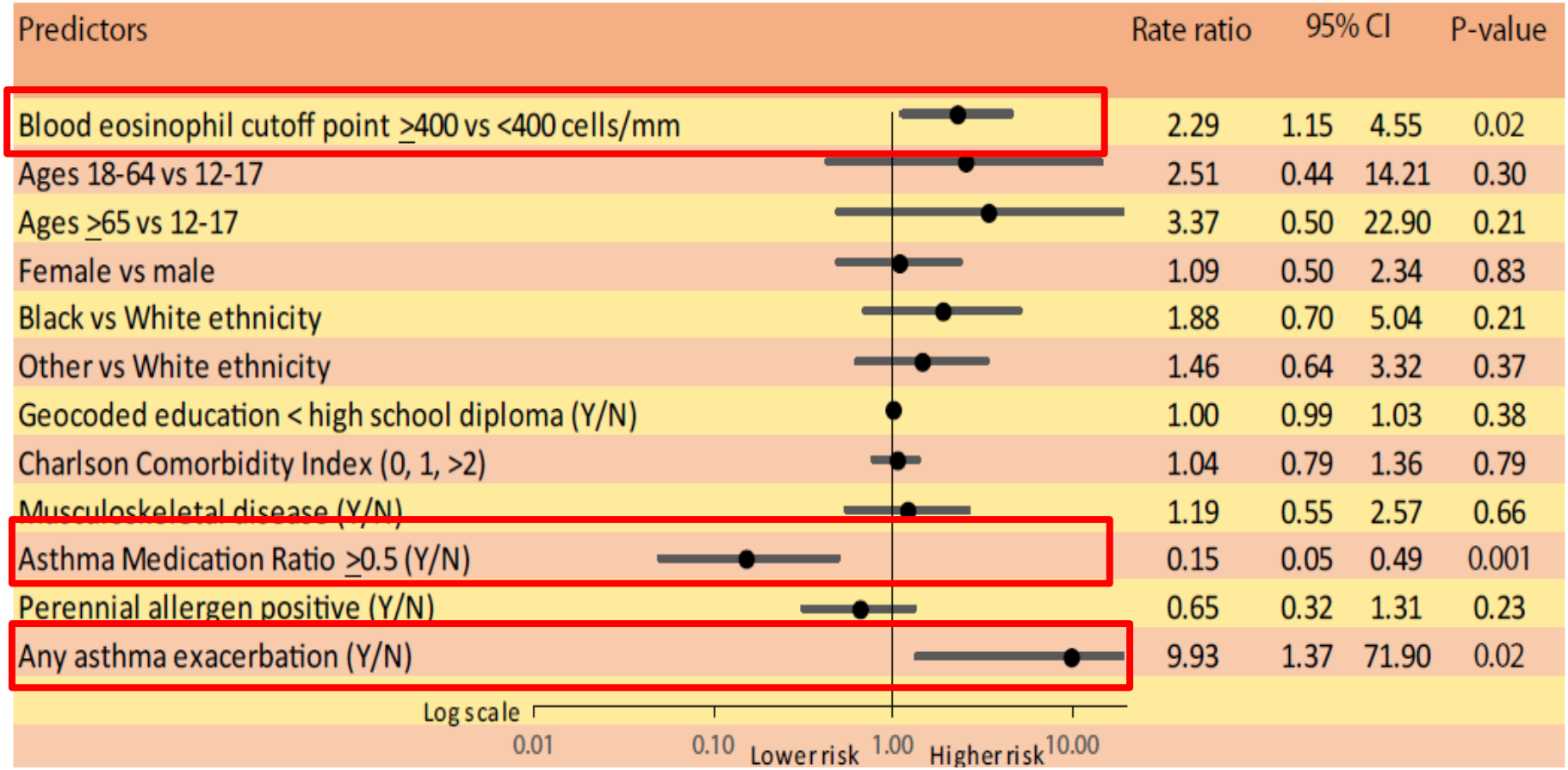
Asthma exacerbations	Blood eosinophils ≥400 cells/mm^3 (N = 77)	Blood eosinophils <400 cells/mm^3 (N = 184)	Rate or risk ratio (95% CI)	*P* value*
Asthma exacerbation (rate/y)	1.2 ± 1.7	0.9 ± 1.3	1.40 (0.97-2.02)	.08
Any asthma exacerbation, N (%)	37 (48.1)	92 (50.0)	0.96 (0.73-1.26)	.78
≥2 asthma exacerbations, N (%)	27 (35.1)	38 (20.7)	**1.70 (1.12-2.57)**	**.013**
≥1 asthma ED visit or hospitalization, N (%)	15 (19.5)	15 (8.2)	**2.39 (1.23-4.64)**	**.010**

Robert S. Zeiger, J Allergy Clin Immunol Pract. 2017 Jan - Feb;5(1):144-153

≥2 Asthma exacerbation in year post index date



≥1 Asthma ED visit or hospitalization in year post index date



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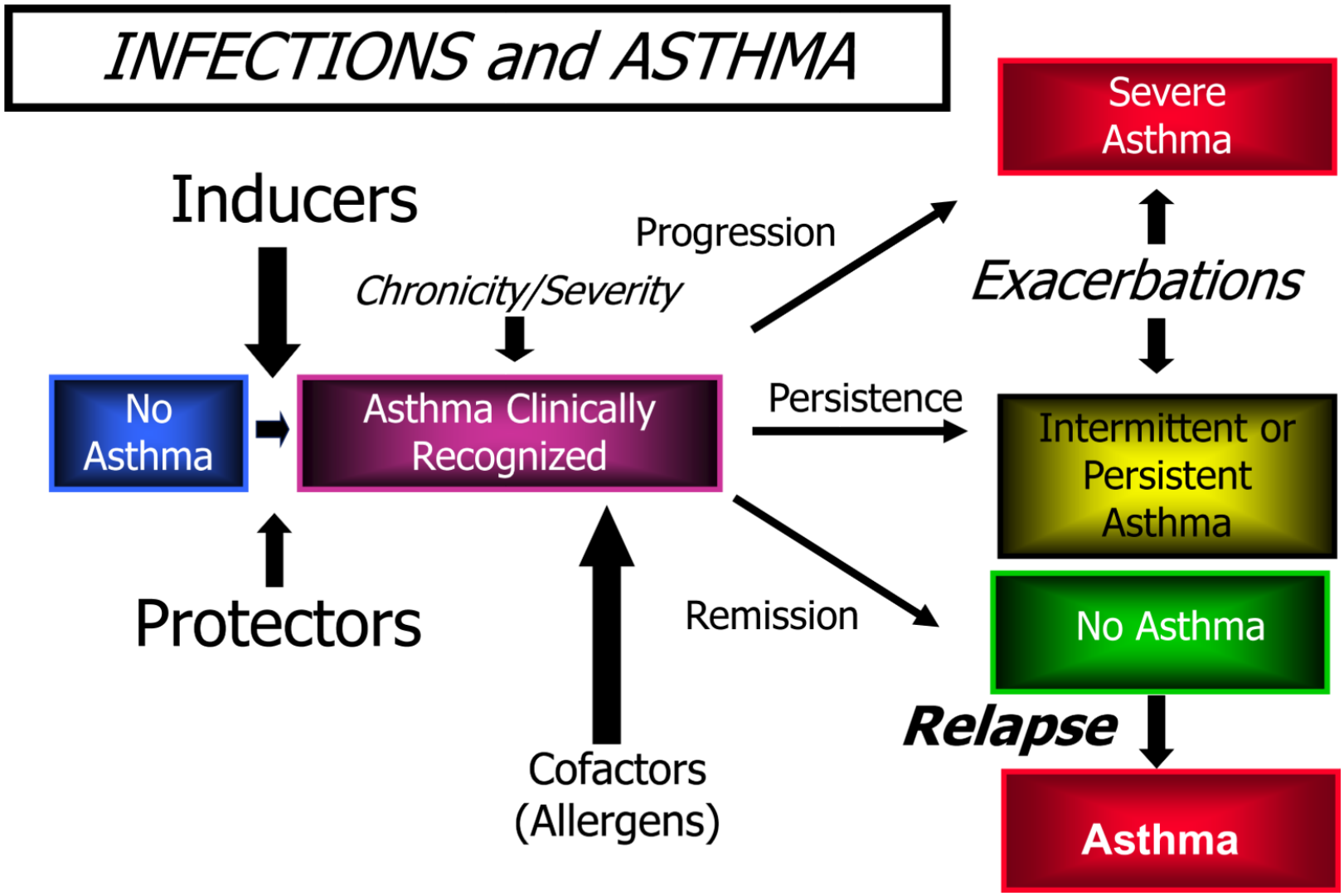
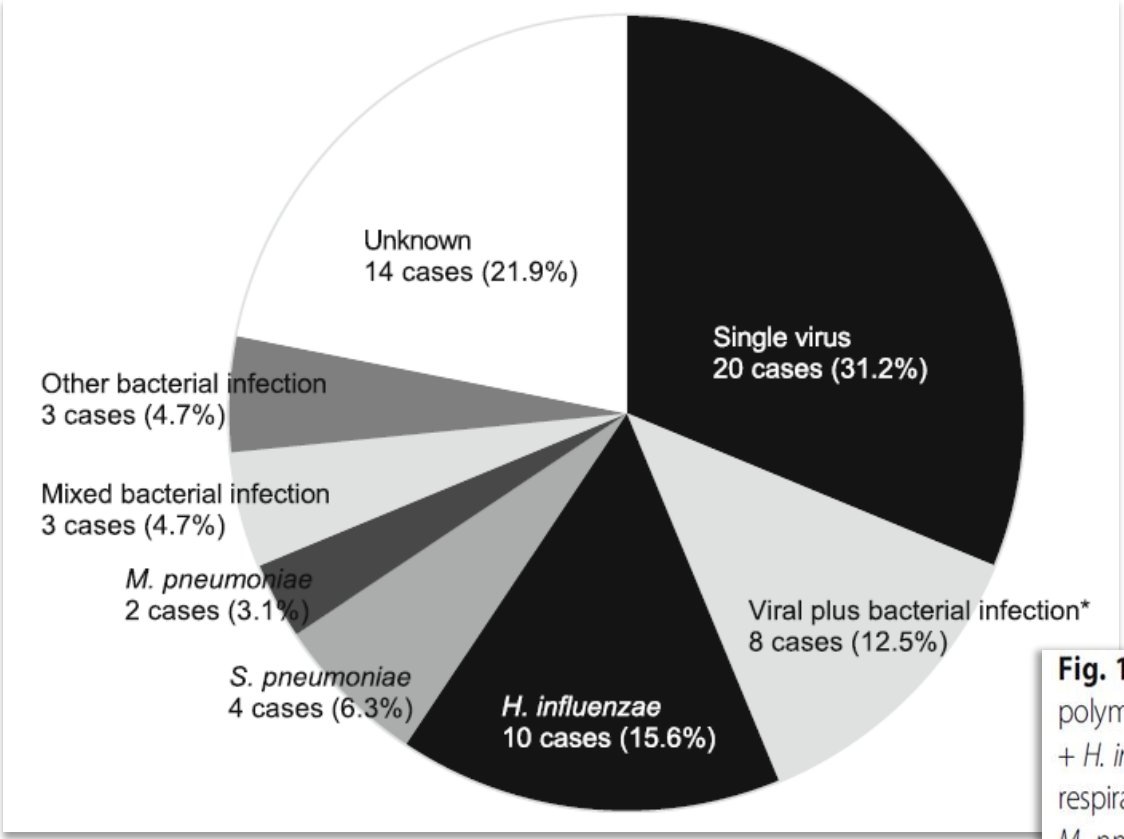
The role of infections in asthma



Detection of pathogens by real-time PCR in adult patients with acute exacerbation of bronchial asthma

Prospectively enrolled adult patients with AEBA from August 2012 to March 2014



The detection rate of **real-time PCR** was significantly higher than that of the conventional methods (76.6% vs. 21.9%, $p<0.001$).

Fig. 1 Percentages of pathogens detected by comprehensive real-time polymerase chain reaction and conventional methods. *Influenza virus + *H. influenzae*, 3 cases (4.7%); rhinovirus + *H. influenzae*, 2 cases (3.1%); respiratory syncytial virus + *H. influenzae*, 1 case (1.6%); influenza virus + *M. pneumoniae*, 1 case (1.6%); influenza virus + *H. influenzae* + *S. pneumoniae*, 1 case (1.6%)

Yoshii et al. BMC Pulmonary Medicine (2017) 17:150

Monthly distribution and frequent pathogens in acute exacerbations of bronchial asthma

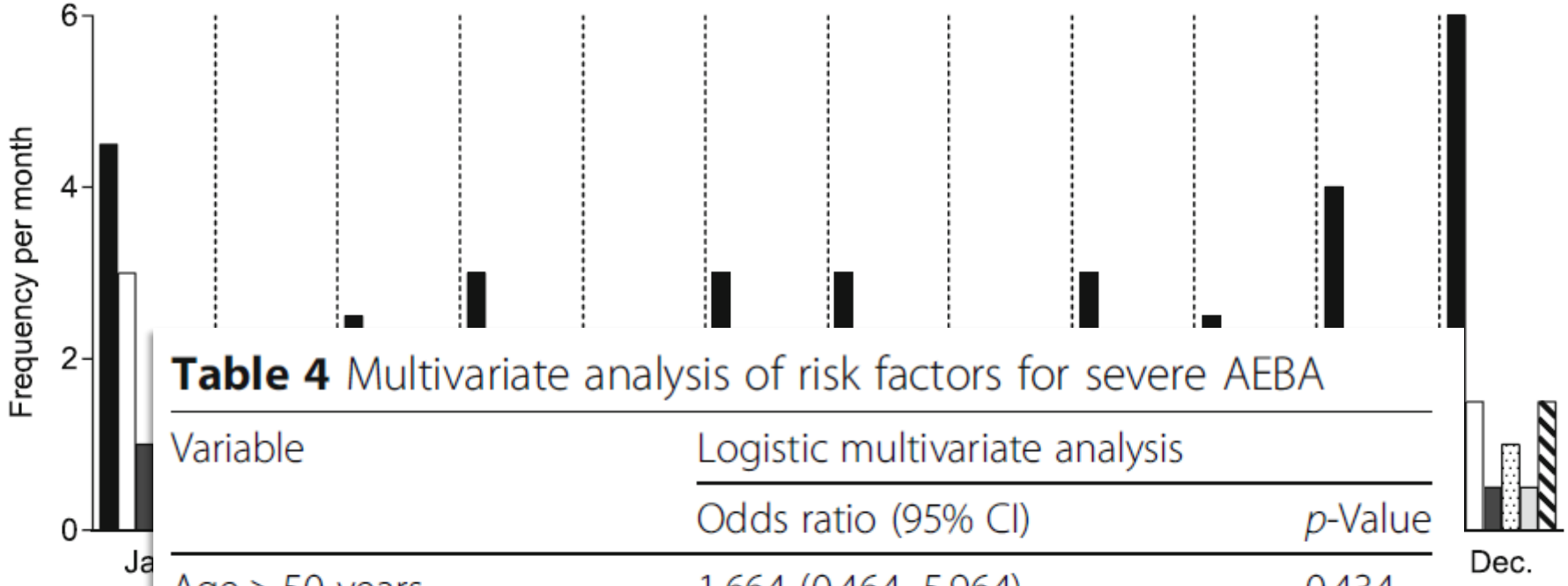


Table 4 Multivariate analysis of risk factors for severe AEBA

Variable	Logistic multivariate analysis	
	Odds ratio (95% CI)	*p*-Value
Age > 50 years	1.664 (0.464–5.964)	0.434
Male sex	1.500 (0.452–4.976)	0.508
Influenza virus	7.107 (1.511–33.43)	0.013

AEBA acute exacerbation of bronchial asthma, *CI* confidence interval

The Importance of Bacterial and Viral Infections Associated with Adult Asthma Exacerbations in Clinical Practice

	Asthma exacerbation inpatients	Stable outpatients
n	48	20
Male (%)	39.6	45.0
Age (y)	57.6	60.2
Asthma onset age (y)	38.4	39.9
Duration of disease (y)	20.2	21.3
Current smoker(%)	37.5*	5.0
Sinusitis (%)	29.2	15.0
COPD (%)	16.7	5.0
Atopic type (%)	81.9	84.2
IgE(IU/mL)	617.2	574.9
ACQ	3.7*†	0.4
FeNO (ppb)	51.2	39.4
Pathogen detection(%)	70.8	75.0
Viral detection (%)	52.1	50.0
Bacterial detection (%)	37.5	30.0

*$p < 0.05$, by Pearson's χ^2 test, Student's *t*-test or Mann-Whitney's U test.

†$p < 0.05$, by multiple logistic regression analysis.

Motoyasu Iikura, PLOS ONE | DOI:10.1371/journal.pone.0123584 April 22, 2015

Virus	n = 25
Rhinovirus A/B/C	5
Influenza A	5
Respiratory syncytial virus A	5
Parainfluenza 3	4
Metapneumovirus	3
Enterovirus	3
Parainfluenza 2	3
Respiratory syncytial virus B	2
Parainfluenza 1	2
Coronavirus 22	1
Bacteria	**n = 18**
S. pneumoniae	9
H. influenzae	6
CNS	2
M. catarrhalis	1
K. pneumoniae	1
H. parainfluenzae	1
B. pertussis	1
C. pneumoniae	1
Co-infection with viruses and bacteria (n = 9)	

Fig 1. Pathogen det

Motoyasu Iikura, PLOS ONE | DOI:10.1371/journal.pone.0123584 April 22, 2015

Table 3. Patients' characteristics by pathogen detection (n = 48).

	Pathogen		Virus		Bacteria	
Characteristic	Positive	Negative	Positive	Negative	Positive	Negative
n	34	14	25	23	18	30
Age (y)	59.9	52.0	59.8	55.2	61.7	55.1
Male (%)	38.2	42.9	32.0	47.8	47.4	52.6
Asthma onset age (y)	41.0	32.0	40.4	36.2	43.0	35.6
Duration of disease(y)	19.9	21.0	20.3	20.0	19.7	20.5
Atopic type(%)	75.8	92.9	64.0*†	95.7	83.3	76.7
Current smoker(%)	38.2	35.7	28.0	47.8	44.4	33.3
CD4 (/μL)	338.2*	257.6	322.2	299.7	325.9	300.9
CD8 (/μL)	168.6	164.7	174.3	160.6	153.8	175.9
Sinusitis (%)	32.3	21.4	32.0	13.0	44.4*†	10.0
Pneumonia (%)	20.6	7.1	12.0	0.0	16.7*	0.0
COPD (%)	21.0	7.1	20.0	13.0	22.2	13.3
IgE(IU/mL)	649.8	340.5	722.9*	507.0	373.3	768.6
ACQ	3.6	3.8	3.6	3.7	3.6	3.7
FeNO (ppb)	42.6	69.4	34.2	68.1	52.2	50.5
Post ACQ	0.6	0.4	0.5	0.4	0.6	0.4
Post FeNO (ppb)	29.8	32.0	28.5	35.6	35.4	30.2

Post ACQ and FeNO levels were measured one month after asthma exacerbation.

*$p < 0.05$, Mann-Whitney U test

†$p < 0.05$, multiple logistic regression analysis.

Table 4. Pathogen detection between asthma inpatients (exacerbation) and stable outpatients (%).

	Asthma attack inpatients	Stable outpatients
Virus		
Rhinovirus A/B/C	10.4	5.0
Influenza A	10.4	10.0
Respiratory syncytial virus A	10.4	5.0
Parainfluenza 3	8.3	10.0
Metapneumovirus	6.3	0.0
Enterovirus	6.3	20.0
Parainfluenza 2	6.3	10.0
Parainfluenza 1	6.3	5.0
Respiratory syncytial virus B	4.2	5.0
Coronavirus 22	2.1	5.0
Bacteria		
S. pneumoniae	18.8*†	0.0
H. influenzae	12.5	30.0
CNS	4.2	0.0
M. catarrhalis	2.1	0.0
K. pneumoniae	2.1	0.0
H. parainfluenzae	2.1	0.0
B. pertussis	2.1	0.0
C. pneumoniae	2.1	0.0

*$p < 0.05$ by Pearson's χ^2 test

†$p < 0.05$, by multiple logistic regression analysis.

Contents

- T2 Inflammation biomarker
  (Blood eosinophil, FENO..)
- History of exacerbation
- Infection

- Multivariable prediction model

  Current level of asthma control can be easily assessed by validated instruments, but it is currently difficult to assess individuals' level of future risk

Development and Validation of Personalized Prediction to Estimate Future Risk of Severe Exacerbations and Uncontrolled Asthma in Patients with Asthma, Using Clinical Parameters and Early Treatment Response

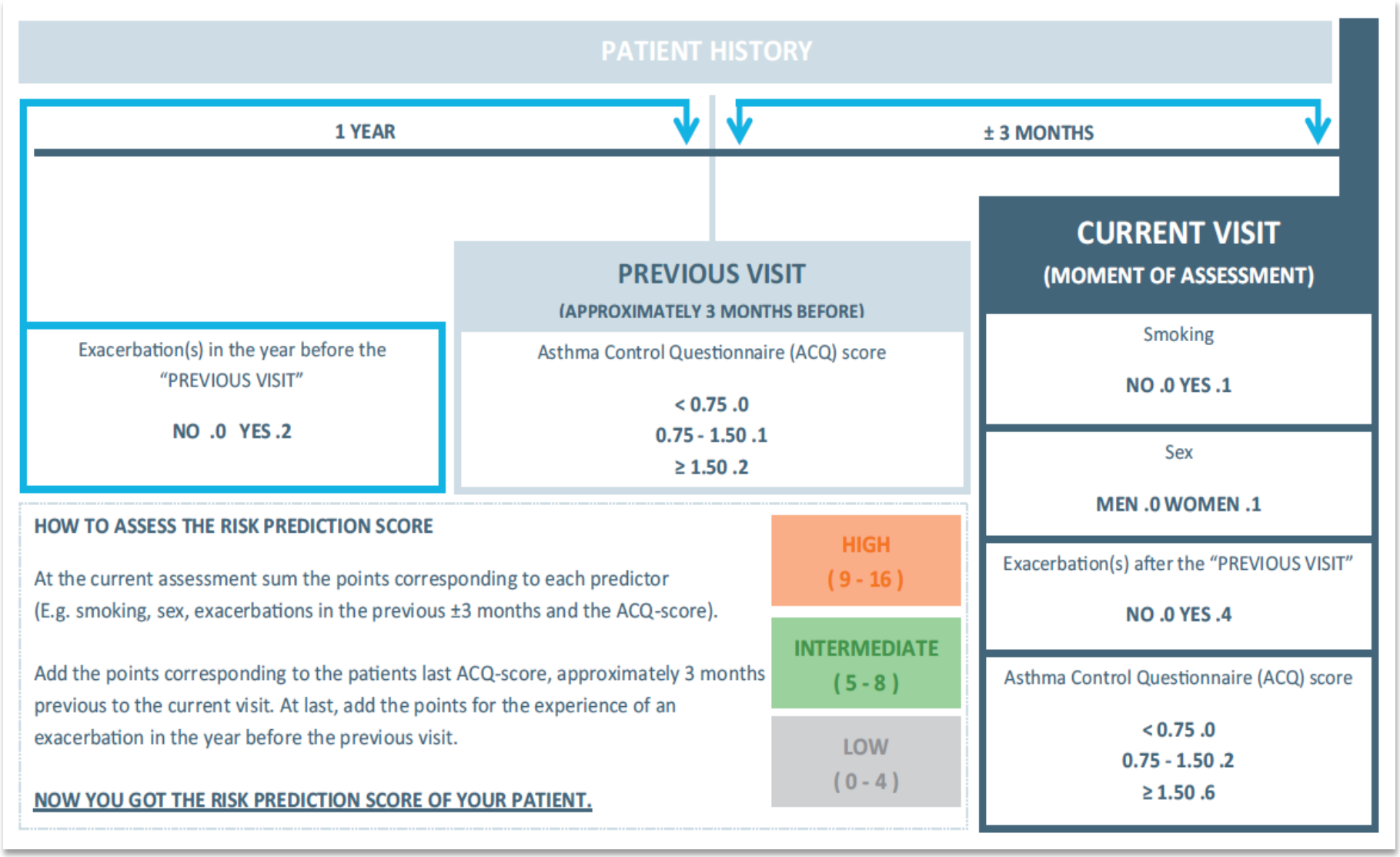
Factor	Point
Current visit	
Current smoking	
No	0
Yes	1
Sex	
Men	0
Women	1
ACQ-6 score	
<0.75	0
0.75-1.50	2
>1.50	6
Exacerbation(s) since the previous visit (~3 mo previously)	
No	0
Yes	4
Previous visit	
ACQ-6 score	
<0.75	0
0.75-1.50	1
>1.50	2
Exacerbation(s) in the previous year	
No	0
Yes	2
Total score (range)	0-16

Future Risk

Low level (11.7%) : 0-4
Intermediate level (47.0%) : 5-8
High level (72.7%) : 9-16

Suzanne Boer, Persijn J. Honkoop. J Allergy Clin Immunol Pract 2018;

The risk prediction score in clinical practice: simplified users guide



Identifying patients at risk for severe exacerbations of asthma: development and external validation of a multivariable prediction model

Factor		Points	
		History	History+spirometry
ACQ score	<0.75	0	0
	0.75–1.50	1	1
	>1.5	4	4
Current smoking	No	0	0
	Yes	3	2.5
Chronic sinusitis	No	0	0
	Yes	3	3.5
Ever admitted for asthma?	No	0	0
	Yes	3	2.5
Steroids previous year?	No	0	0
	Yes	5	5
Spirometry (% predicted)	>90		0
	80–90		0.25
	<80		0.50
Total score (range)		0–18	0–18

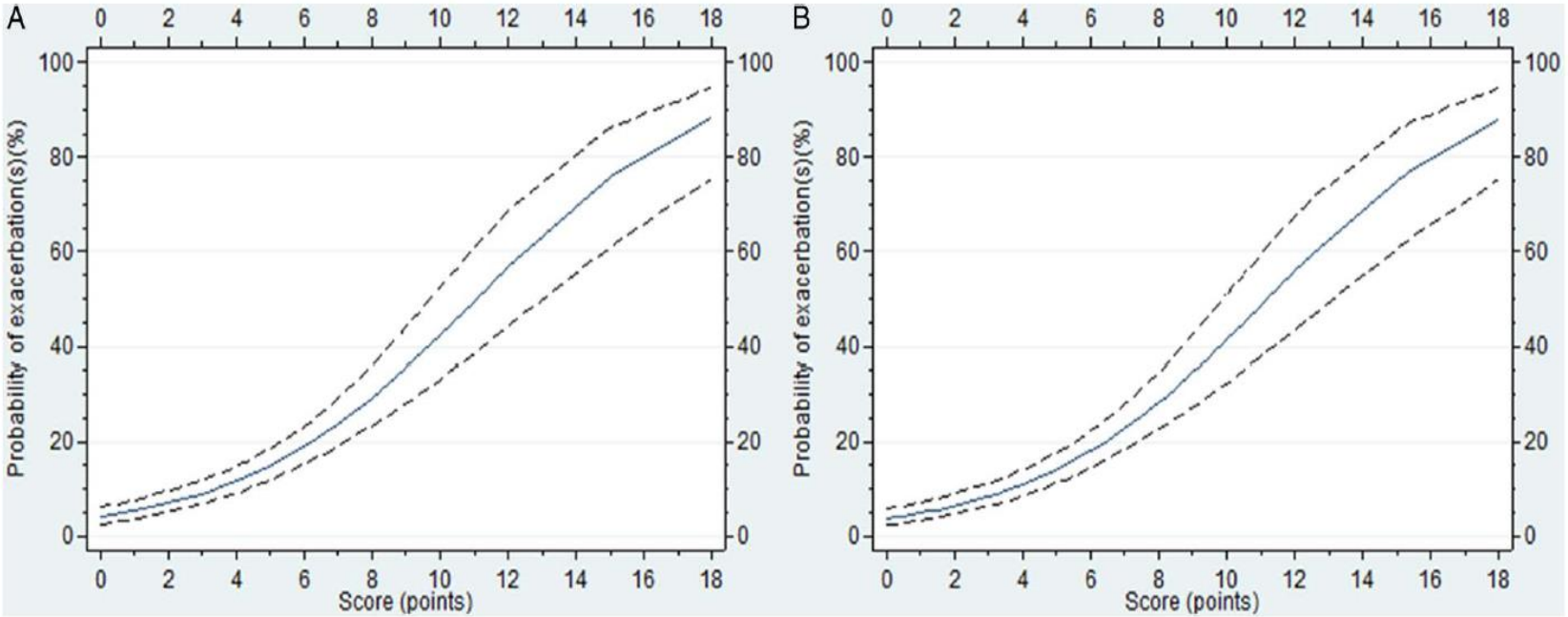
ACQ, Asthma Control Questionnaire.

Construction of the asthma risk score for the history and history+spirometry model

(AUROC 0.79)

Loymans RJB, et al. Thorax 2016;71:838–846

Predicted probabilities of at least one exacerbation during the next 12 months (y-axis) versus the points accredited by the score system (x-axis) for the history model (1) and history+spirometry model (2).



Summary

- T2 Inflammation biomarker
  Blood eosinophil, FENO
- History of exacerbation
  Powerful prognostic factor
  Regular visit : good prognosis
- Infection
  Real-time PCR
  Influenza virus and S. pneumoniae
- Multivariable prediction model
  Simple history-based model ± spirometry

Thank you