

Big Data Research of Severe Asthma

동국대학교 경주병원
김상혁

Contents

- **Introduction**
- **Datasets for Big Data Research of Severe Asthma**
- **Severe Asthma Research by Using Big Data**
- **Future direction**

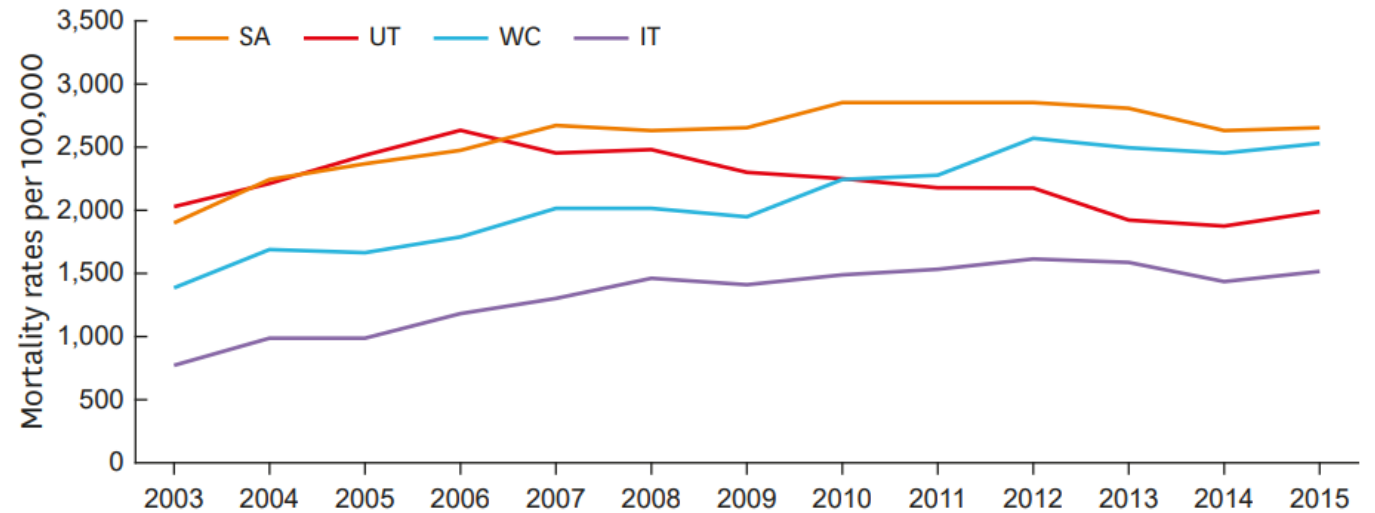
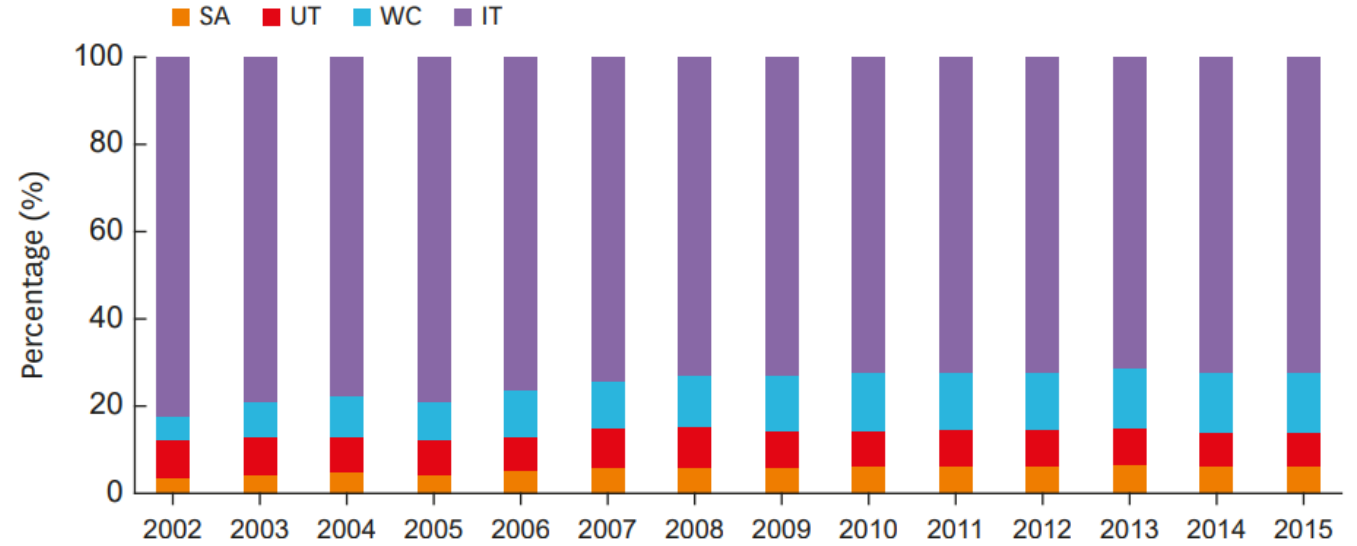
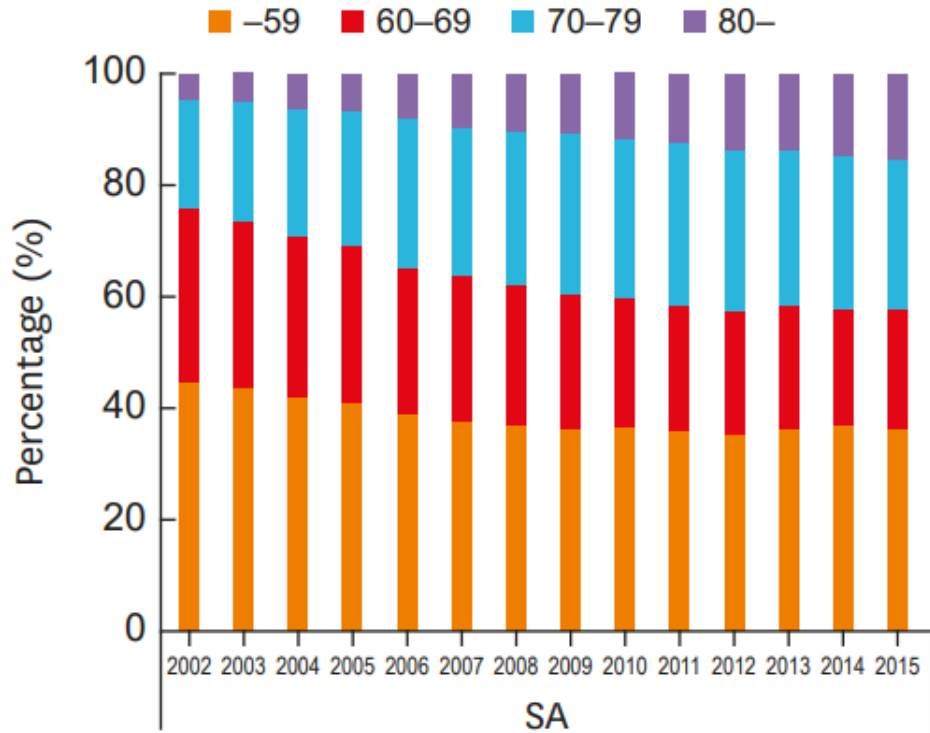
Contents

- **Introduction**
- **Datasets for Big Data Research of Severe Asthma**
- **Severe Asthma Research by Using Big Data**
- **Future direction**

Severe asthma in South Korea

NHISS data

Characteristics	Asthma with frequent exacerbations (UCT) [†]	
	Yes	No
Regular treatment*		
Yes	SA	WC
No	UT	IT



Why severe asthma is a problem?

Small number



17%

● **difficult-to-treat asthma**

= high intensity treatment
+ poor symptom control

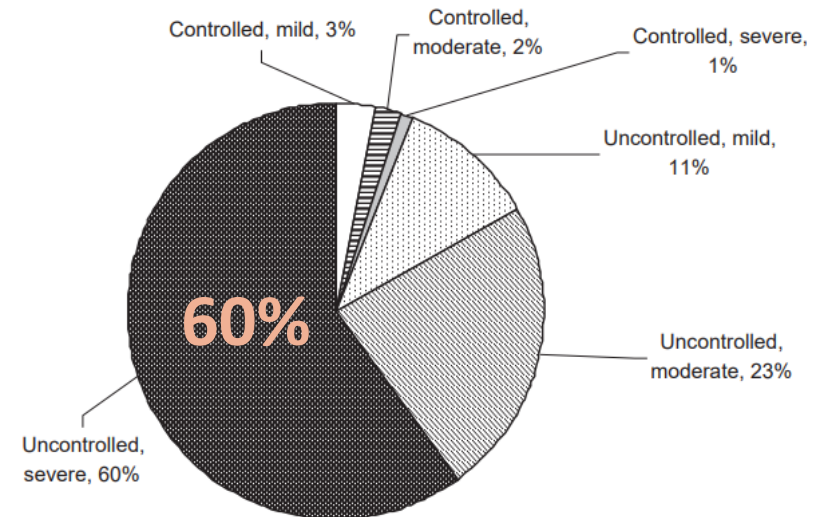


3.7%

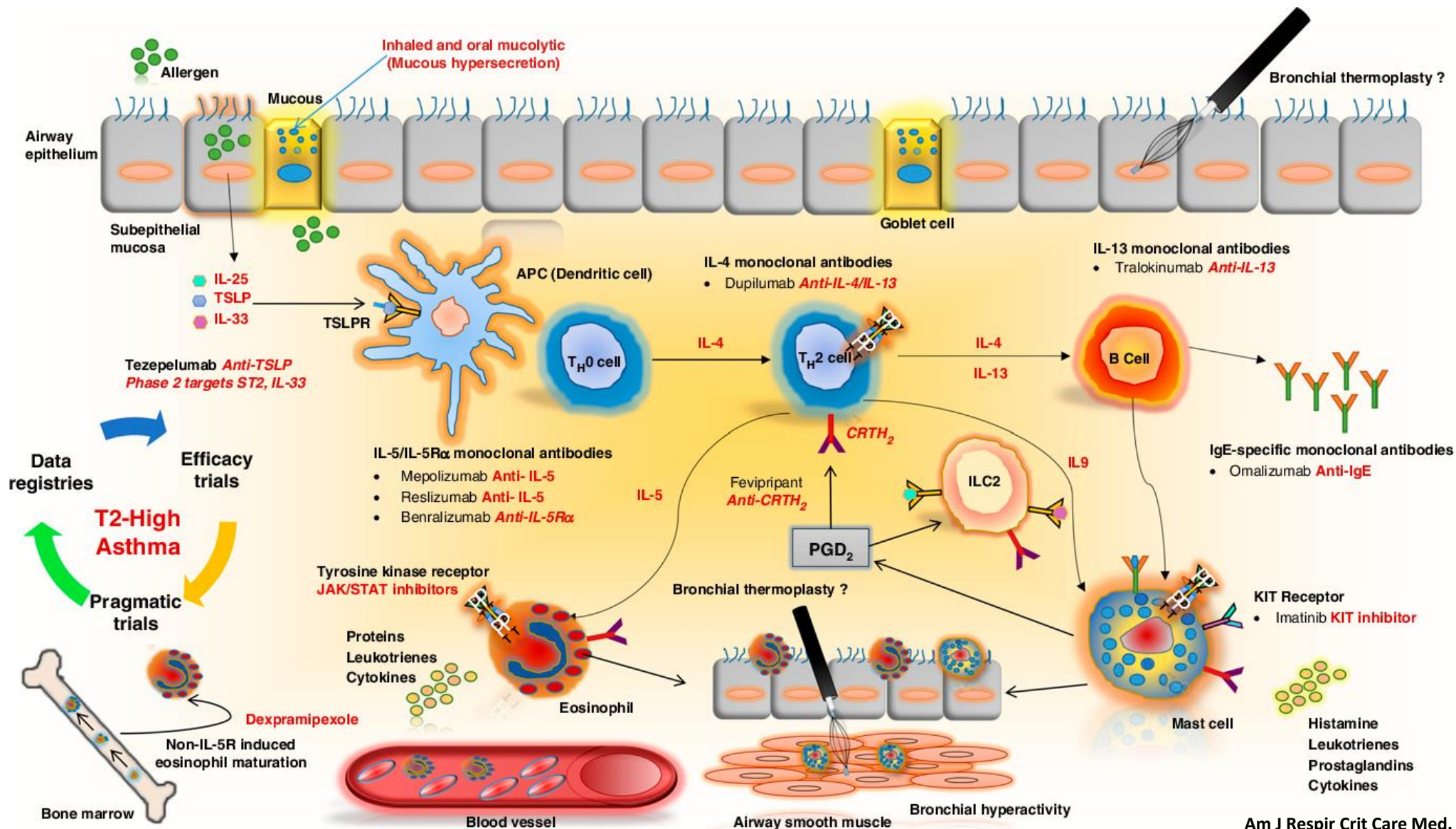
● **severe asthma**

= high intensity treatment
+ poor symptom control
+ good adherence and
inhaler technique

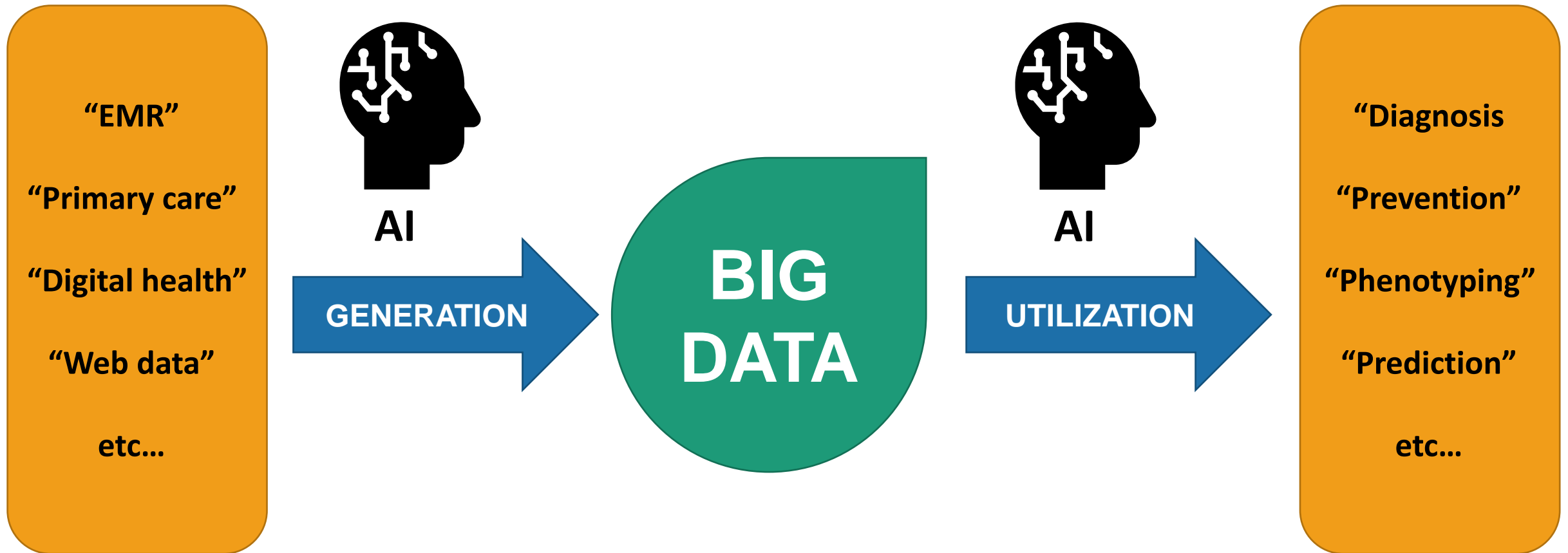
Huge burden



Precision medicine for severe asthma



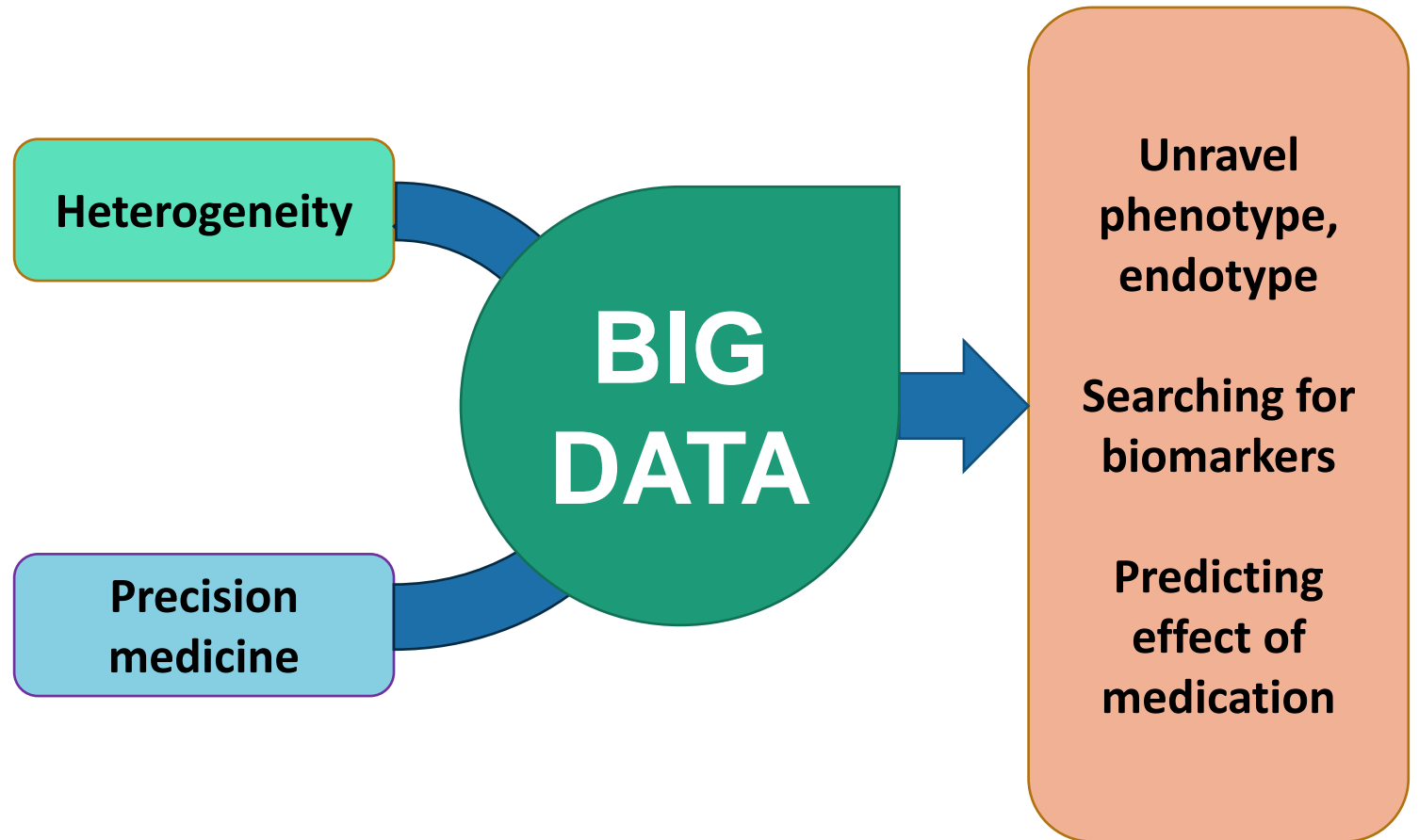
Big data and AI



Severe asthma, precision medicine, and big data



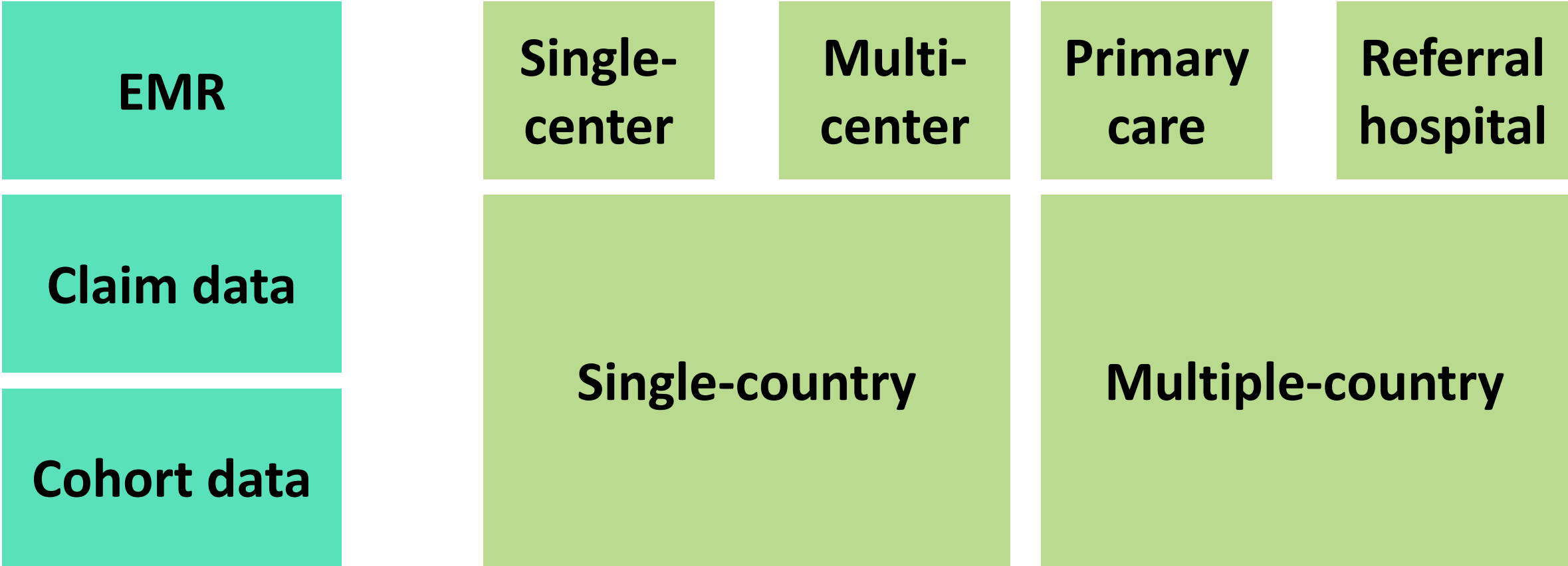
Severe Asthma



Contents

- **Introduction**
- **Datasets for Big Data Research of Severe Asthma**
- **Severe Asthma Research by Using Big Data**
- **Future direction**

Available data source



EMR : Optum

Optum EHR Data

Gain visibility across therapeutic areas and the continuum of care.

Avoiding common pitfalls that prevent maximizing investments in real world data: what life sciences executives need to know.



- UnitedHealth Group, largest healthcare organizations globally
- Founded in 2011
- Headquarter in USA



Includes 150 national and local payers



Allows for larger sample sizes with more than 60 million lives



Spans all care settings

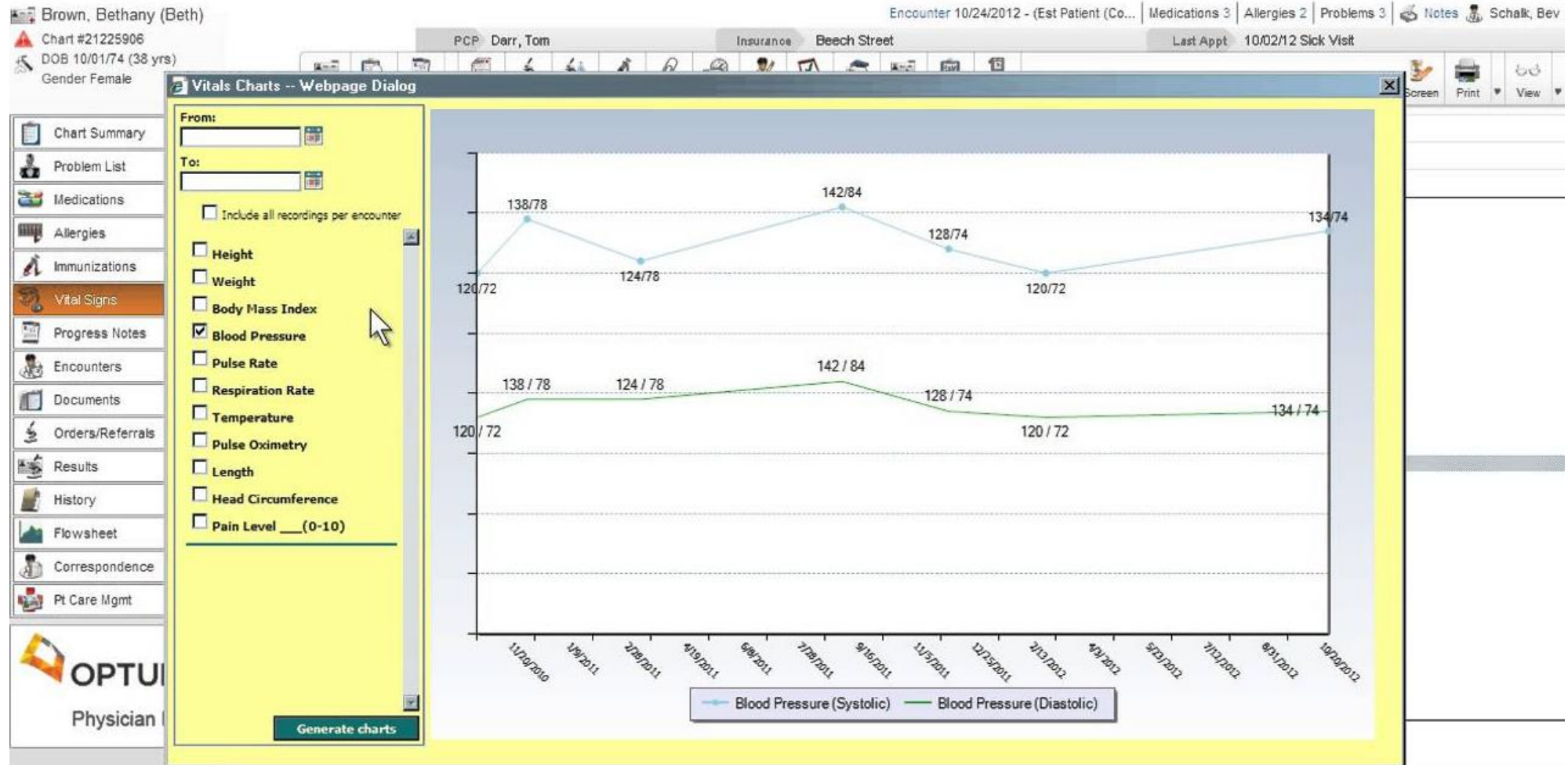


Is longitudinal, with data back to 2007



Is a closed system that is eligibility-controlled

EMR : Optum



EMR : Optum

- **Defining patient cohorts for clinical research**

Another way to demonstrate the value of real-world data is to show how it can be used to create a patient cohort.

All research begins with an identification of the inclusion and exclusion criteria that will be used to draw conclusions and make sound decisions.

With more than 4 million HER data, 3.2 million of them linked to claims data, we have a very large and diverse patient population.

Control (CDC). This is a direct result of claims data from all payer types being included in the data set.

**4 million HER data
– 3.2 million of them linked
claims data**

	Optum EHR data	CDC national data*
Sex		
Male	37%	40%
Female	63%	60%
Age		
0–4 years	4%	3%
5–14 years	13%	14%
15–19 years	6%	9%
20–24 years	6%	7%
25–34 years	13%	12%
35–64 years	41%	39%
65+ years	17%	16%

EMR : Optum

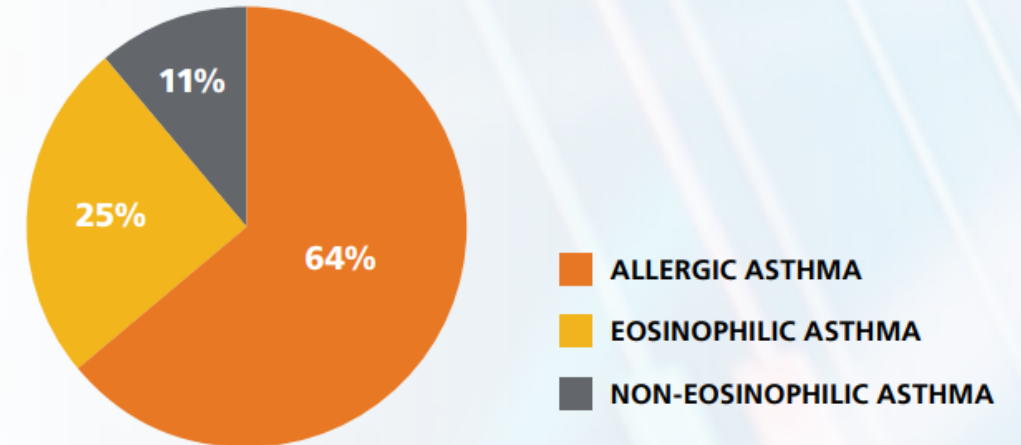
- **Sub-typing of the disease**

Drilling down even further, you can identify three kinds of severe asthma in the data: allergic, eosinophilic, and non-eosinophilic. See *Figure 4*.

These severity types are extracted from clinically rich and specific EHR data. For example, eosinophilic asthma is clinically defined as a patient who has an eosinophil lab greater than 3% or greater than 500 cells/mcL. In addition, allergic asthma can be identified by positive mentions found in the physician notes.

The clinical data in the EHR contains specificity needed to accurately segment and select the appropriate sub-group in a disease area. In many diseases, labs, clinical measures and the physician's notes contain the information needed to define patient cohorts. This richness of data allows researchers to have greater confidence in the patient cohorts they are studying and avoid delays caused by insufficient sample sizes at a study's inception.

Figure 4: Severe asthma sub-type



EMR : Optum

- Understanding the length of time on therapy and line of therapy patterns

Figure 5: Duration of time on therapy

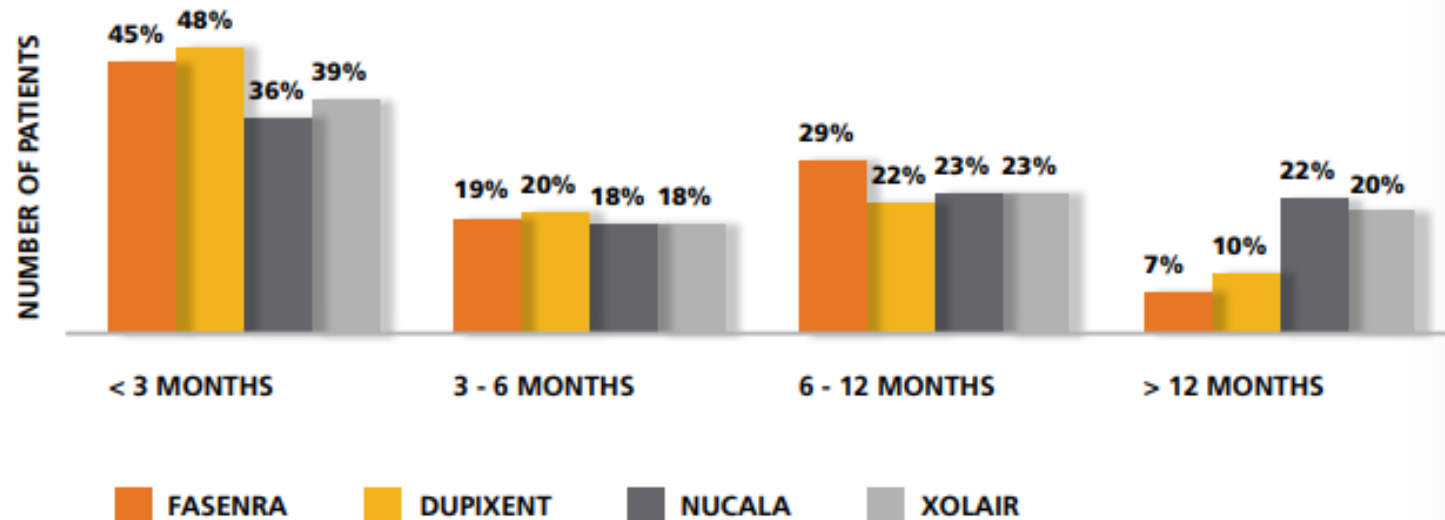
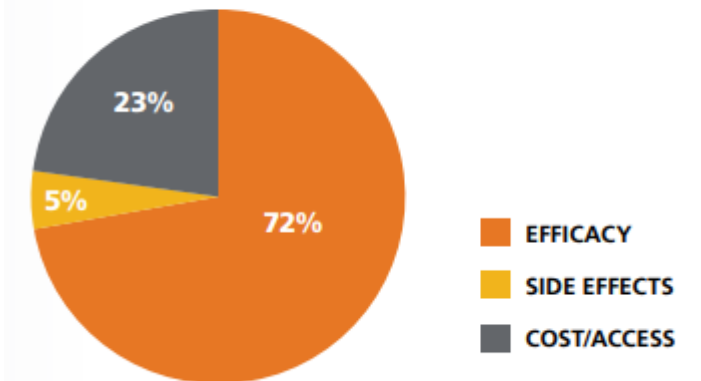


Figure 6: Reasons for discontinuation — Biologic



EMR : Optum

- Clinically profiling patients

Figure 7: FEV1 Category prior to biologic initiation

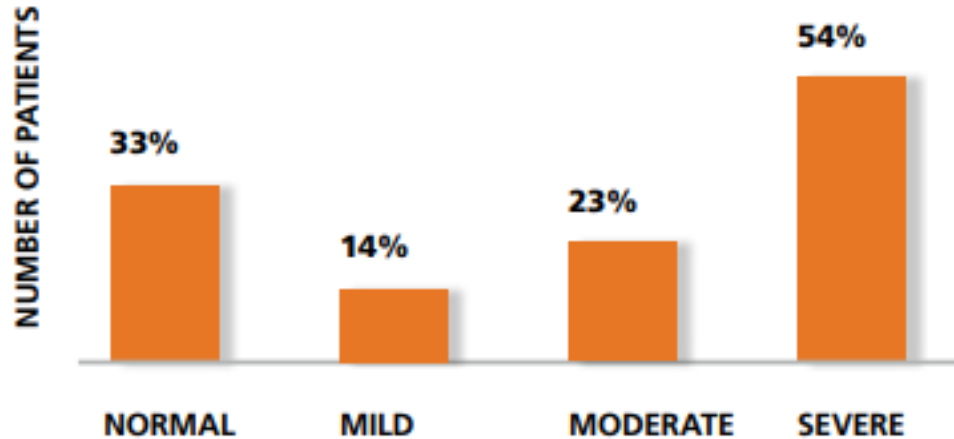
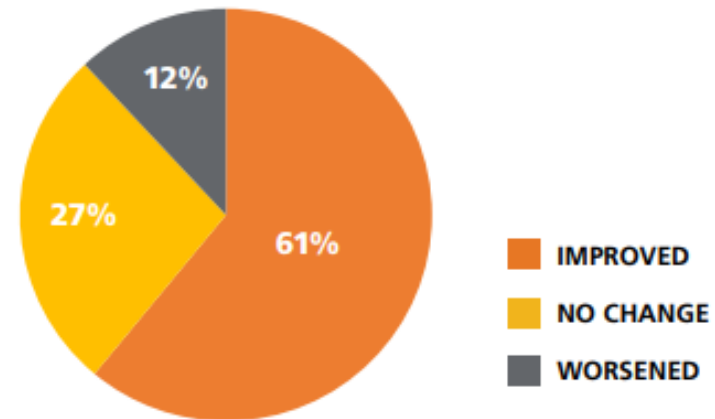


Figure 8: Change in FEV1 at 12 weeks post treatment initiation



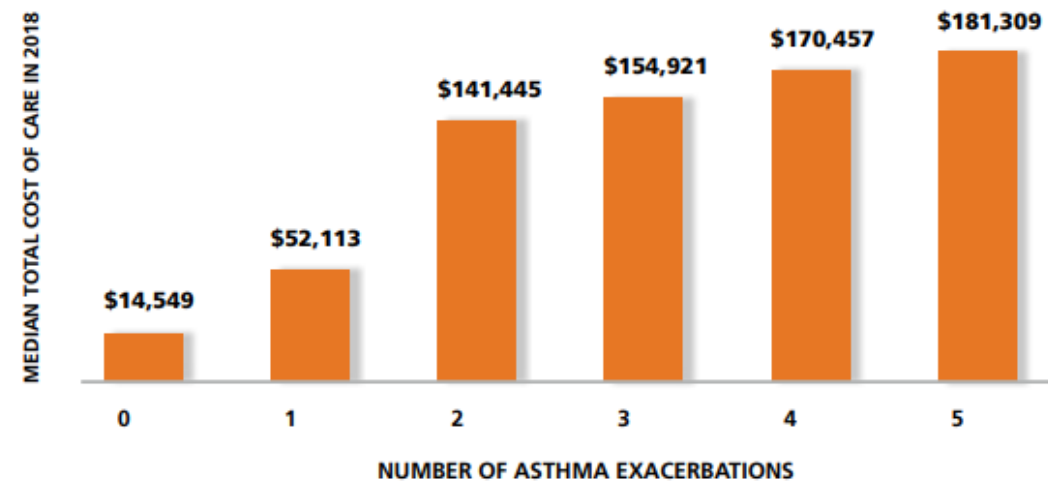
EMR : Optum

- **Taking into consideration the total cost of care**

One of the most valuable aspects of this kind of data is linking directly to the cost of care. Here, in *Figure 9*, you can track asthma exacerbations and follow disease burden or cost of care based on the number of exacerbations.

This shows how uncontrolled asthma impacts the health system, using both claims and EHR data points. Linking the two kinds of data allows for analyses that measure the cost impact segmented by a clinical category. In an uncontrolled setting, patients with uncontrolled eosinophilic asthma who have more asthma-related exacerbations tend to have a higher cost burden on the health care system.

Figure 9: Cost burden of asthma exacerbations in an uncontrolled eosinophilic asthma



EMR : SAVANA Manager



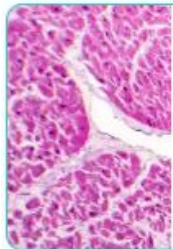
Generating RWE across 13 countries and 5 languages



- International medical company
- Founded in 2014
- Headquarter in Spain

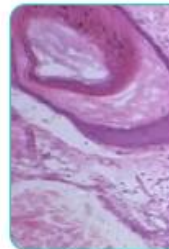
EMR : SAVANA Manager

High-validity Virtual Registries
across 16 Therapeutic Areas in 13 countries



Cardiology

Anticoagulants in Atrial Fibrillation
Coronary disease and Diabetes Mellitus type II



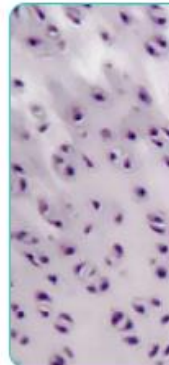
Dermatology

Psoriasis
Onychomycosis



Pneumology

COPD
COVID-19
Severe Asthma



Rheumatology

Spondyloarthritis
Psoriatic Arthritis
Rheumatoid Arthritis
Rheumatoid Arthritis and Interstitial Lung Disease

EMR: Big Pac



A 360° medical company

We are a multinational company dedicated to preventive and precision medicine and a leader in the healthcare diagnosis and treatment excellence. We provide individualised therapy for patients, with a commitment to technological innovation.

Big Pac: Spain's largest technology database

1,9 mill.

anonymised patients in our database

550

pharmacies monitored weekly

+2.000

healthcare professionals generate new information

- Medical technology and healthcare services company
- Founded in 2015
- Headquarter in Spain

EMR: Big Pac



1

Patients go to health centres where **doctors** issue diagnoses and prescribe medicines



3

This activity generates millions of pieces of data



5

We use this data to draw **Health Intelligence** conclusions from which **companies and institutions in the healthcare sector** make business decisions.



2

Pharmacies sell to patients and, in turn, buy medicines from **wholesalers**



4

Big Pac (r) is our patient database

EMR: Optimum Patient Care

opc
UK

Optimum Patient Care is a non-profit social enterprise, working with primary care practitioners to produce high quality patient profiles that can improve clinical outcomes and a make a difference.

>>> **105 PUBLICATIONS**

>>> **20+ MILLION PATIENTS RECORDS IN OPCR**

>>> **30 YEARS RESPIRATORY RESEARCH EXPERIENCE**

>>> **40 YEARS PRIMARY CARE EXPERIENCE**

- Founded in 2010
- 992 general practices
- Mean duration of 11.7 years follow-up
- Data extracted from clinical software system

EMR: Optimum Patient Care

Collaborative Network



Key Activities



Investigation

Investigations and analysis of current data and world's best practice programmes (e.g. quality improvement programs in UK, USA and worldwide), as applied to the UK



Information

Information gathering and GP liaison activities. Design and development of information gathering systems



Development

Development of algorithms and database programming to achieve appropriate information gathering for the analysis phase



Testing

Testing of conclusions based on analysis of the evidence gathered. Concept development of preliminary theoretical treatment protocols.

EMR: Optimum Patient Care

1. All 8,814 GP practices within the UK are eligible to contribute data

- OPCRD includes Practice Data from all major UK Clinical System Providers (EMIS, SystemOne, Vision) and is not restricted by geographical uptake of specific system providers.

2. Data is enriched through the active OPC network of 1,100 GP sites across the UK

- >68,000 patients have responded to disease-specific questionnaires during bespoke and tailored quality improvement activities enabling a uniquely rich data source.
- OPCRD can be linked to secondary care datasets and national disease registries, where appropriate approvals are in place.

3. Data can be accessed swiftly to meet the growing demand for timely research outputs.

- OPCRD assures users that dataset production will be completed within 3 weeks from study approval by ADEPT (Anonymised Data Ethics & Protocol Transparency)

These unique features, combined with OPCRD being one of the UK's largest growing primary care databases (>3 million new patients added per year), makes it a valuable resource for researchers, with the ability to support a wide range of studies and analyses including:

Claim data : IBM MarketScan dataset

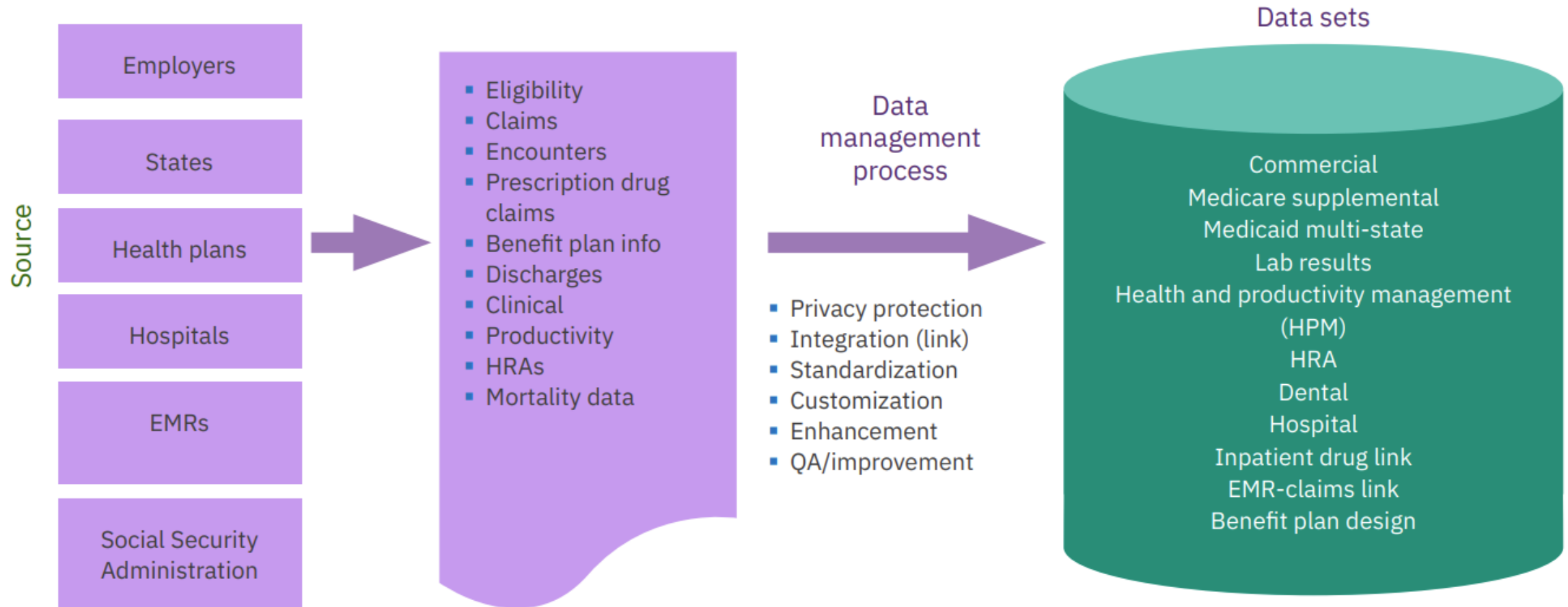


Precise real-world data.
Conclusive real-world
evidence.

Drive impactful decisions with real-world
evidence, from uniquely sourced real-
world data and trusted experts.



Claim data : IBM MarketScan dataset



Claim data : IBM MarketScan dataset

IBM MarketScan Research Databases Access

Data and research resources for population health and health services



IBM MarketScan Databases (formerly known as the Truven Health MarketScan Research Databases) are currently available for use by UCSF affiliated researchers.

A UCSF site license provides access to the de-identified commercial claims (inpatient, outpatient, emergency and outpatient pharmacy) databases covering more than 50 million covered lives across the US. The data are contributed by managed care organizations and large, self-insured employers, and can be used for a wide array of population health research.

Access for use by UCSF affiliates is free for unpublished or internally funded/nonfunded research. For extramurally funded projects there is an incremental fee of \$30,000/study for non-profit funded research and \$60,000/study for industry sponsored research.

Claim data : USA CMS data



Get started

Most viewed datasets

Dataset _____ Order and Referring Page last modified July 3, 2023	Dataset _____ Opt Out Affidavits Page last modified June 22, 2023	Dataset _____ COVID-19 Nursing Home Data Page last modified June 29, 2023	Dataset _____ Medicare Fee-For-Service Public Provider Enrollment Page last modified April 19, 2023
--	--	--	--

Explore Data

- Medicare is a single-payer, national social insurance program
- Started since 1966
- Americans aged 65 and older

About

About Us

The data.cms.gov site is maintained by CMS and contains datasets, tools and more.



Claim data : USA CMS data

Specific Chronic Conditions

Information on prevalence, use and spending for select chronic conditions among Original Medicare (or fee-for-service) beneficiaries.

[Subscribe](#)

Data update frequency
Annually

Latest data available
2018

Data source
Centers for Medicare & Medicaid Services

- Alcohol Abuse Drug Abuse/ Substance Abuse
- Alzheimer's Disease and Related Dementia
- Arthritis (Osteoarthritis and Rheumatoid)
- Asthma
- Atrial Fibrillation
- Cancer (Breast, Colorectal, Lung, and Prostate)
- Chronic Kidney Disease
- Chronic Obstructive Pulmonary Disease
- Depression
- Diabetes
- Drug Abuse/ Substance Abuse

Claim data : USA CMS data

Medicare Chronic Conditions Dashboard: County Level

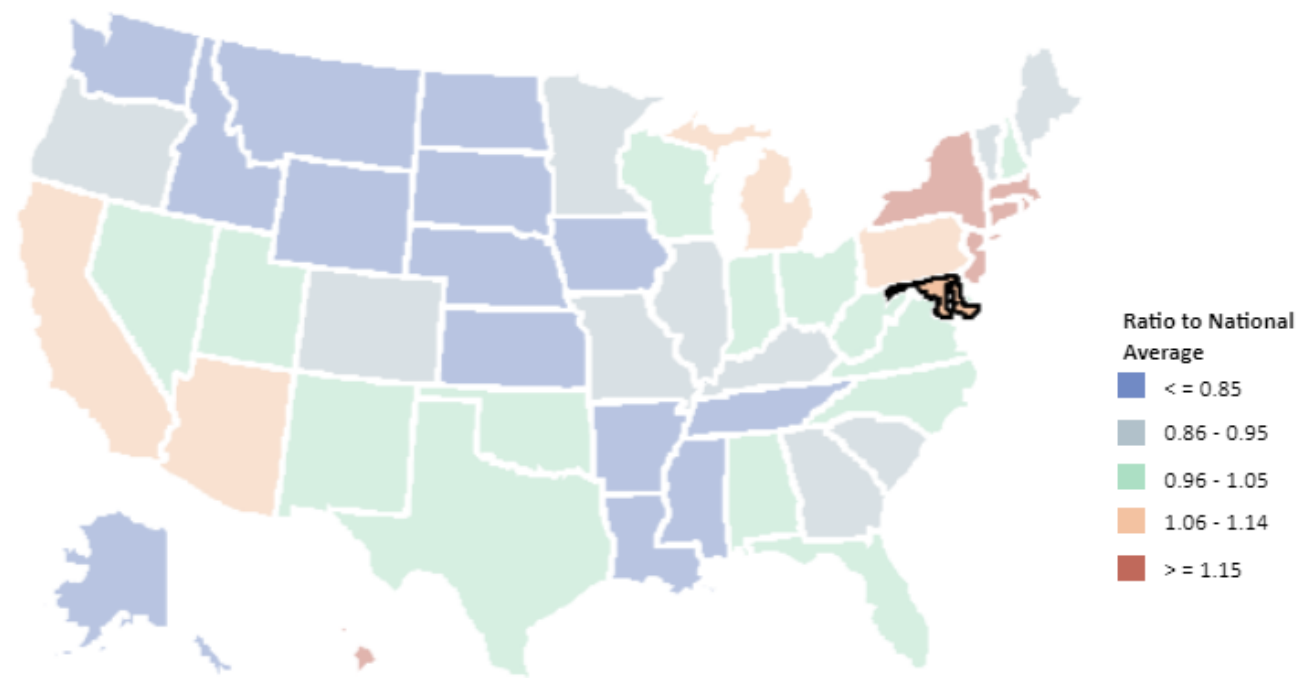
Comparison of Geographic Areas by Chronic Conditions, 2018

Prevalence

Spending and U

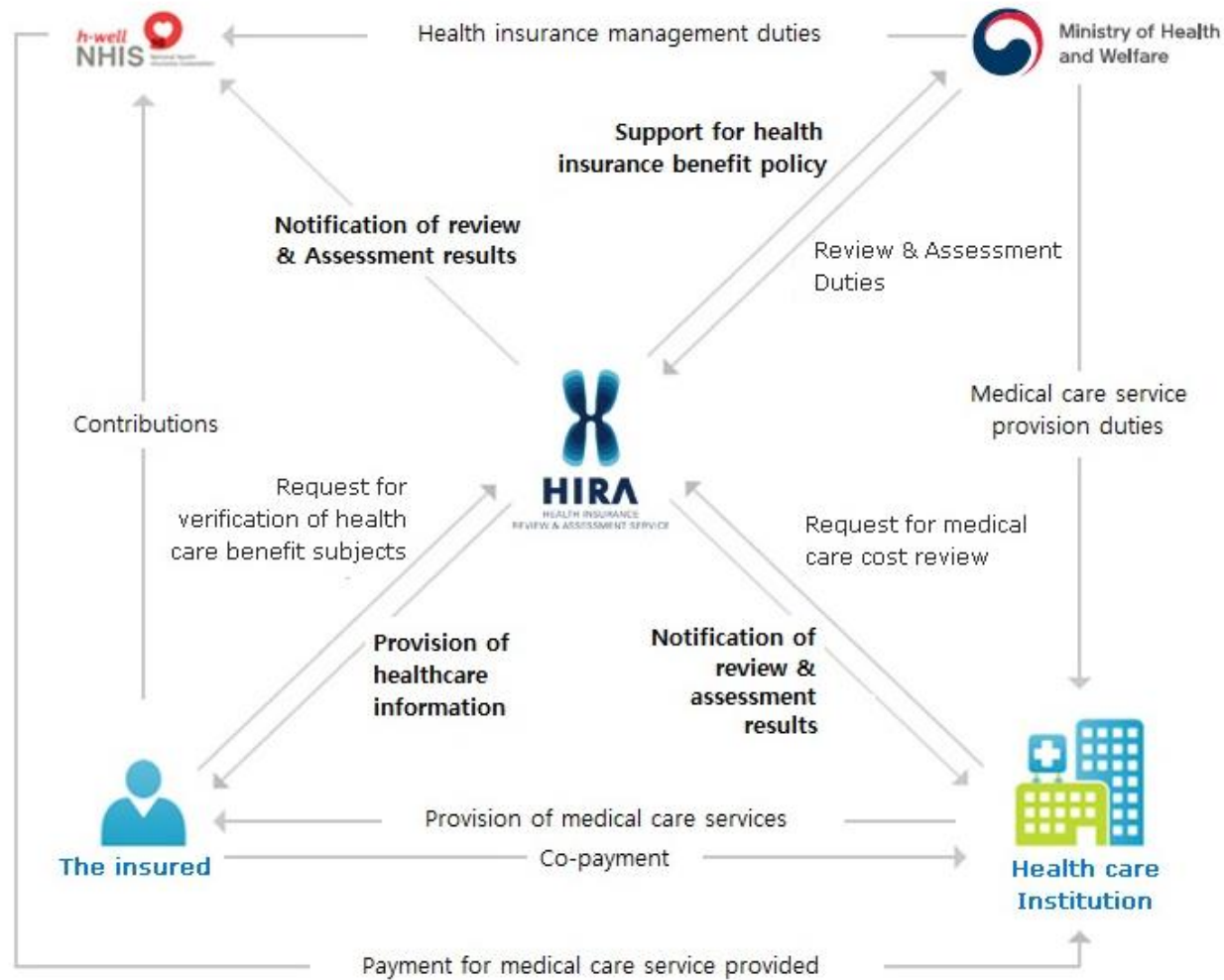
Asthma Prevalence: State to National Ratio

Chronic Condition: Asthma



State	Prevalence
National	4.97%
Alabama	4.99%
Alaska	3.46%
Arizona	5.38%
Arkansas	3.88%
California	5.30%
Colorado	4.48%
Connecticut	6.47%
Delaware	5.22%
District of Columbia	6.10%
Florida	5.19%
Georgia	4.70%
Hawaii	5.70%

Claim data : Korea NHIS/HIRA



Claim data : Korea NHIS/HIRA

건강보험심사평가원에서 보유하고 있는

다양한 보건의료데이터를
국민에게 개방합니다.

서비스 소개 바로가기 →

데이터결합 서비스 개편안내

결합에서 반출까지 결합신청자의 온라인 신청으로 결합전문기관 이용이 쉽고 편리해집니다.

오프라인

결합 신청서 제출



온라인

결합 신청, 진행상태 확인



Claim data : Korea NHIS/HIRA



Cohort : Danish National Database for Asthma

Study population: Persons above the age of 6 years, with a specific focus on 6–44 years, are included. The DNDA links three existing nationwide registries of administrative records in the Danish health care system: the National Patient Register, the National Health Insurance Services Register, and the National Prescription Registry. For each year, the inclusion criteria are a second purchase of asthma prescription medicine within a 2-year period (National Prescription Registry) or a diagnosis of asthma (National Patient Register). Patients with chronic obstructive pulmonary disease are excluded, but smokers are not excluded.

Descriptive data: A total of 366,471 prevalent patients with asthma have been identified (year 2014 – as a preliminary test search). This number is in agreement with the estimates of ~400,000 inhabitants that are available for patients with possible asthma in Denmark. Data encompass the following quality indicators: annual asthma control visits and pharmacological therapy.

Main variables: The variables included are spirometry, as well as tools for diagnosis (including allergy testing), smoking status, height, weight, and acute hospital admissions and unscheduled visits.

Conclusion: DNDA is available from January 1, 2016.

Cohort : NORDSTAR

The NORdic Dataset for aSThma Research (NORDSTAR) is a population-based dataset including individual-level data about all asthma patients in four Nordic countries (Denmark, Finland, Norway and Sweden). It is built on nationwide data and contains long-term longitudinal follow-up of asthma populations in routine care. The data include diagnoses, medication dispensing, use of resources and costs, socio-demographics and mortality. Currently, the dataset comprises:

- ✓ 3,3 milion asthma patients
- ✓ Up to 30 years of follow-up
- ✓ 50 million person-years of follow-up
- ✓ 2 million+ asthma related care contacts
- ✓ 1000+ asthma related deaths

Cohort : NORDSTAR

NORDSTAR is supported by a multi-party, collaborative research platform comprising clinical expertise, pharmaceutical manufacturer perspectives and data analytics competence

NSAN is a network of severe asthma specialists from the Nordic countries focusing on improving the diagnostics and treatment of severe and possible severe asthma.

Quantify Research maintains and secures data, performs data management and analysis, and expedites medical communications

The dataset include:

- Demographics
- Socioeconomics
- Prescribed drugs
- Health care resource use
- Mortality

Current patient count:

- Denmark: 770,502
- Finland: 232,731
- Norway: 853,450
- Sweden: 1,416,263

International registry

- International Severe Asthma Registry (ISAR)

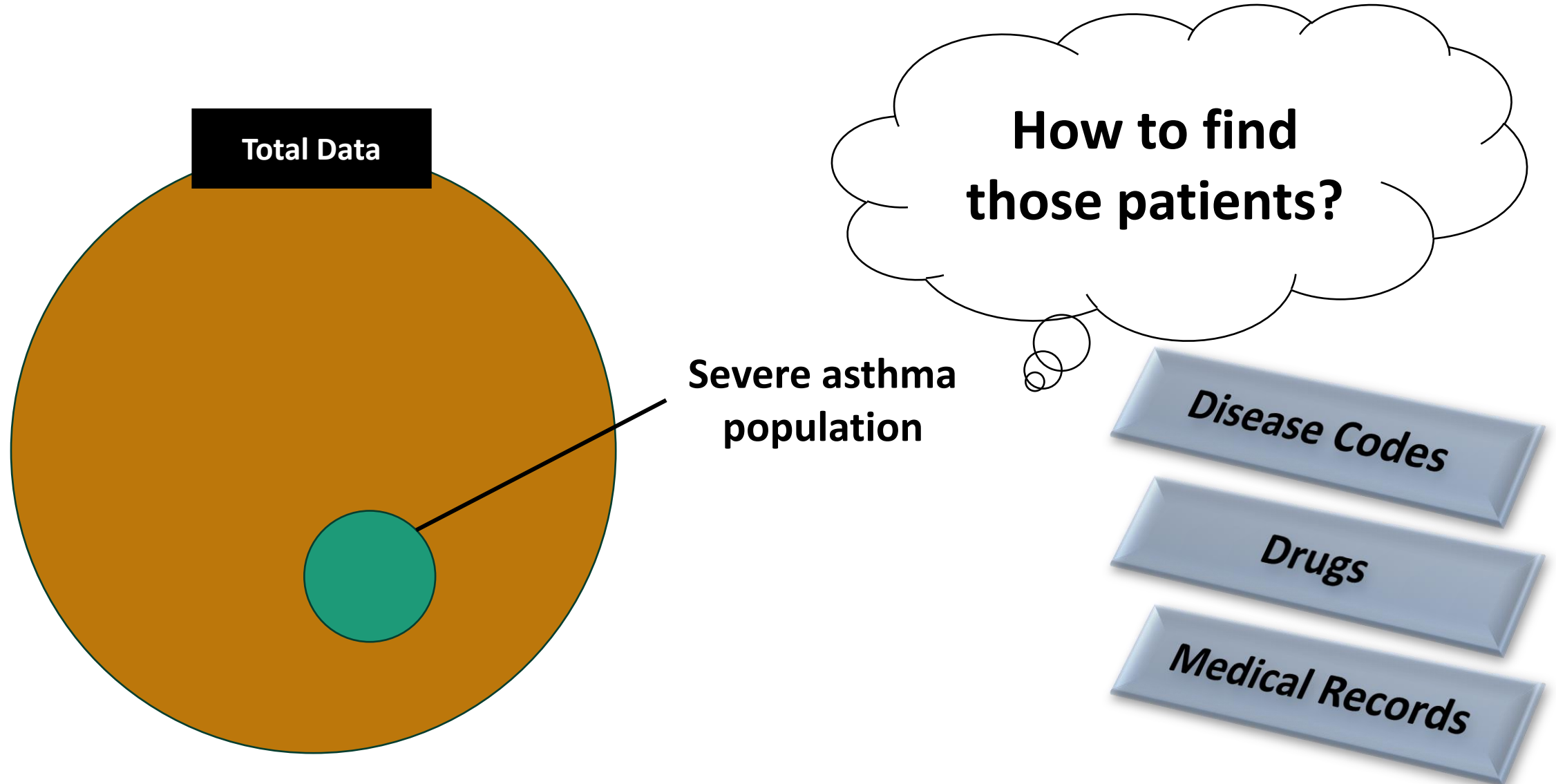


The **International Severe Asthma Registry** is a global collaborative initiative to gather **anonymous, longitudinal, real-life data for patients with severe asthma**. ISAR offers a rich source of real-life data for scientific research to understand and improve symptoms, treatments, and patient outcomes for severe asthma. The database will also provide an international platform for research collaboration in respiratory medicine and patient care.

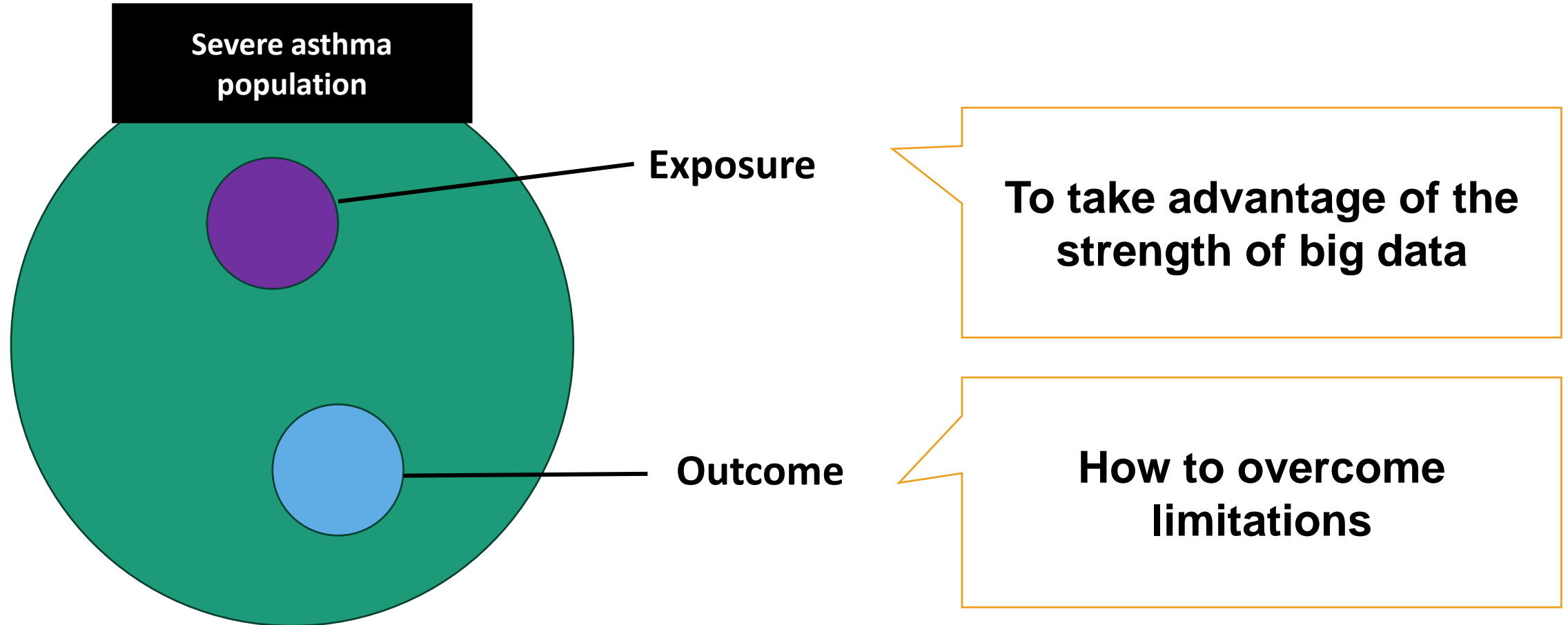
Contents

- **Introduction**
- **Datasets for Big Data Research of Severe Asthma**
- **Severe Asthma Research by Using Big Data**
- **Future direction**

From Big Data To Research Data



From Big Data To Research Data



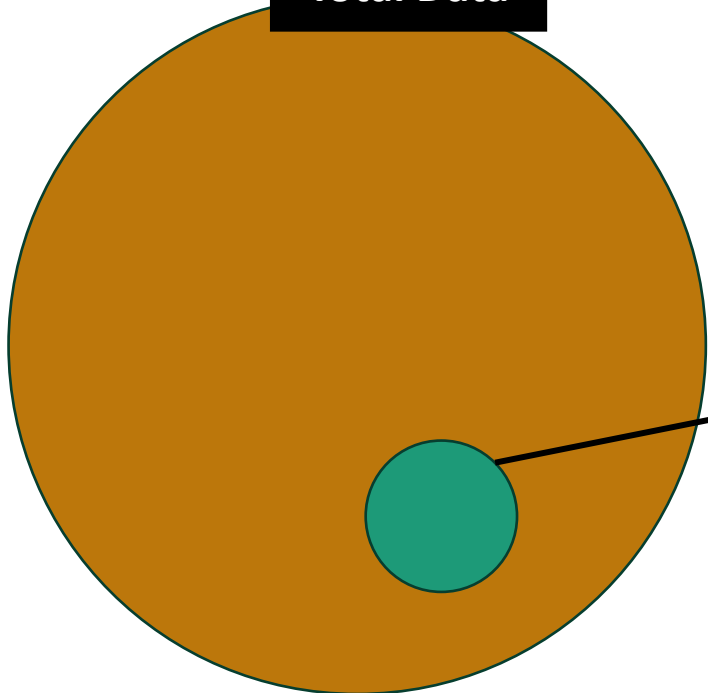
Strength of Big Data Research

- Excellent external validity : large-scale, heterogeneous/unselected patients
- Cost-effective and rapid compared to prospective study
- Capture rare disease and outcome
- Expect long-term prognosis

Weakness of Big Data Research

- Bias : confounding, selection, information, recall, or missing data
- Validity : limitation of operational definition
- Lack of important parameters : lung function, laboratory data, imaging

Total Data

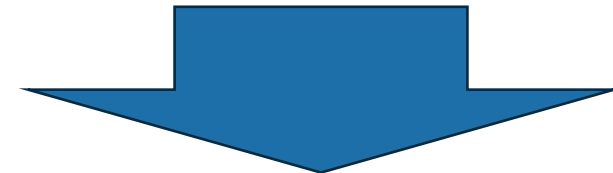
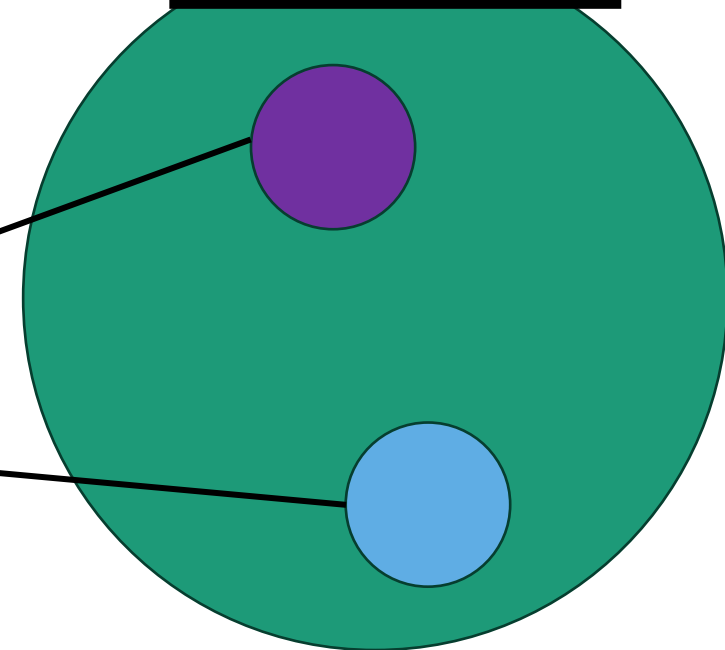


Population

Exposure

Outcome

**Severe asthma
population**



Definition!

EMR: Optum



HHS Public Access

Author manuscript

J Allergy Clin Immunol Pract. Author manuscript; available in PMC 2022 July 01.

Published in final edited form as:

J Allergy Clin Immunol Pract. 2021 July ; 9(7): 2742–2750.e1. doi:10.1016/j.jaip.2021.02.031.

Asthma Patients Who Stop Asthma Biologics Have a Similar Risk Of Asthma Exacerbations as Those Who Continue Asthma Biologics

Molly M Jeffery, PhD¹, Jonathan W Inselman, MS², Jacob T Maddux, MD³, Regina W Lam, BA⁴, Nilay D Shah, PhD^{1,2,5}, Matthew A Rank, MD^{2,6,7}



HHS Public Access

Author manuscript

J Allergy Clin Immunol Pract. Author manuscript; available in PMC 2022 July 01.

Published in final edited form as:

J Allergy Clin Immunol Pract. 2021 July ; 9(7): 2742–2750.e1. doi:10.1016/j.jaip.2021.02.031.

Asthma population

N = 2.01 million

ICD-10 (J45.x)

Biologic users

N = 4,985

Persistent asthma

+

At least one
administration of
biologics drug

Persistent asthma

- 1) At least one ED visit or inpatient encounter with diagnosis of asthma
- 2) At least 4 outpatient encounters on different days with diagnosis asthma + at least two asthma medication fills
- 3) At least four asthma medication fills in 1 year

Five biologic medication

Benralizumab, dupilumab, mepolizumab, omalizumab, or reslizumab



HHS Public Access

Author manuscript

J Allergy Clin Immunol Pract. Author manuscript; available in PMC 2022 July 01.

Published in final edited form as:

J Allergy Clin Immunol Pract. 2021 July ; 9(7): 2742–2750.e1. doi:10.1016/j.jaip.2021.02.031.

Exposure

Stop biologics after 6–12 months of use

Stopper: use of 6 to 2 months, and 6+ months of follow-up after discontinuing

Continuers: remained on biologic treatment for at least 18 months

Outcome

Increase of 50% or more in exacerbation in 6 months after

Exacerbation definition

- 1) Hospital or emergency department visit with asthma
- 2) Systemic corticosteroid fill associated with an outpatient visit



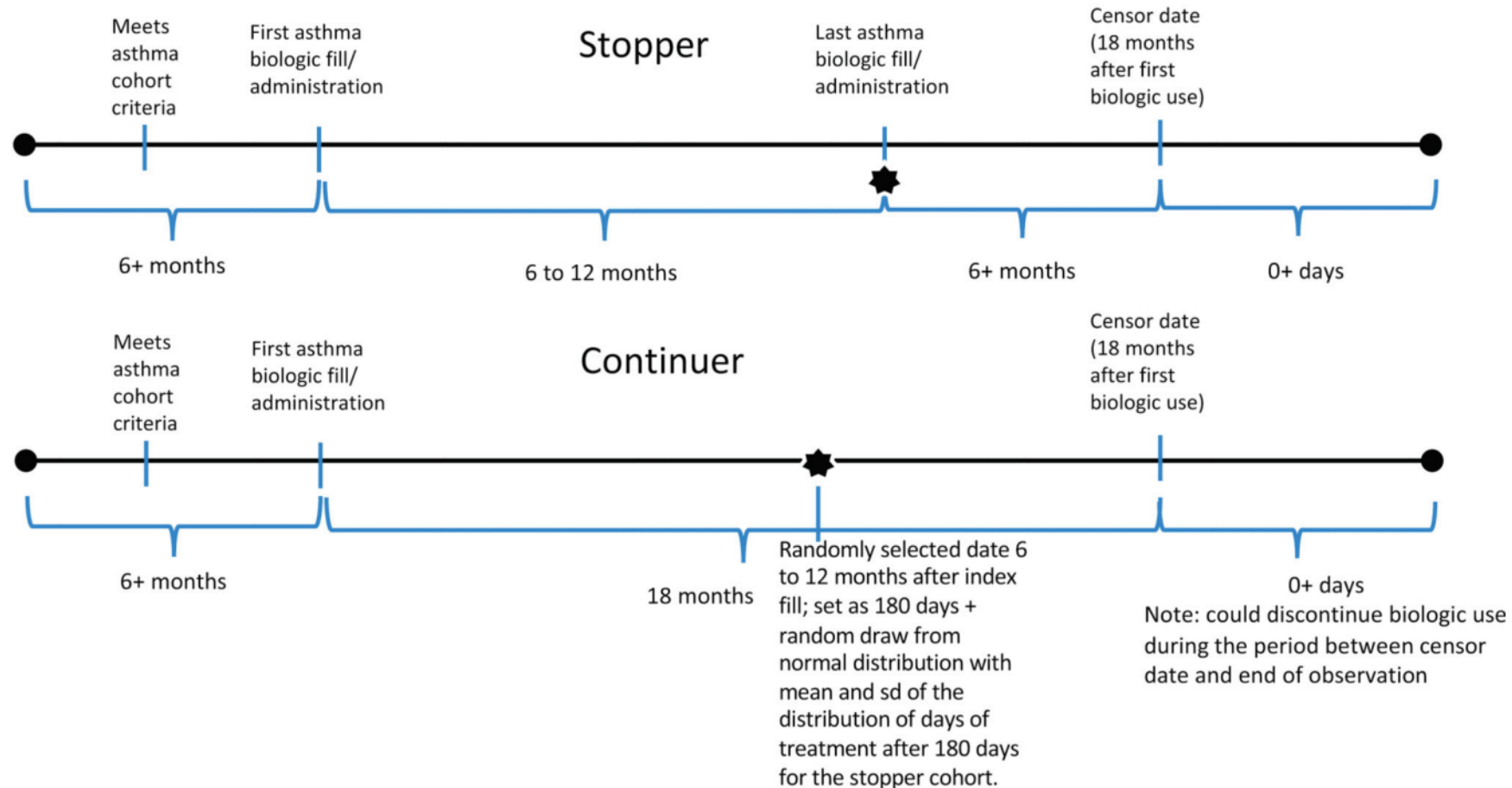
HHS Public Access

Author manuscript

J Allergy Clin Immunol Pract. Author manuscript; available in PMC 2022 July 01.

Published in final edited form as:

J Allergy Clin Immunol Pract. 2021 July ; 9(7): 2742–2750.e1. doi:10.1016/j.jaip.2021.02.031.





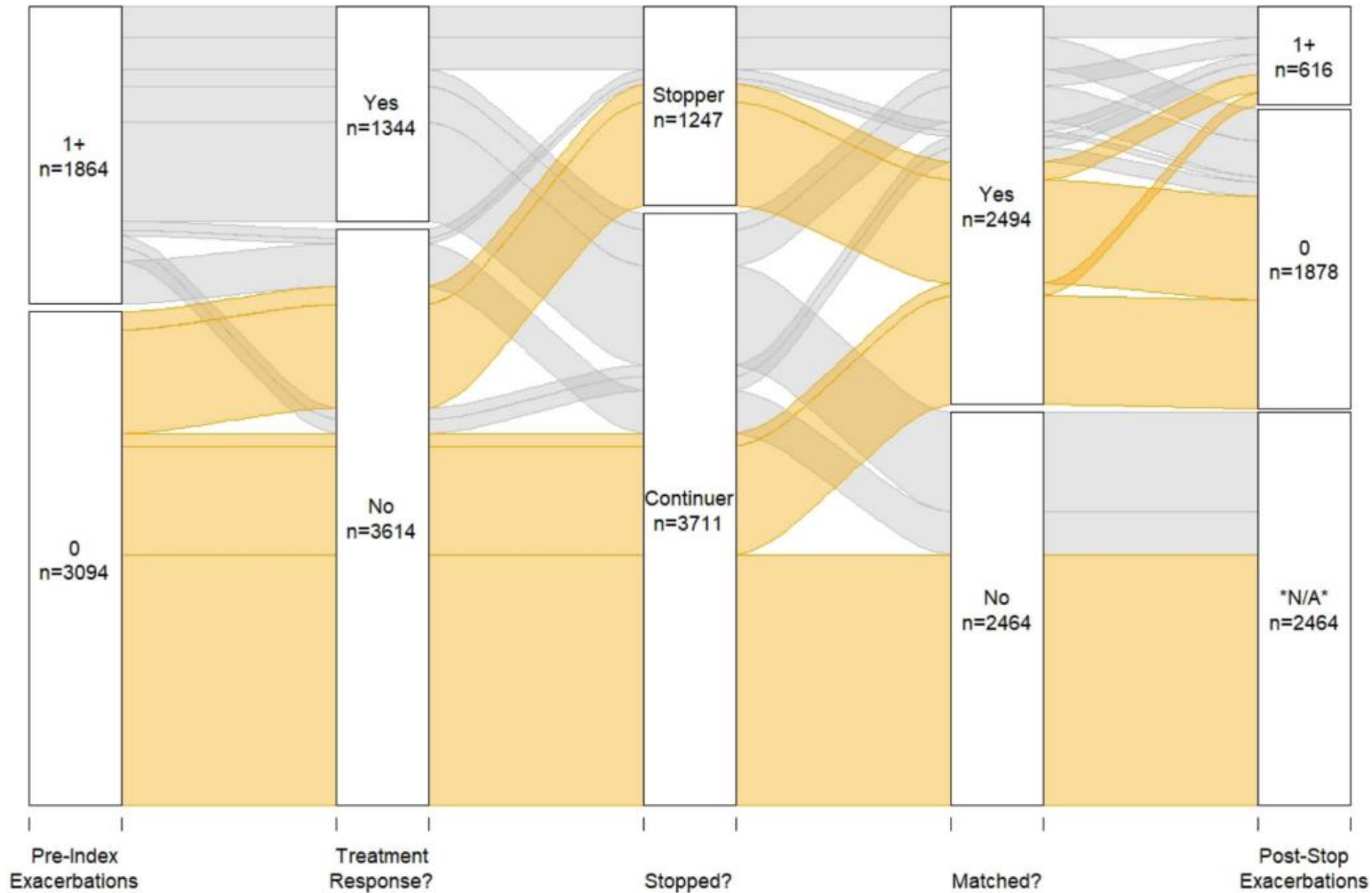
HHS Public Access

Author manuscript

J Allergy Clin Immunol Pract. Author manuscript; available in PMC 2022 July 01.

Published in final edited form as:

J Allergy Clin Immunol Pract. 2021 July ; 9(7): 2742–2750.e1. doi:10.1016/j.jaip.2021.02.031.





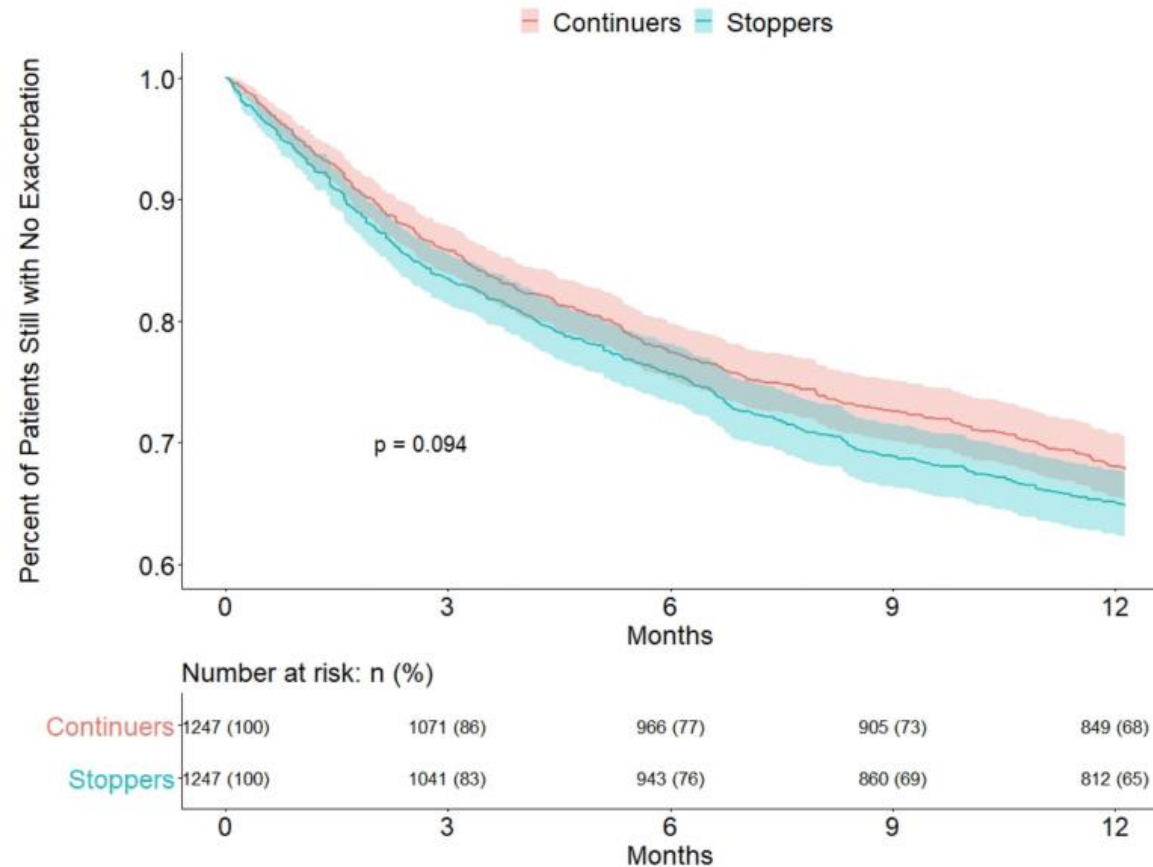
HHS Public Access

Author manuscript

J Allergy Clin Immunol Pract. Author manuscript; available in PMC 2022 July 01.

Published in final edited form as:

J Allergy Clin Immunol Pract. 2021 July ; 9(7): 2742–2750.e1. doi:10.1016/j.jaip.2021.02.031.



EMR: Big pac

JIACI Journal of Investigational
Allergology
and Clinical Immunology

Prevalence, T2-biomarkers and cost of severe asthma in the era of biologics: The BRAVO-1 study

Domingo C^{1, 2}, Sicras-Mainar A³, Sicras-Navarro A³, Sogo A^{1,3}, Mirapeix RM⁴, Engroba C⁵

¹Pulmonary Service, Corporació Sanitària Parc Taulí, Sabadell, Barcelona, Spain

²Department of Medicine, Faculty of Medicine, Universitat Autònoma de Barcelona (UAB), Cerdanyola, Barcelona, Spain

³Atrys Health-HEOR, Barcelona, Spain

⁴Department of Morphological Sciences, Faculty of Medicine, Universitat Autònoma de Barcelona (UAB), Cerdanyola, Barcelona, Spain

⁵Department of Market Acces, Sanofi, Barcelona, Spain

Prevalence, T2-biomarkers and cost of severe asthma in the era of biologics: The BRAVO-1 study

Asthma

N = 40,553

ICD 10 codes: J45-J46

Severe asthma

N = 3,031 (7.7%)

High dose ICS

+

Additional controller medication (LABA, LTRA, theophylline, or OCS more than 6 months)

Definitions

- 1) Uncontrolled severe asthma: 2 exacerbations requiring OC use more than 3 days or hospital admission during the previous years
- 2) OCS-dependent: OCS intake on a regular basis for \geq six months
- 3) T2: Peripheral blood EOS \geq 150, FeNO \geq 25 ppb, allergic, or requiring OCS maintenance

Outcome

Prevalence of asthma/severe asthma, OCS-dependent asthma, T2 asthma

Cost of asthma management

Prevalence, T2-biomarkers and cost of severe asthma in the era of biologics: The BRAVO-1 study

Table 3. Medication administered, adherence to therapy and exacerbations during the follow-up period.

Study groups,	Controlled N = 1.087 (35.9%)	Uncontrolled N = 1.944 (64.1%)	Total N = 3.031 (100%)	p- value
<i>Medication used</i>				
Oral/injectable corticosteroids	13.1%	68.5%	48.6%	<0.001
Chronic use oral corticosteroids	21.0%	37.0%	31.2%	<0.001
Systemic antibiotics	7.3%	36.2%	25.8%	<0.001
Combined ICS/LABA	100.0%	100.0%	100.0%	0.999
Leukotriene antagonists	3.0%	69.8%	45.9%	<0.001
Methylxanthines	6.0%	9.7%	8.4%	<0.001
Short acting anticholinergic drugs	3.6%	20.7%	14.5%	<0.001
Biological treatments	2.9%	4.3%	3.8%	0.049
- Omalizumab	2.1%	3.2%	2.9%	0.045
- Others	0.8%	1.1%	0.9%	0.687
Nebulized treatments	9.9%	23.5%	17.3%	0.022

Prevalence, T2-biomarkers and cost of severe asthma in the era of biologics: The BRAVO-1 study

Table 4. Biomarker characterization according to study groups

Study groups,	Controlled	Uncontrolled	Total	p-value
N° of patients, %	N = 1.087 (35-9%)	N = 1.944 (64.1%)	N = 3.031 (100%)	
Mean EOS, cel/mcL	267 (119)	348 (154)	322 (148)	0.031
Mean FeNO, ppb	34.2 (16.2)	37.0 (14.1)	36.2 (14.8)	0.462
Mean Ig E, UI/mL	187.9 (109.1)	271.6 (139.3)	245.6 (135.6)	0.015
EOS ≥ 150	74.6%	85.9%	81.9%	<0.001
FeNO ≥ 25	74.5%	86.8%	82.4%	<0.001
Allergic (Ig E > 100 UI/mL + positive prick test)	38.8%	59.9%	52.4%	<0.001
EOS ≥ 150 or FeNO ≥ 25 or Allergic or OC	54.8%	96%	81.2%	<0.001

EMR: Optimum

Original Article

Potential Severe Asthma Hidden in UK Primary Care

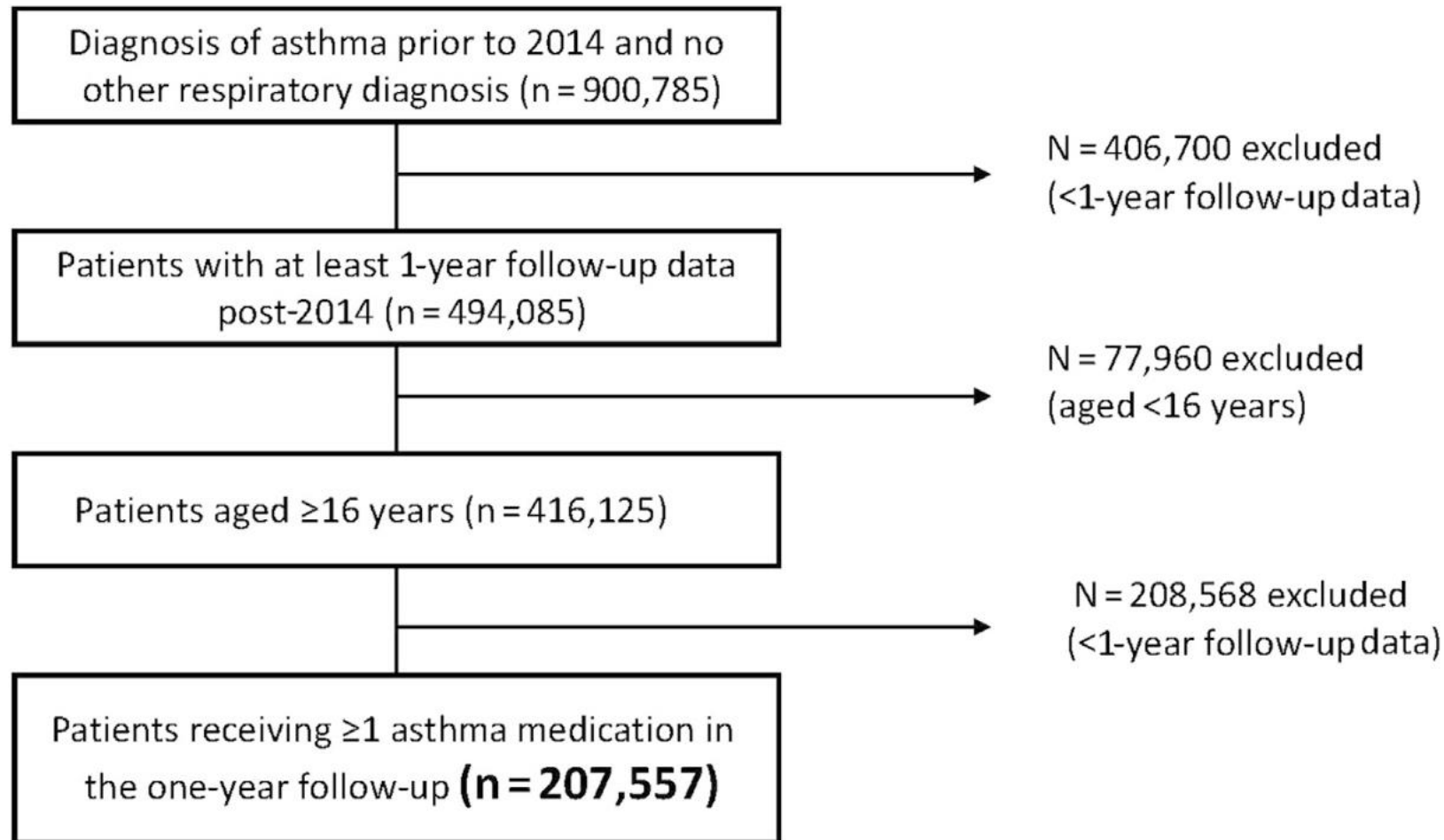


Dermot Ryan, MD^a, Heath Heatley, PhD^b, Liam G. Heaney, MD^c, David J. Jackson, MBBS, PhD^d, Paul E. Pfeffer, MRCP, PhD^e, John Busby, PhD^c, Andrew N. Menzies-Gow, FRCP, PhD^f, Rupert Jones, MD^g, Trung N. Tran, MD, PhD^h, Mona Al-Ahmad, MDⁱ, Vibeke Backer, MD^j, Manon Belhassen, PhD^k, Sinthia Bosnic-Anticevich, PhD^l, Arnaud Bourdin, MD, PhD^m, Lakmini Bulathsinhala, MPH^{b,n}, Victoria Carter, BSc^{b,n}, Isha Chaudhry, MSc^b, Neva Eleangovan, BSc^{b,n}, J. Mark FitzGerald, MD, FRCPC^o, Peter G. Gibson, MBBS, FRACP^{p,q}, Naeimeh Hosseini, MDⁿ, Alan Kaplan, MD, FCFP^{r,s}, Ruth B. Murray, PhDⁿ, Chin Kook Rhee, MD, PhD^t, Eric Van Ganse, MD, PhD^k, and David B. Price, FRCGP^{b,n,u} *Edinburgh, London, Plymouth, Cambridge, and Aberdeen, United Kingdom; Singapore, Singapore; Belfast, Northern Ireland; Gaithersburg, MD; Kuwait; Copenhagen, Denmark; Lyon and Montpellier, France; Glebe, Newcastle, and New Lambton Heights, NSW, Australia; Vancouver, BC, Canada; Stouffville and Toronto, ON, Canada; and Seoul, Korea*

Potential Severe Asthma Hidden in UK Primary Care



ORCRD subjects

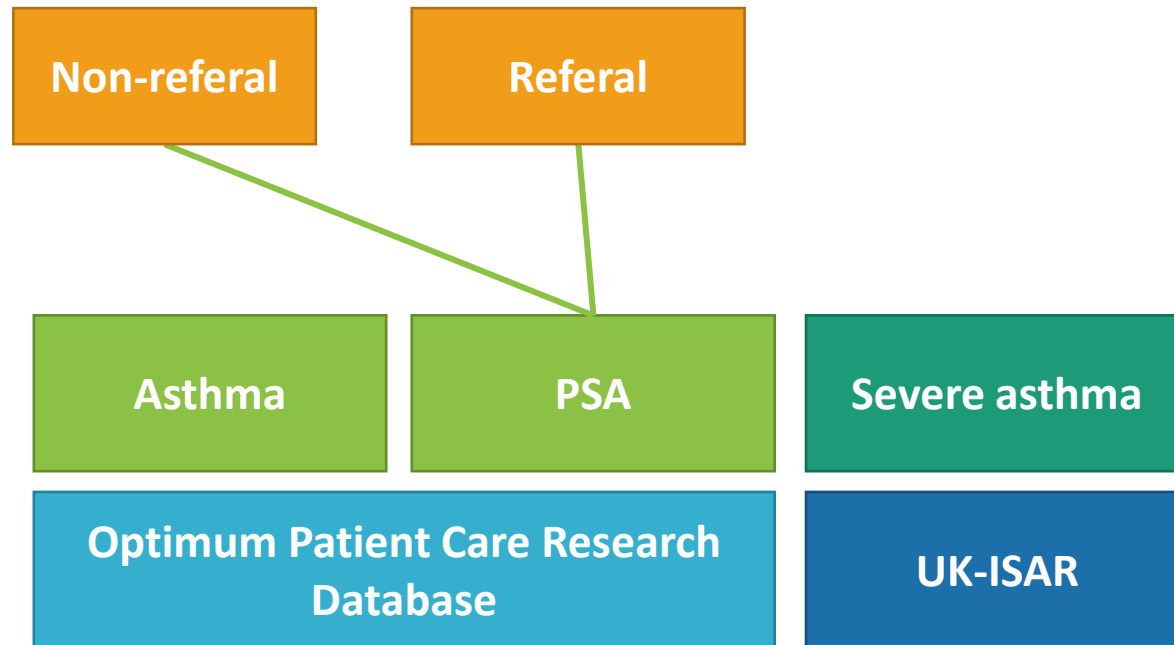


Potential Severe Asthma Hidden in UK Primary Care



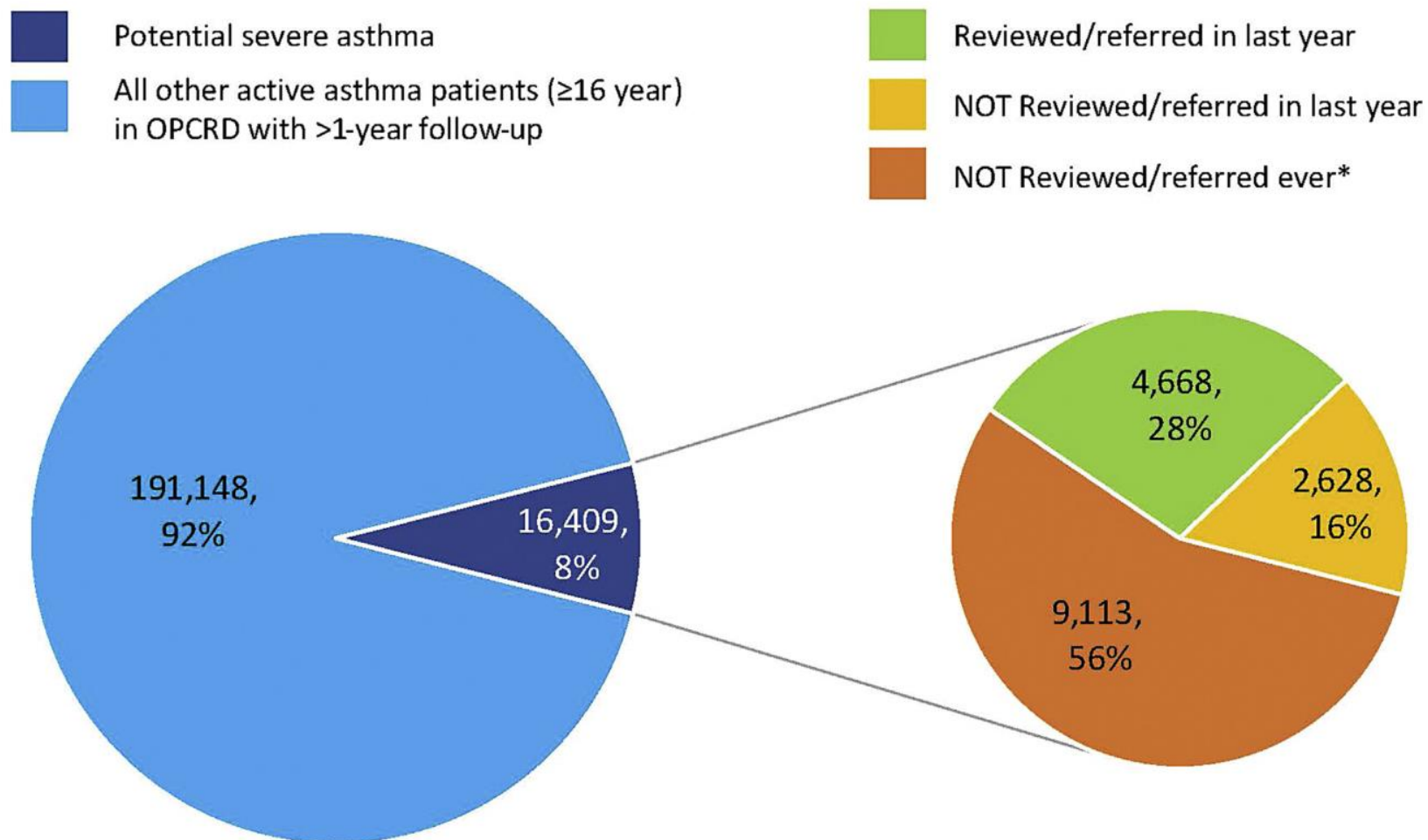
Definitions

Potential SA : GINA step 4 and 2 or more exacerbation **OR** GINA step 5

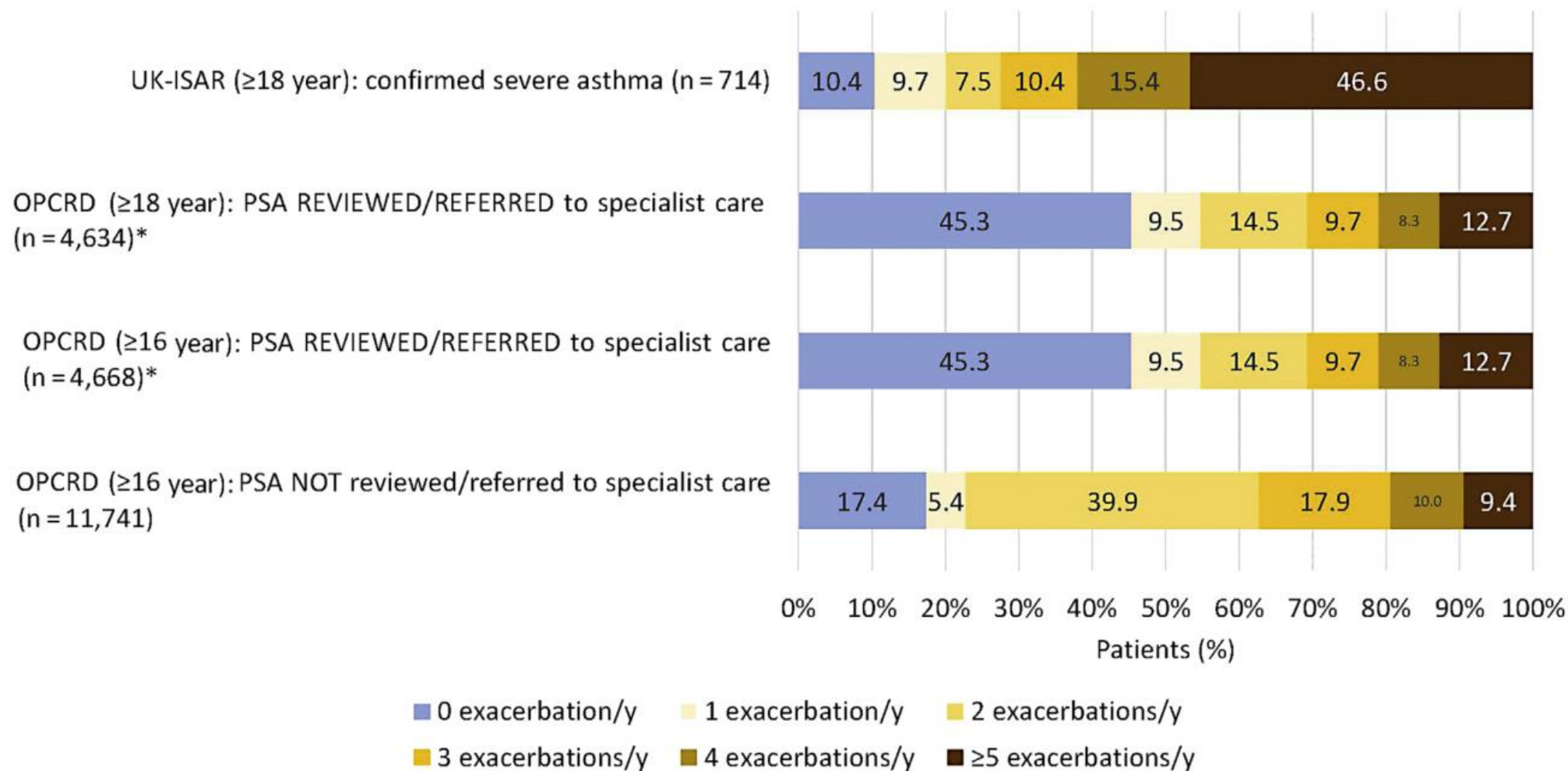


Variable	Description
Comorbidities	<ul style="list-style-type: none"> For UK-ISAR, comorbidities are captured in free text, and so are likely underreported (particularly when compared with the patients' long-term primary care record) OPCRD: comorbidities are coded
Exacerbation	<ul style="list-style-type: none"> Worsening of asthma requiring systemic corticosteroids
Asthma control	<ul style="list-style-type: none"> OPCRD: assessed 5 ways: <ol style="list-style-type: none"> Royal College of Physicians questionnaire²¹ Asthma Control Test²² Risk Domain Asthma Control¹⁹ Overall Asthma Control Short-acting β_2-agonist use UK-ISAR: assessed by the Asthma Control Questionnaire²³
Adherence	<ul style="list-style-type: none"> OPCRD: assessed using the medication possession ratio, with good adherence to treatment defined as a ratio $\geq 70\%$ (based on ICS prescription refills).²⁴ UK-ISAR: assessed by asking the question, "is there evidence of poor adherence?" during systematic assessments, which was answered as "clinical impression," "prescription records," "objective measures," or "no."

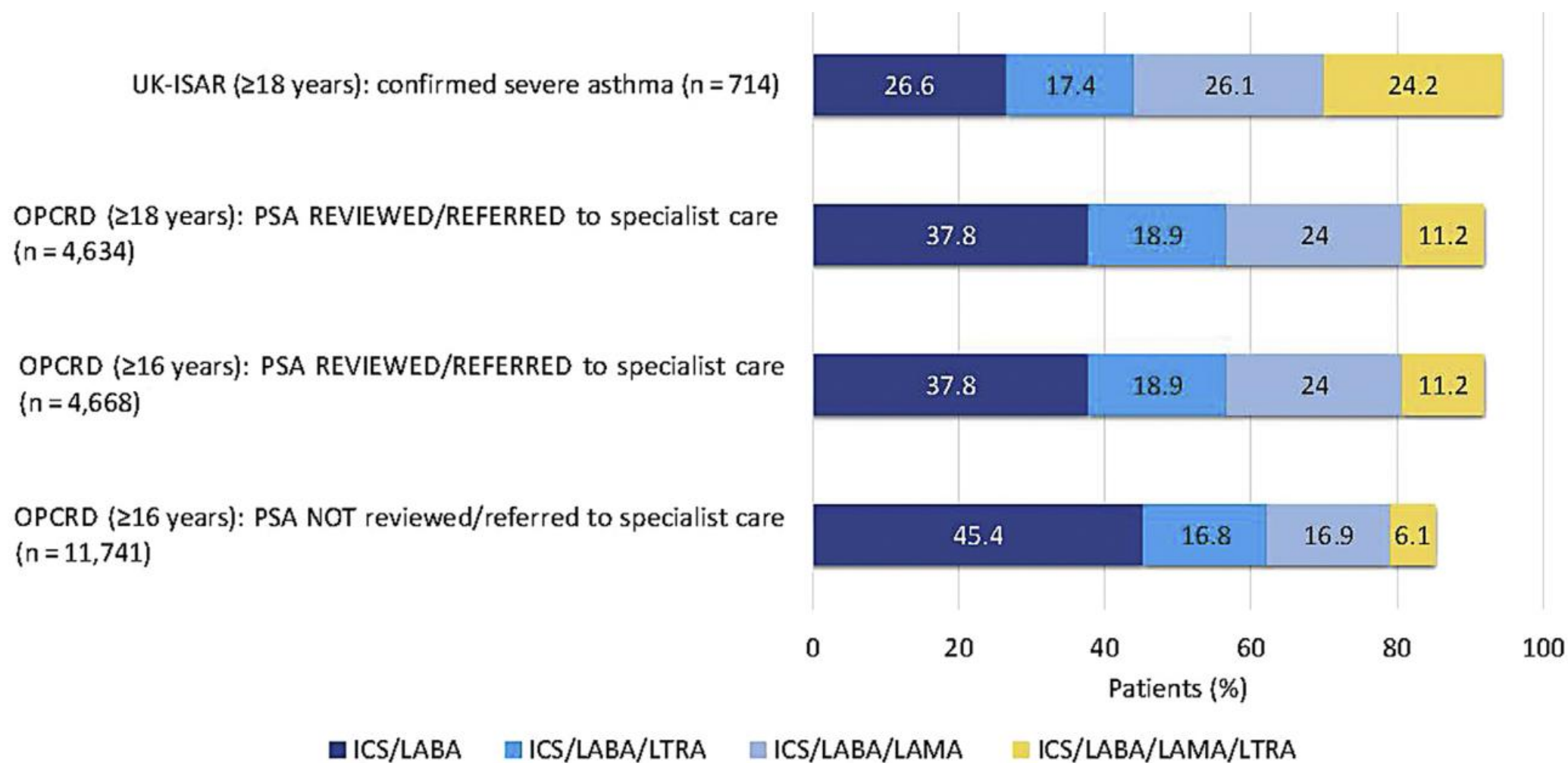
Potential Severe Asthma Hidden in UK Primary Care



Potential Severe Asthma Hidden in UK Primary Care



Potential Severe Asthma Hidden in UK Primary Care



Claim data : USA CMS data



The Journal of Allergy and Clinical Immunology:
In Practice

Volume 11, Issue 2, February 2023, Pages 546-554.e2



Original Article

Impact of Mepolizumab on Exacerbations in the US Medicare Population



Sanjay Sethi, MD^a, Michael Bogart, PharmD^b, Thomas Corbridge, MD^b, Anissa Cyhaniuk, MA^c, and Beth Hahn, PhD^b
Buffalo, NY; Triangle Park, NC; and Plano, Texas

What is already known about this topic? The burden of severe asthma is improved by real-world use of the anti-IL-5 mAb mepolizumab in database studies.

What does this article add to our knowledge? Initiating treatment with mepolizumab significantly reduces asthma exacerbations and oral corticosteroid use as well as exacerbation-related costs in a large, diverse population of Medicare patients with severe asthma.

How does this study impact current management guidelines? This study indicates that mepolizumab reduced the burden of asthma exacerbations and oral corticosteroid use while providing cost savings for elderly patients with severe asthma.

Claim data : USA CMS data

Original Article

Impact of Mepolizumab on Exacerbations in the US Medicare Population



Enrolled patients
N = 1,278

Study population

- Aged 12 years or older with one or more prescriptions or administration claims for mepolizumab

Primary outcome

Asthma exacerbation

- 1) Outpatient or ER claim with asthma and systemic steroid
- 2) Inhospital admission claim with asthma code

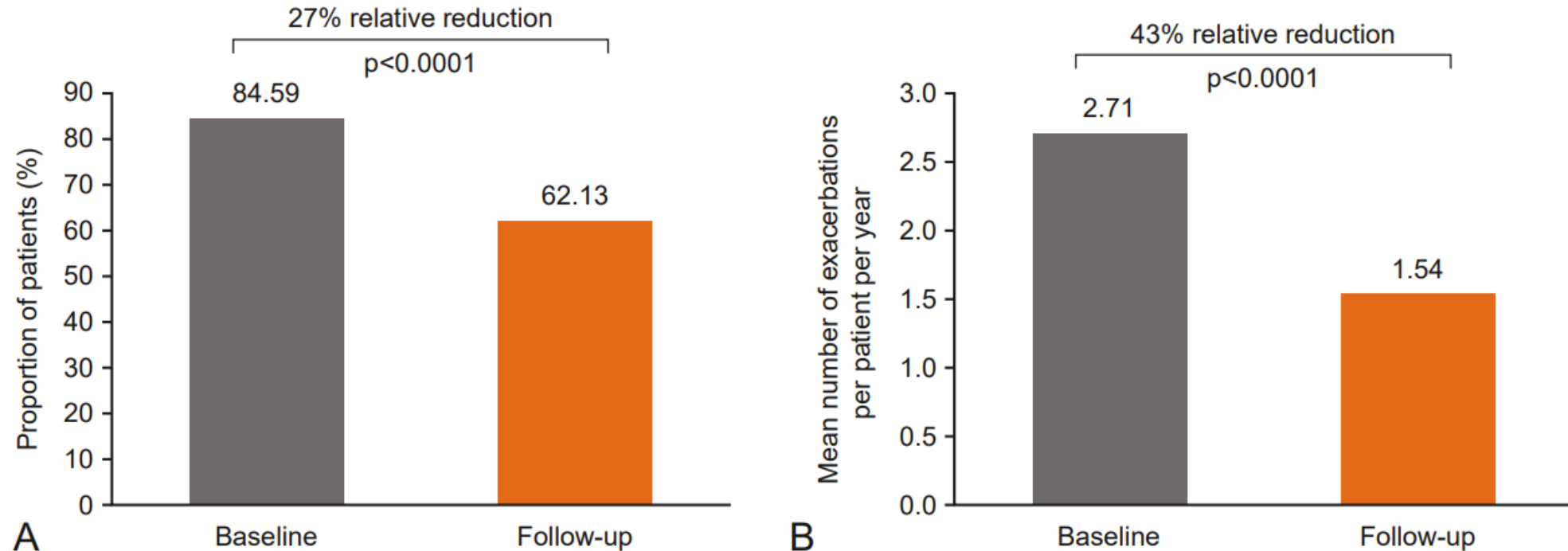
Secondary outcome

- 1) Proportion of patients with OCS use
- 2) Mean number of OCS claims/person
- 3) Proportion of patients with chronic OCS (assessed by PD-equivalent)

Claim data : USA CMS data

Original Article

Impact of Mepolizumab on Exacerbations in the US Medicare Population



Claim data : Korea NHIS/HIRA







The Journal of Allergy and Clinical Immunology:
In Practice

Volume 9, Issue 5, May 2021, Pages 1939-1947.e7



Original Article

Cost-Effectiveness of Tiotropium in Elderly Patients with Severe Asthma Using Real-World Data

[Sung-Hyun Hong PhD^a](#), [Jeong-Yeon Cho PharmD^a](#), [Tae-Bum Kim MD, PhD^b](#),
[Eui-Kyung Lee PhD^a](#), [Sun-Hong Kwon PhD^a](#)  , [Ju-Young Shin PhD^a](#)  

Cost-Effectiveness of Tiotropium in Elderly Patients with Severe Asthma Using Real-World Data

**Candidates,
N = 179,724**

N = 4,738

**Moderate-high dose ICS
LABA
+
(+) one more severe
exacerbation**

Primary outcome

Asthma exacerbation

- 1) Systemic CS burst; an outpatient visit with at least three days of high-dose oral CS or single systemic CS + asthma diagnosis
 - 2) ED visit
 - 3) Hospitalization
- * High-dose oral CS = equivalent to 30mg PD per day

Secondary outcome

Costs

Two controlled status for each and three asthma exacerbation

Cost-Effectiveness of Tiotropium in Elderly Patients with Severe Asthma Using Real-World Data

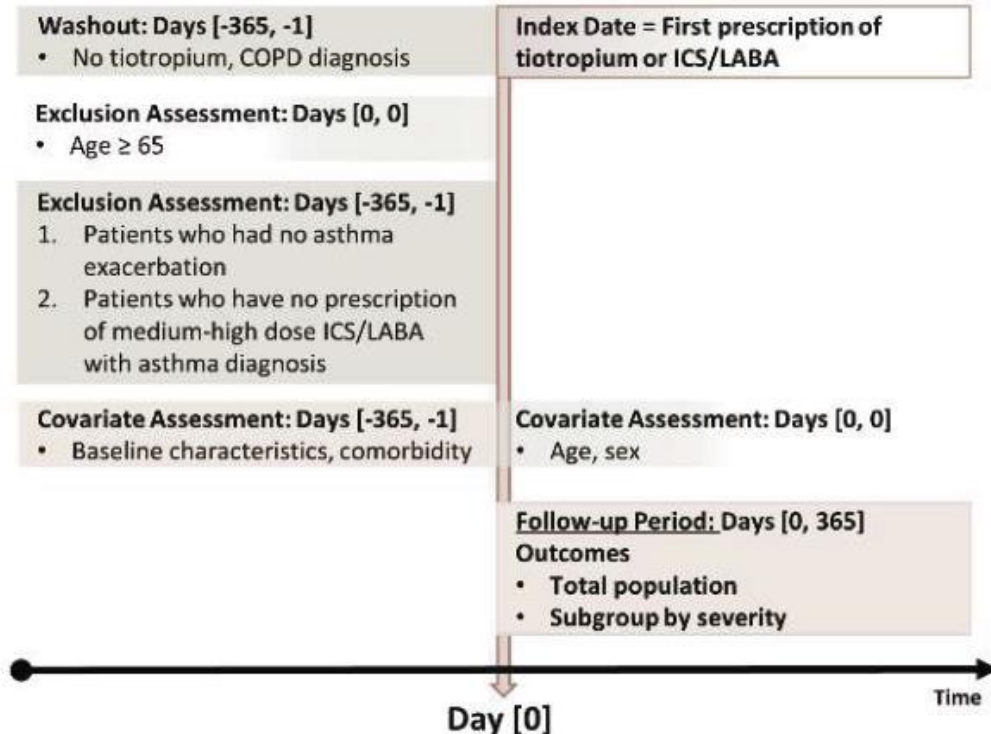
Phase I: Real-world evidence generation

A retrospective cohort study using claims data

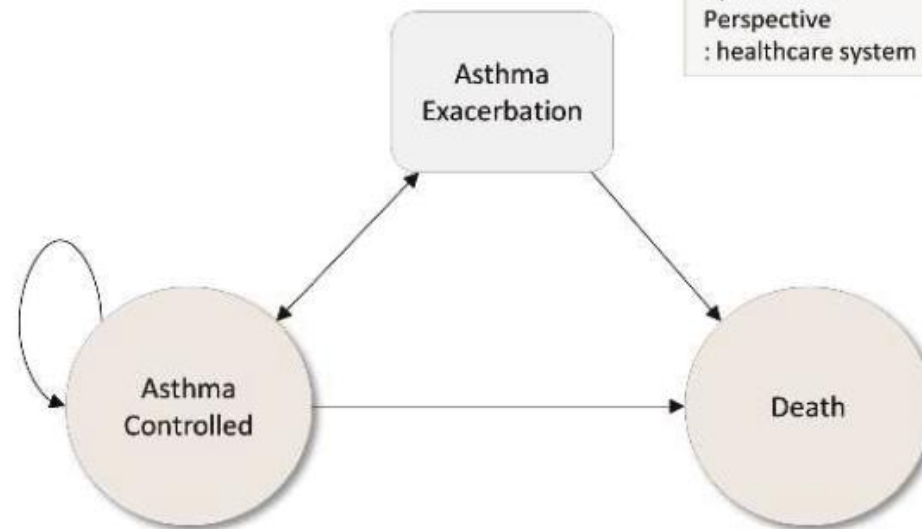
Phase II: Cost-effectiveness analysis

A Markov model

Study design



Time horizon: life-time
Cycle: 2 weeks
Perspective: healthcare system



Outcomes

- The incidence of asthma exacerbation
- Asthma related costs
- Cost of asthma exacerbation

- Estimated quality-adjusted life years
- Estimated costs
- Incremental cost effectiveness ratio

Cost-Effectiveness of Tiotropium in Elderly Patients with Severe Asthma Using Real-World Data

Table 3. Annual incidence rate of asthma exacerbations and rate ratio

Patient group	Number of exacerbations, Mean (SD)				RR (95% CI)
	SCS burst	ED visit	Hospitalization	Total	
Total					
Tiotropium + ICS/LABA (N=274)	1.24 (4.28)	0.01 (0.12)	0.30 (0.76)	1.55 (4.33)	0.72 (0.62–0.83)
ICS/LABA (N=822)	1.84 (4.52)	0.02 (0.13)	0.23 (0.66)	2.09 (4.67)	
Subgroup: frequent SABA user^a					
Tiotropium + ICS/LABA (N=65)	2.40 (7.51)	0.03 (0.17)	0.34 (0.99)	2.77 (7.51)	0.68 (0.60–0.85)
ICS/LABA (N=195)	3.47 (7.32)	0.03 (0.16)	0.37 (0.80)	3.87 (7.55)	
Subgroup: frequent exacerbator^b					
Tiotropium + ICS/LABA (N=148)	2.11 (5.84)	0.01 (0.12)	0.30 (0.71)	2.43 (5.86)	0.77 (0.65–0.88)
ICS/LABA (N=444)	2.67 (5.69)	0.02 (0.15)	0.31 (0.74)	2.99 (5.83)	

ED, emergency department; *SABA*, short-acting beta-agonist; *RR*, rate ratio; *SCS*, systemic corticosteroid.

The rate ratio was calculated using Poisson regression and adjusted for pre-index period comorbidities (dementia, diabetes with complications, and frequent use of SABA).

^aPatients who were prescribed SABA four times or more in the past year.

^bPatients who experienced asthma exacerbation more than once in the past year.

Cost-Effectiveness of Tiotropium in Elderly Patients with Severe Asthma Using Real-World Data

Table 3. Annual incidence rate of asthma exacerbations and rate ratio

Patient group	Number of exacerbations, Mean (SD)				RR (95% CI)
	SCS burst	ED visit	Hospitalization	Total	
Total					
Tiotropium + ICS/LABA (N=274)	1.24 (4.28)	0.01 (0.12)	0.30 (0.76)	1.55 (4.33)	0.72 (0.62–0.83)
ICS/LABA (N=822)	1.84 (4.52)	0.02 (0.13)	0.23 (0.66)	2.09 (4.67)	
Subgroup: frequent SABA user^a					
Tiotropium + ICS/LABA (N=65)	2.40 (7.51)	0.03 (0.17)	0.34 (0.99)	2.77 (7.51)	0.68 (0.60–0.85)
ICS/LABA (N=195)	3.47 (7.32)	0.03 (0.16)	0.37 (0.80)	3.87 (7.55)	
Subgroup: frequent exacerbator^b					
Tiotropium + ICS/LABA (N=148)	2.11 (5.84)	0.01 (0.12)	0.30 (0.71)	2.43 (5.86)	0.77 (0.65–0.88)
ICS/LABA (N=444)	2.67 (5.69)	0.02 (0.15)	0.31 (0.74)	2.99 (5.83)	

ED, emergency department; *SABA*, short-acting beta-agonist; *RR*, rate ratio; *SCS*, systemic corticosteroid.

The rate ratio was calculated using Poisson regression and adjusted for pre-index period comorbidities (dementia, diabetes with complications, and frequent use of SABA).

^aPatients who were prescribed SABA four times or more in the past year.

^bPatients who experienced asthma exacerbation more than once in the past year.

Cost-Effectiveness of Tiotropium in Elderly Patients with Severe Asthma Using Real-World Data

Outcomes	The modeled frequency of clinically significant exacerbations			Effectiveness		Cost (USD)		Cost-Effectiveness
	SCS burst	ED visit	Hospitalization	QALYs	Controlled state	Treatment for exacerbation	Total costs	ICER (USD/QALY)
Base case								
Tiotropium + ICS/LABA	11.31	0.09	2.70	6.90	9,907	5,673	15,580	60,074
ICS/LABA	17.13	0.19	2.16	6.87	8,269	5,030	13,299	
Incremental				0.038			2,281	
RCT as clinical outcomes								
Tiotropium + ICS/LABA	4.31	0	0.45	7.02	9,943	1,081	11,024	82,051
ICS/LABA	5.42	0	0.49	7.00	8,293	1,227	9,520	
Incremental				0.018			1,504	
Subgroup analysis: frequent SABA user^a								
Tiotropium + ICS/LABA	21.24	0.27	3.01	6.82	10,760	6,114	16,875	4,078
ICS/LABA	32.28	0.28	3.44	6.72	9,057	7,413	16,471	
Incremental				0.099			404	
Subgroup analysis: frequent exacerbator^b								
Tiotropium + ICS/LABA	18.69	0.09	2.66	6.85	9,534	6,028	15,563	8,332
ICS/LABA	24.86	0.19	2.89	6.79	8,241	6,812	15,053	
Incremental				0.061			509	

RCT, randomized controlled trial; SABA, short-acting beta-agonist; SCS, systemic corticosteroid; ED, emergency department; QALYs, quality-adjusted life years; ICER, incremental cost-effectiveness ratio.

^aPatients who were prescribed SABA four times or more in the past year.

^bPatients who experienced asthma exacerbation more than once in the past year.

Claim data : Korea NHIS/HIRA



EUROPEAN RESPIRATORY *journal*

FLAGSHIP SCIENTIFIC JOURNAL OF ERS





ORIGINAL ARTICLE
ASTHMA



CrossMark

Increased mortality in patients with corticosteroid-dependent asthma: a nationwide population-based study

Hyun Lee¹, Jiin Ryu², Eunwoo Nam², Sung Jun Chung¹, Yoomi Yeo¹, Dong Won Park¹, Tai Sun Park¹, Ji-Yong Moon¹, Tae-Hyung Kim ¹, Jang Won Sohn¹, Ho Joo Yoon¹ and Sang-Heon Kim ¹

Increased mortality in patients with corticosteroid-dependent asthma: a nationwide population-based study

Asthma
N = 466,941

≥ 18 years
AND
At least 2 claims J45-46
AND
Asthma-related drugs (ICS,
systemic CS,
bronchodilator, LTRA,
xanthine)

**CS-dependent
asthma**
N = 8,334 (1.8%)

Presence of asthma
AND
Prescription of systemic
CS under ICD-10 codes
J45-46 for ≥ 6 months

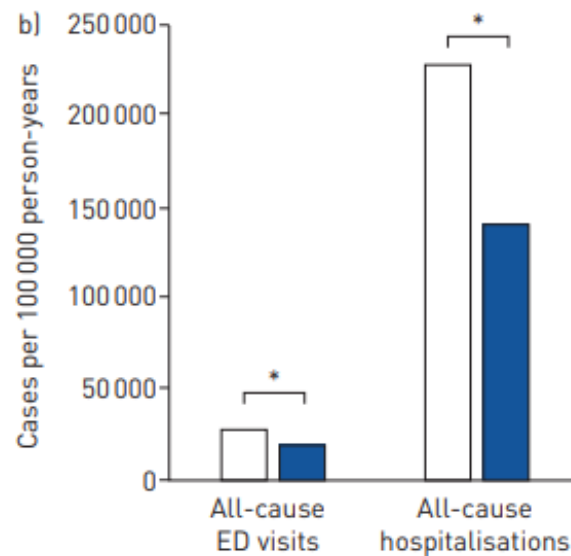
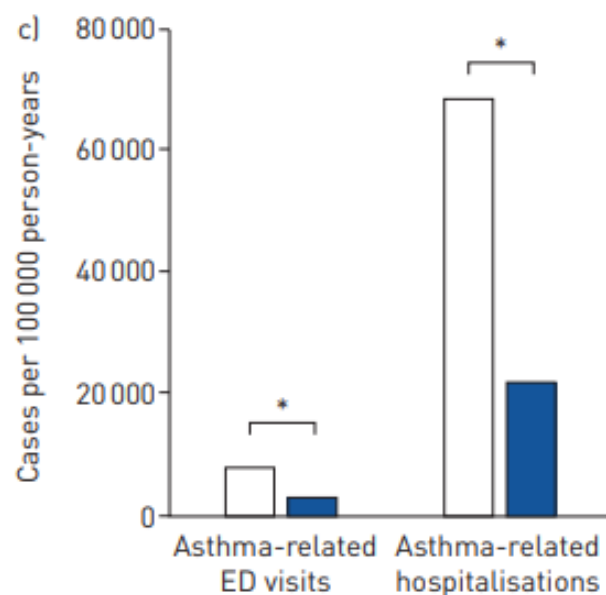
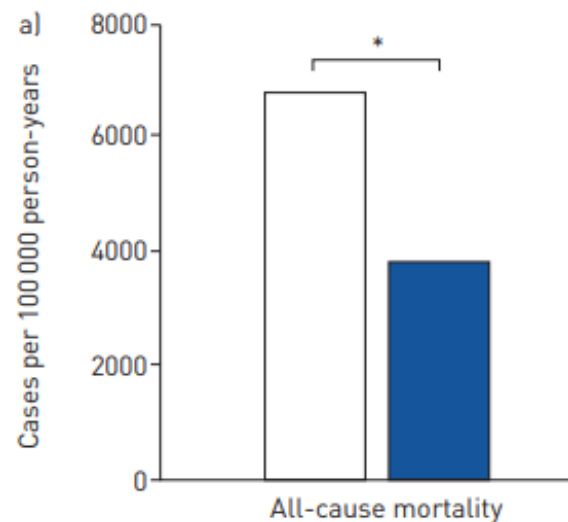
Primary outcome

All-cause mortality
Mortality data provided by Statistics Korea

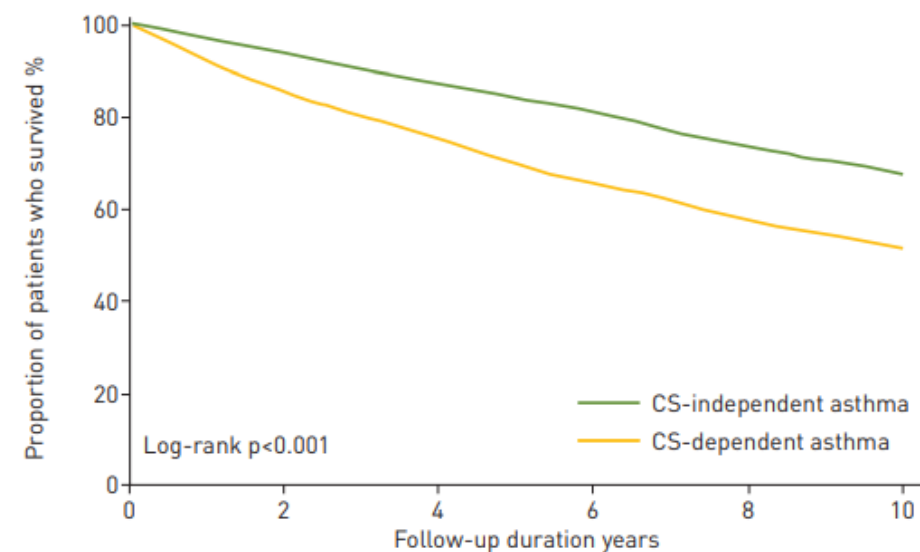
Secondary outcome

**All-cause or asthma-related ED visits or
hospitalization**
Under ICD-10 codes J45-46

□ CS-dependent asthma
■ CS-independent asthma



Increased mortality in patients with corticosteroid-dependent asthma: a nationwide population-based study



At risk n:

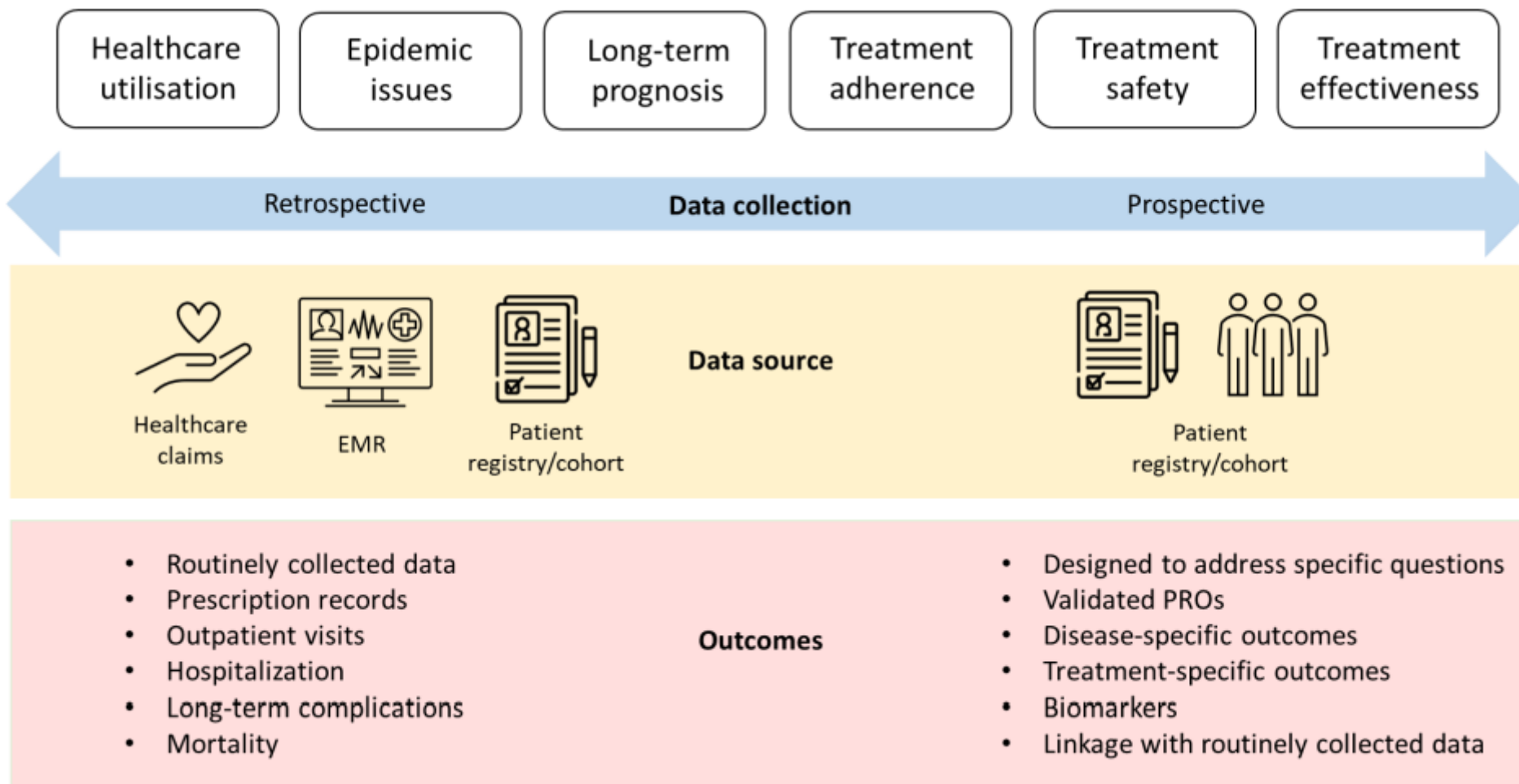
CS-independent asthma	8334	7904	7297	6735	6159	29
CS-dependent asthma	8334	7129	6249	5462	4835	47

Contents

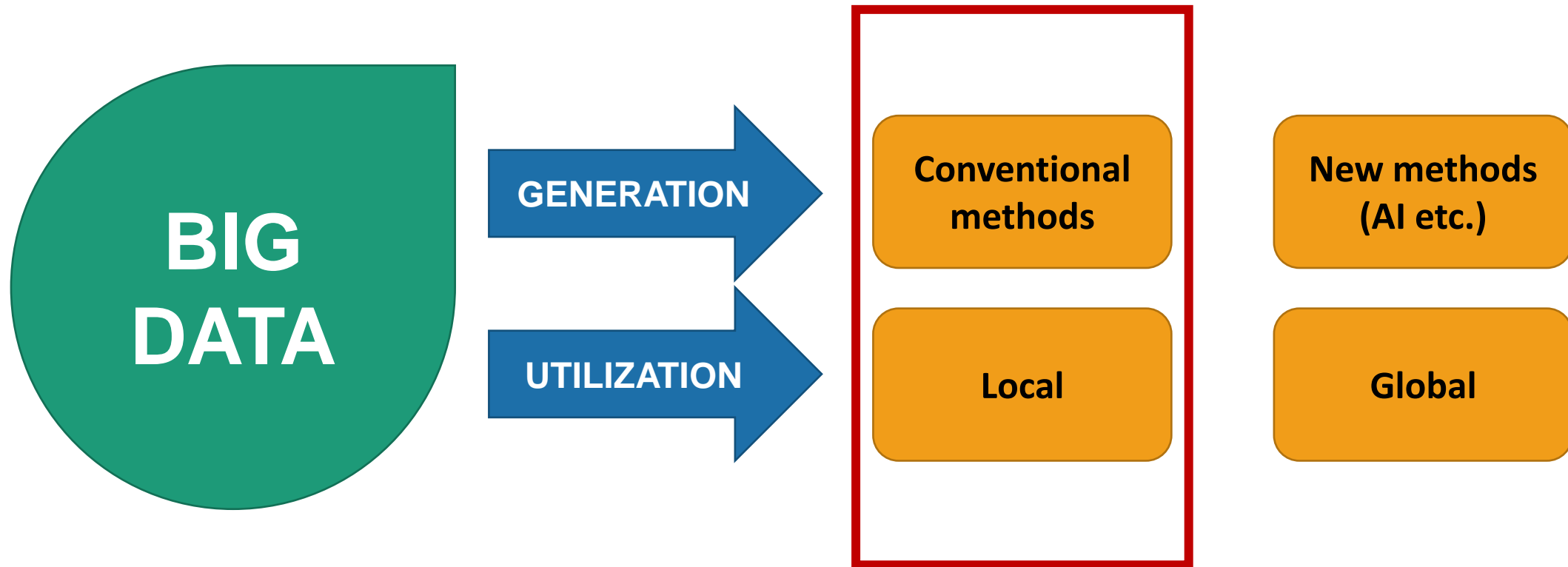
- **Introduction**
- **Datasets for Big Data Research of Severe Asthma**
- **Severe Asthma Research by Using Big Data**
- **Future direction**

Future direction

Fit for purpose

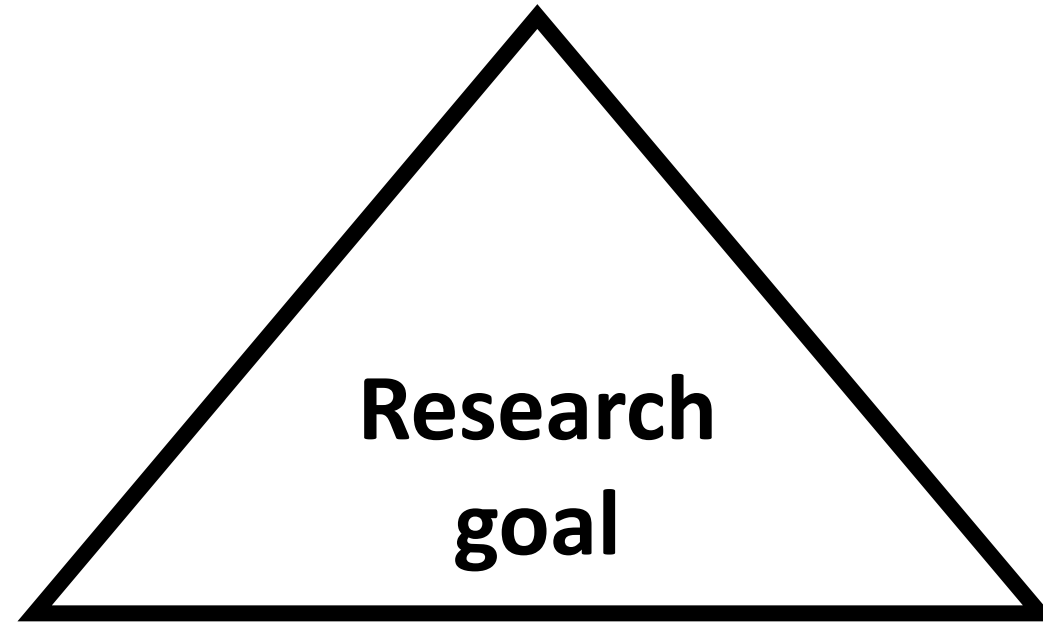


Making or Using a Big Data



Which data should be used?

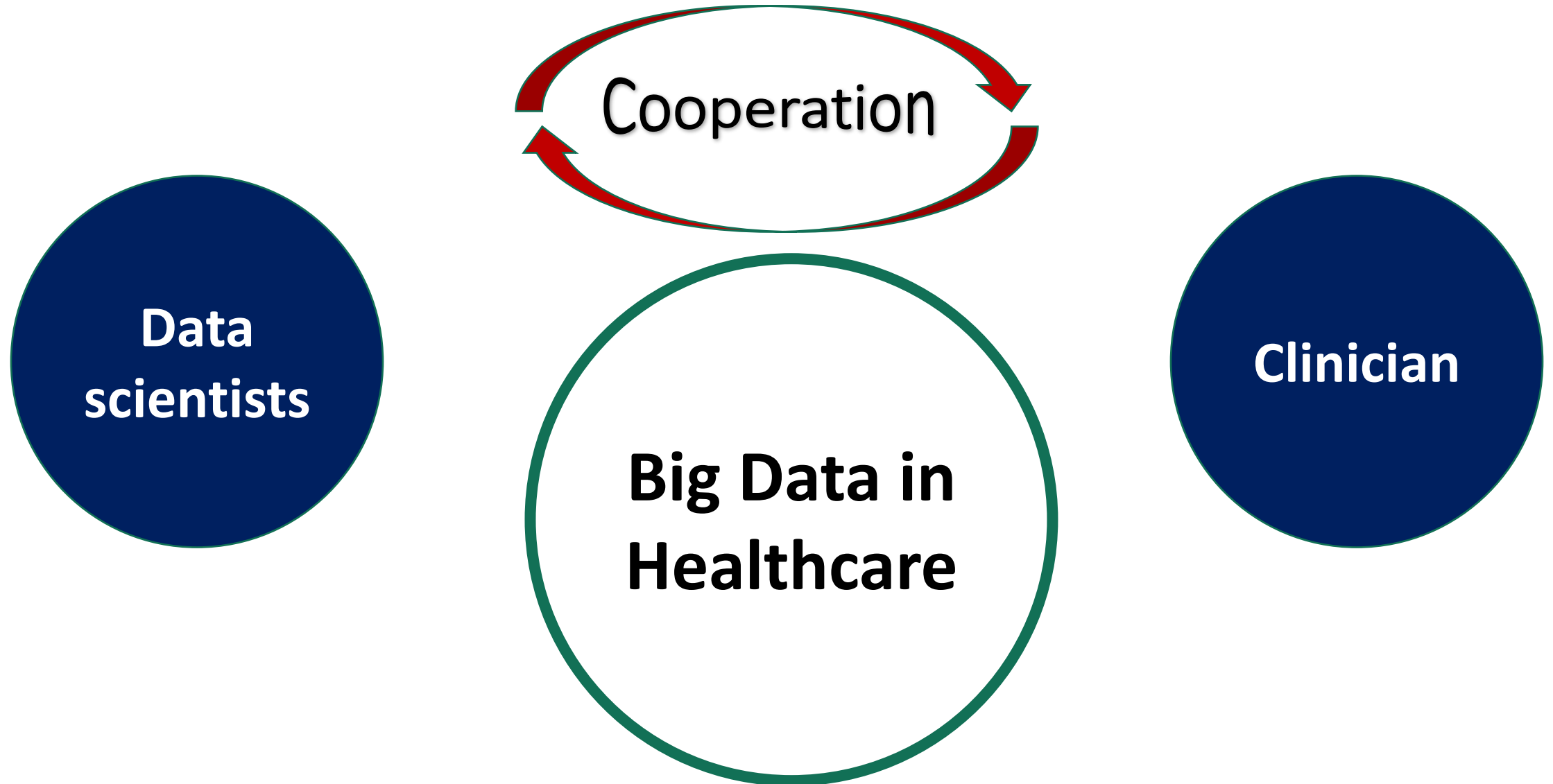
Cross-sectional
large-volume data



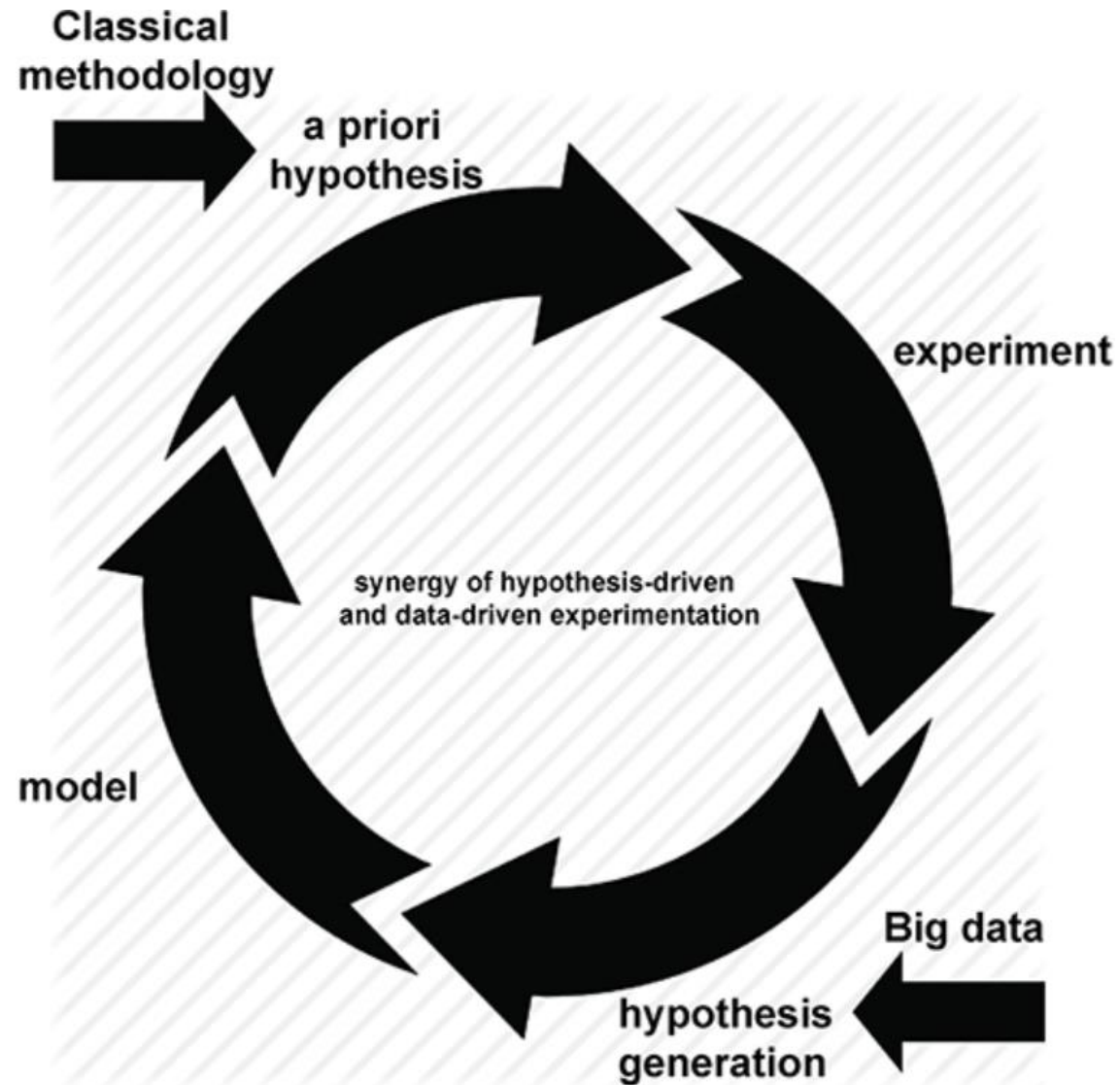
Combined

Longitudinal large-volume data

The divide between data scientists and clinicians



Synergic cycle



Artificial Intelligence

ARTICLE

doi:10.1038/nature16961

Mastering the game of Go with deep neural networks and tree search

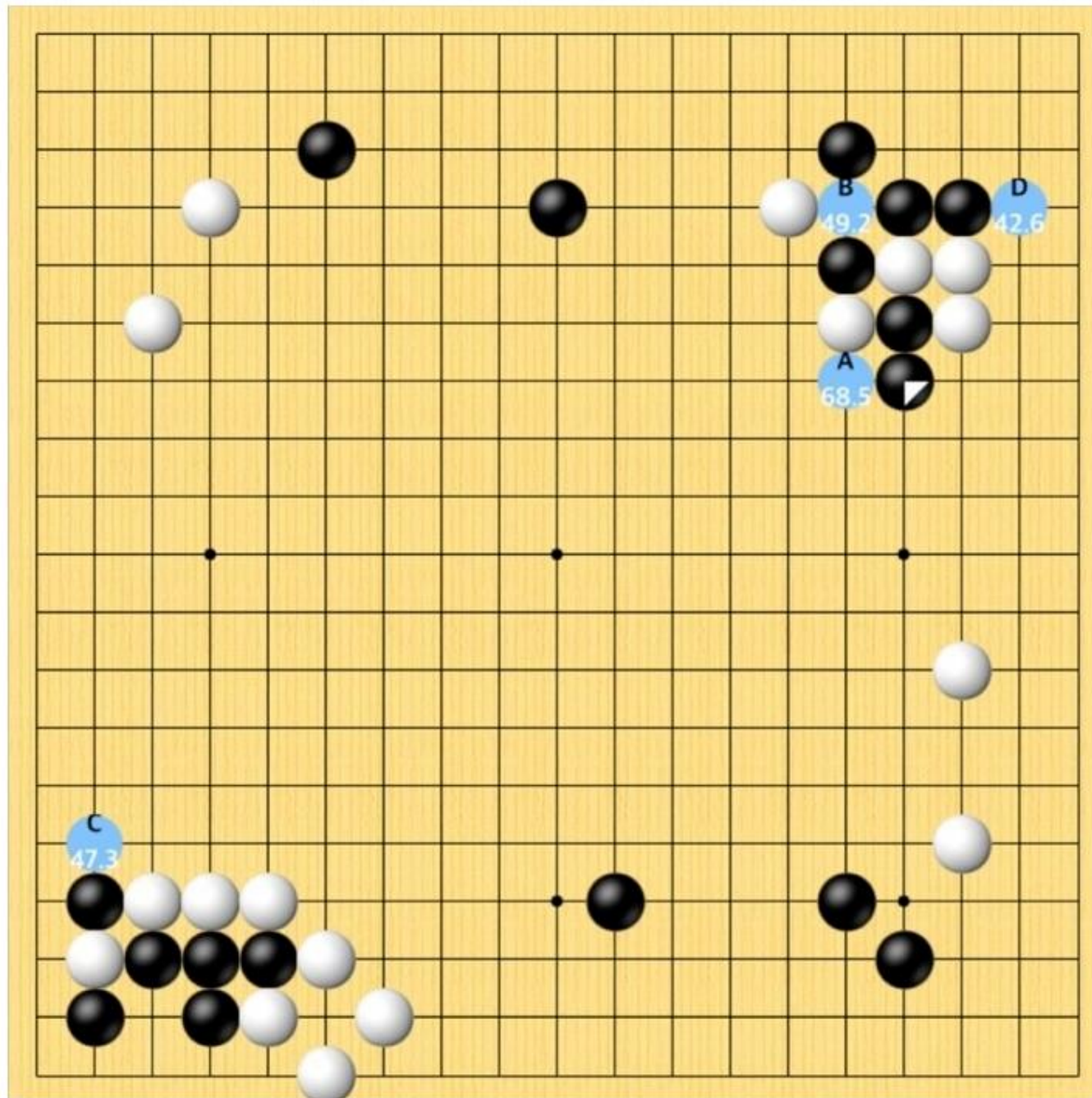
David Silver^{1*}, Aja Huang^{1*}, Chris J. Maddison¹, Arthur Guez¹, Laurent Sifre¹, George van den Driessche¹, Julian Schrittwieser¹, Ioannis Antonoglou¹, Veda Panneershelvam¹, Marc Lanctot¹, Sander Dieleman¹, Dominik Grewe¹, John Nham², Nal Kalchbrenner¹, Ilya Sutskever², Timothy Lillicrap¹, Madeleine Leach¹, Koray Kavukcuoglu¹, Thore Graepel¹ & Demis Hassabis¹



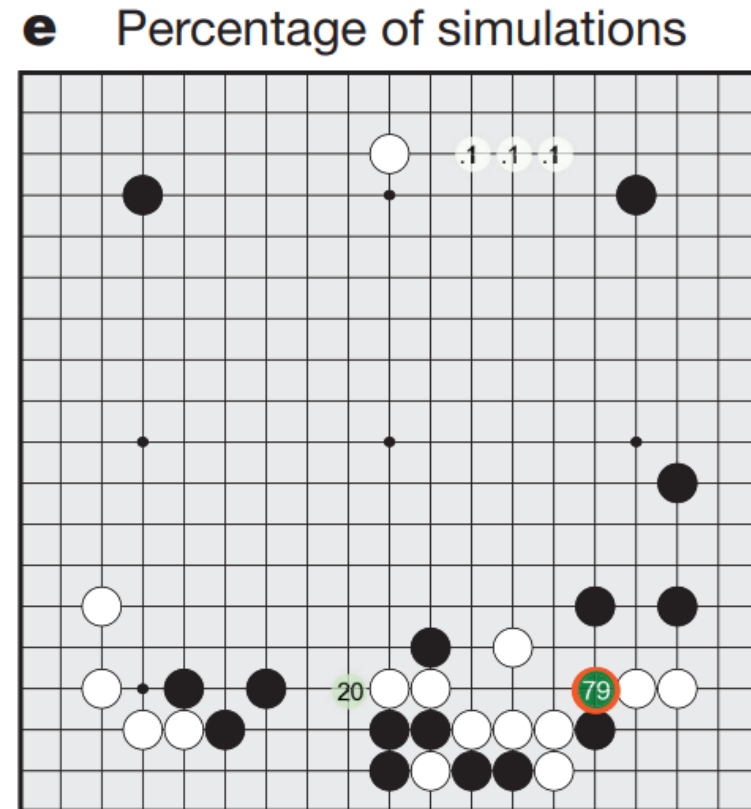
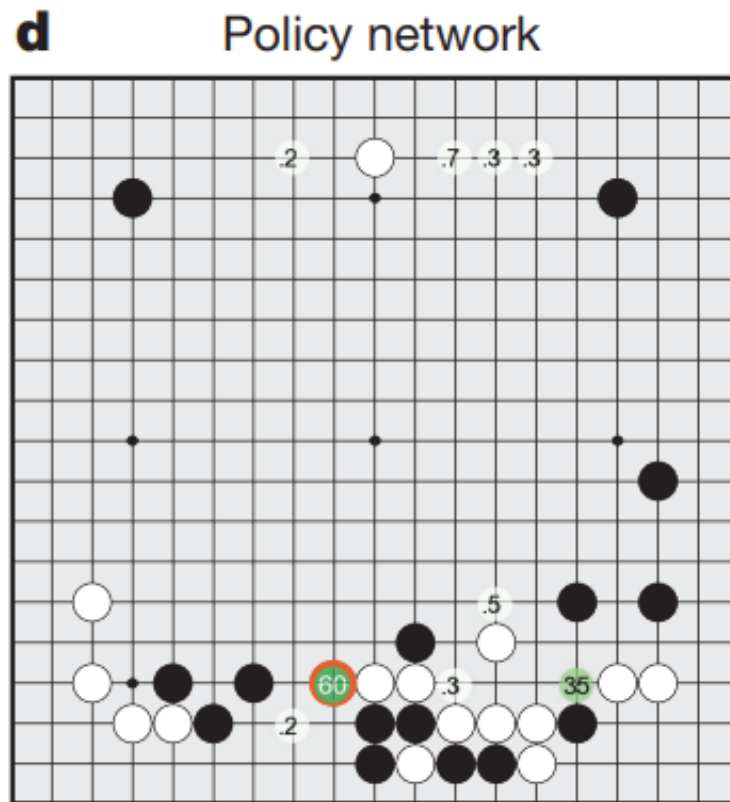
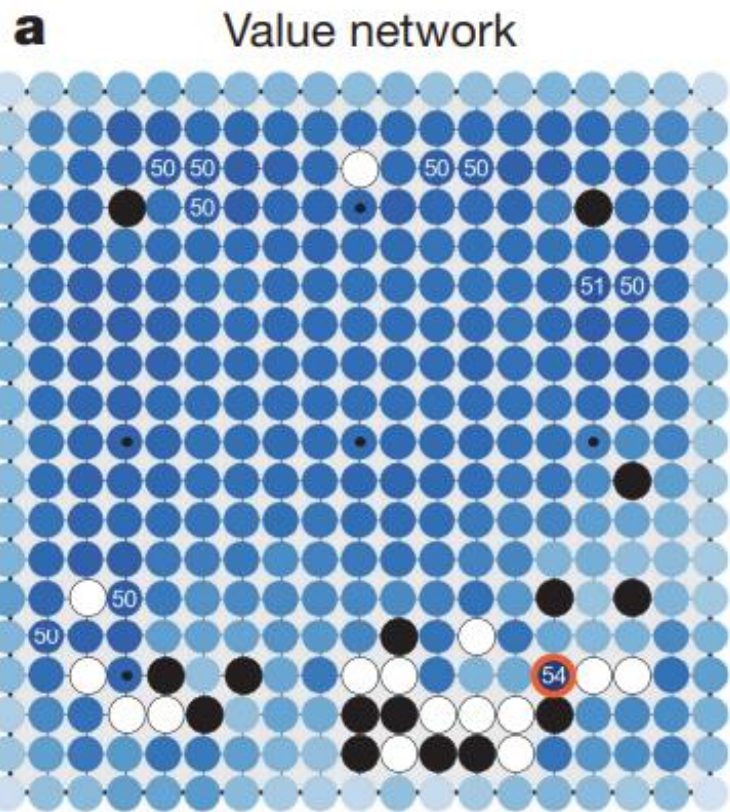
Blue spot



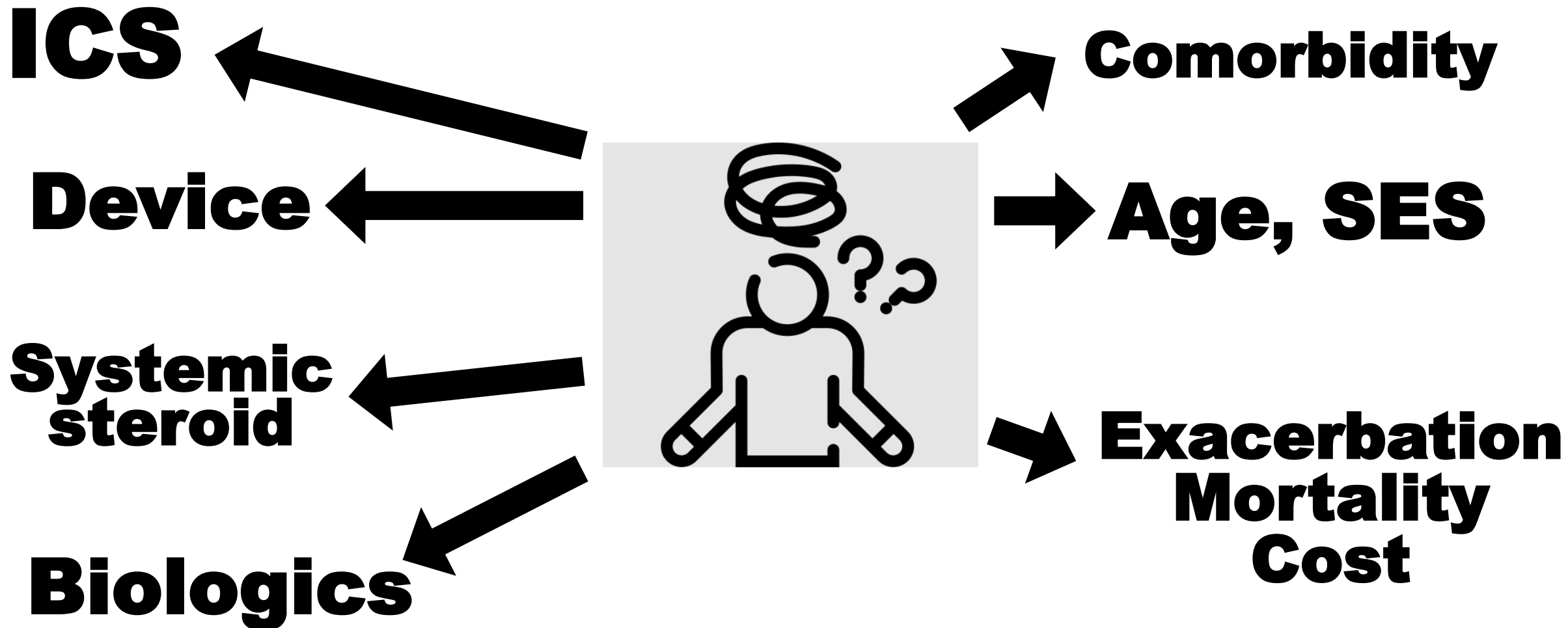
Severe Asthma



Policy network



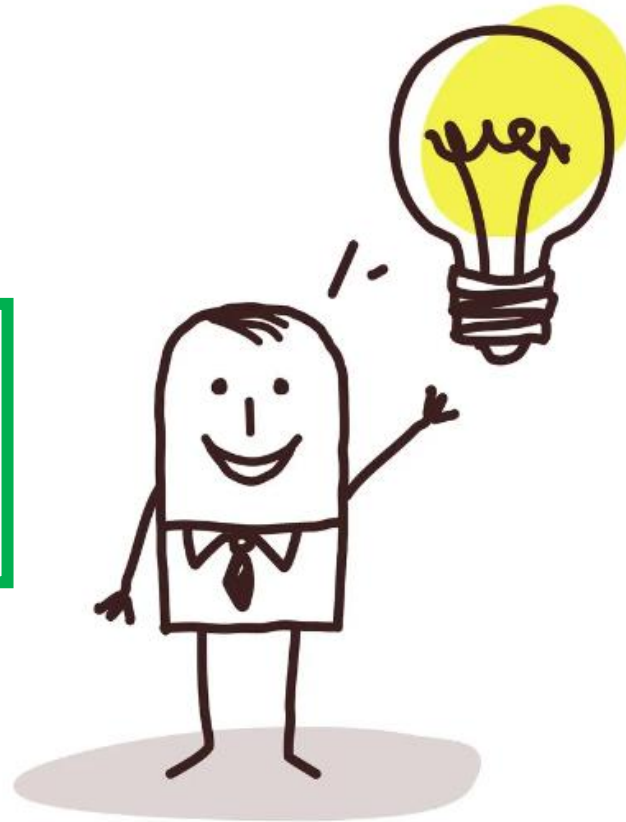
How to apply in Respiratory Medicine



How to apply in Respiratory Medicine

Expert's decision

Biologics



- ➔ **Omalizumab** 19
- ➔ **Mepolizumab** 67
- ➔ **Tezepelumab** 44

Summary

- Big data can be a good source of severe asthma research
- We should know about available dataset
- For real-research, operational definition is important
- Take advantage of the strength of big data, but weakness should overcome
- In the future, AI can be used in both generation and utilization of big data
- New statistical methods, including AI, can be used as a novel approach

Thank you for your attention

Artificial intelligence techniques in asthma: a systematic review and critical appraisal of the existing literature

Konstantinos P. Exarchos , Maria Beltsiou, Chainti-Antonella Votti and Konstantinos Kostikas

Affiliation: Respiratory Medicine Dept, School of Medicine, University of Ioannina, Ioannina, Greece.

Correspondence: Konstantinos Kostikas, University of Ioannina Medical School, Respiratory Medicine Dept, Leoforos Stavrou Niarchou, Ioannina, 45500, Greece. E-mail: ktkostikas@gmail.com

