P34

Carbon footprint associated with severe asthma care before and after benralizumab initiation: BENEFIT study

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Conflict-of-interest statement

- Mandy Nizard is an AstraZeneca employee
- This study was supported by AstraZeneca

Asthma prevalence is increasing, but national prevalences depend on diagnosis and environmental factors

>300 million
people are living with asthma worldwide[4]

... **1 in 5** in some countries[2]

By **2025,** a further
+100 million
may be affected[8]

4-9% **have asthma globally[2]**

There is a large geographic variation in asthma prevalence, severity and mortality. The French prevalence of asthma is 5,8%.[3]

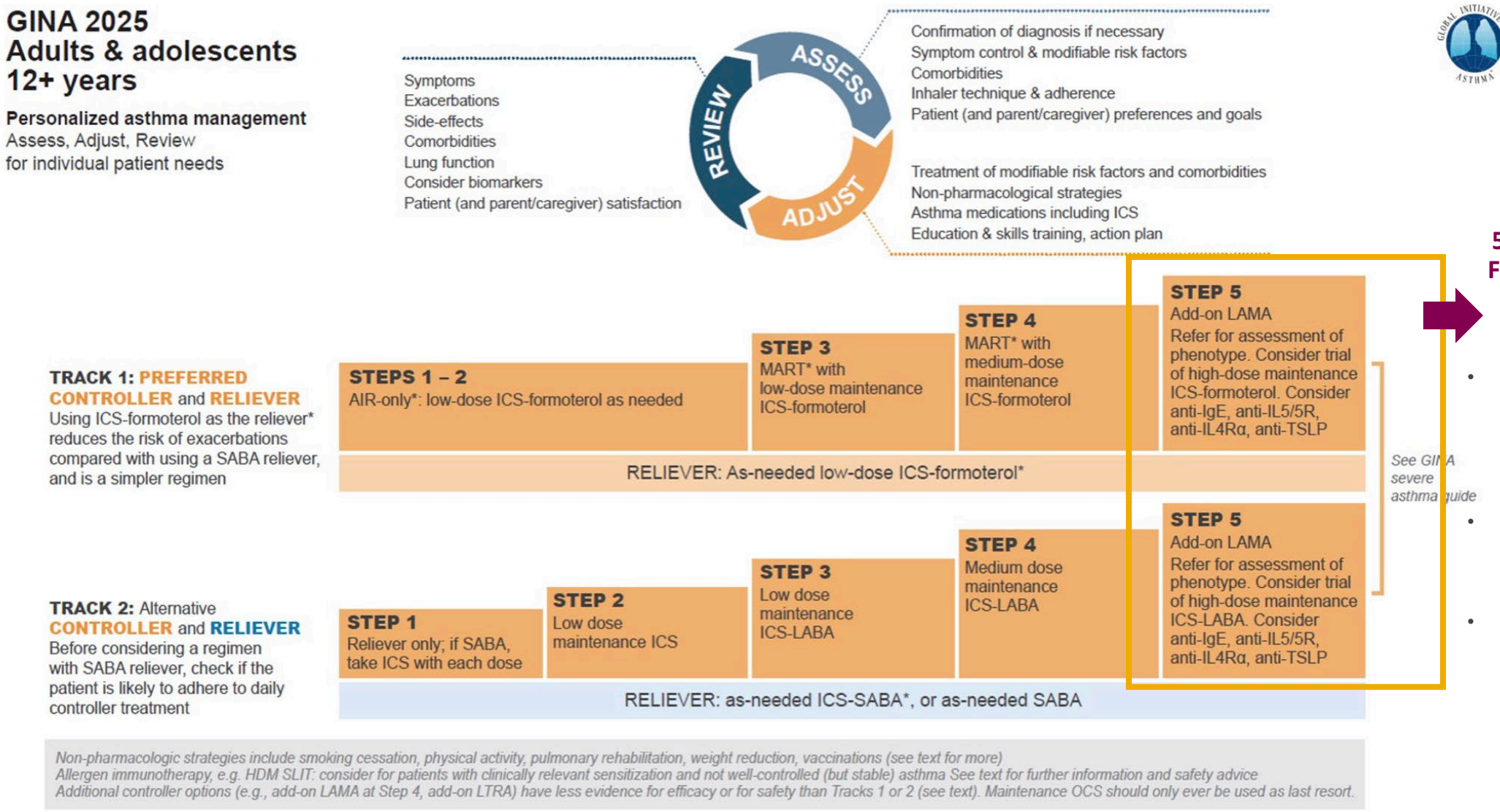
Asthma is more prevalent in high-income countries, while most **asthma-related mortality occurs in low–middle-income countries**;[1,2] probably due to increased urbanisation and pollution, and higher rates of obesity[5]

The true prevalence is still unclear there are major challenges for asthma diagnosis[4-9]

- lack of adequate disease knowledge
- lack of specialized diagnostic facilities
- limited access to spirometry
- social stigma associated with asthma

1. Dharmage SC, et al. Epidemiology of Asthma in Children and Adults Front Pediatr 2019;7:246; 2. To T, et al. BMC Public Health 2012;12:204; 3. Delmas MC, et al. J of Resp Diseases, 2021. 4. Louis R, et al. Eur Respir J 2022;2101585; 5. Enilari O, Sinha S. Ann Glob Health 2019;85:2; 6. Kavanagh J, Jackson DJ, Kent BD. *Breathe*. 2019;**15**(1):e20–e27. doi: 10.1183/20734735.0362-2018; 7. Accordini S, Cappa V, Braggion M, et al. *Int Arch Allergy Immunol*. 2011;**155**(4):403–411. doi: 10.1159/000320780; 8. Zeitouni et al. *Ann Thorac Med.* 2022 Apr-Jun; 17(2): 71–80; 9. Maciag et al Chest 2020 Apr 21;158(3):913–922. doi: 10.1016/j.chest.2020.04.011

Management of severe asthma according to GINA guidelines



5% of asthma patients in France suffer from severe asthma [1]

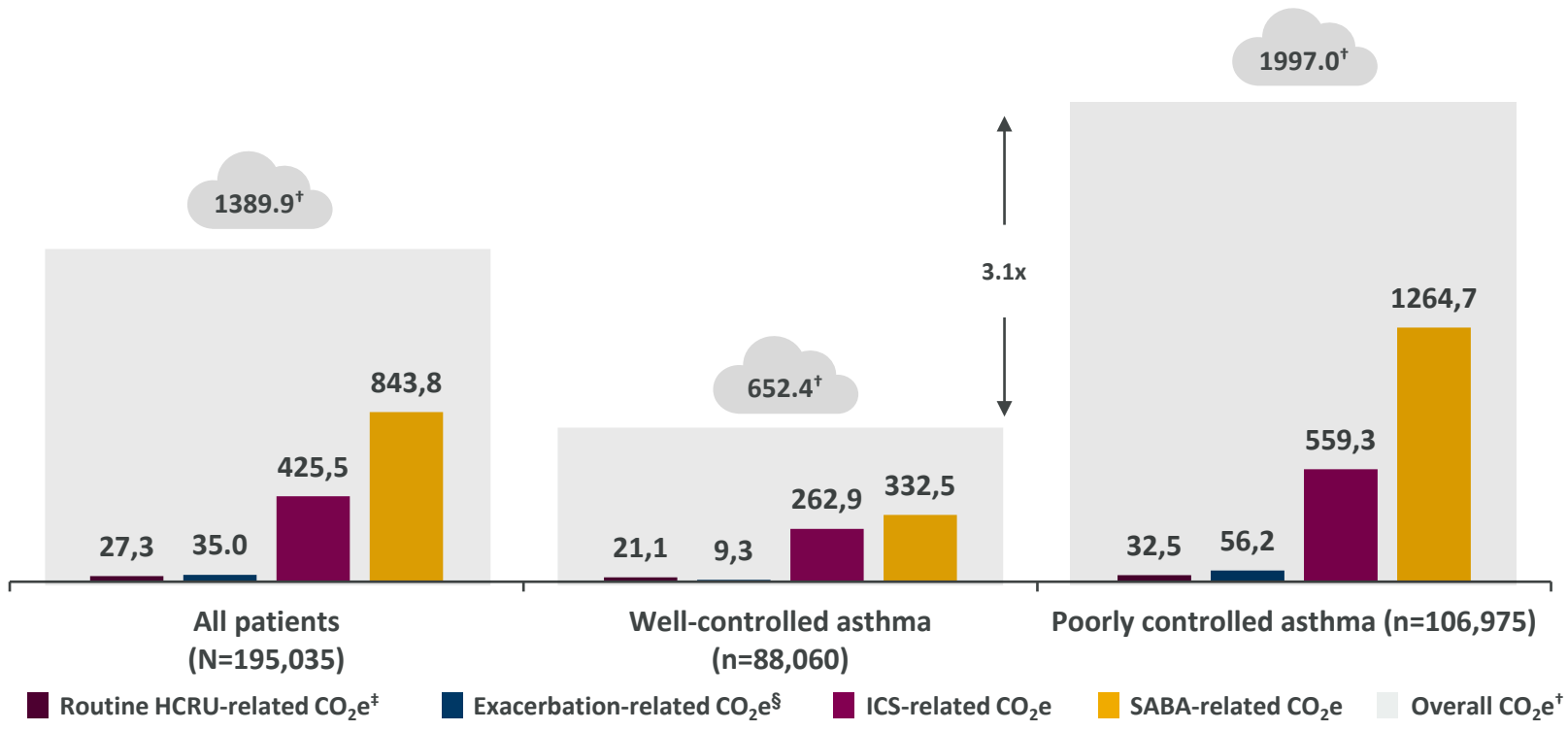
- 2/3 of patients with severe asthma have had at least one hospital stay, and the use of emergency departments was twice that of the general population [2]
- Exacerbations are responsible for hospital admissions in 12% to 27% of patients with severe asthma each year [3]
- Severe asthma has a major impact on patients' working lives and quality of life [4-9]

GINA: Global Initiative for Asthma.

1. Bourdin A et al. The Burden of Severe Asthma in France: A Case-Control Study Using a Medical Claims Database. (2019). 2. Demoly P. et al. Impact en vie réelle de l'asthme sévère non contrôlée sur la morbi-mortalité des patients âgés de 12 ans et plus en France (2020). 3. Soong W. et al. Real-World Asthma Exacerbation And Hospitalization Rates By Treatment Among Specialist-Treated United States Severe Asthma Patients. (2020). 4 Inserm. Asthma (2017). 5. Demoly P. et al. Impact en vie réelle de l'asthme sévère non contrôlé sur la morbi-mortalité des patients âgés de 12 ans et plus en France (2020). 6. Pavord I. et al. Severe T2-high asthma in the biologics era: European experts' opinion. (2019). 7. Price DB et al. Adverse outcomes from initiation of systemic corticosteroids for asthma: long-term observational study (2018). 8. Gargouri. R. Relationship between asthma control and patient quality of life. (2018). 9. Santé Publique France. Asthma: prevalence and impact on daily life. Analyse des données de l'enquête décennale santé 2003 de l'Insee. (2019).

Uncontrolled asthma is associated with 3x higher GHG emissions versus controlled

Per capita* GHG emissions associated with asthma care[1,2]



3.1x

higher per capita GHG emissions for poorly versus well-controlled asthma

~45%

of the total GHG emissions of treating asthma in the UK per year derives from treating **exacerbations** and from **suboptimal inhaler use** in poorly controlled asthma (~300,000 tonnes CO_2e)

1. Wilkinson A, et al. Thorax 2023;doi 10.1136/thorax-2023-220259:; 2. Maslova E, et al. PA2382 IERS September 2023

* Per capita refers to per 10000 person-years. GHG = Greenhouse gases

BENEFIT study objectives

- Describe the baseline sociodemographic and clinical characteristics of patients receiving benralizumab in real word settings in France
- Describe and compare the related medical resource utilization of the patients 12 months before and 12 months after the initiation of benralizumab
- Describe and compare the real-life GHG emissions of severe asthma management 12 months before and after the initiation of benralizumab

Study Design

SNDS

- **Design:** Single-arm observational retrospective cohort study
- **Data source:** National French health claims database (SNDS)
- **Study period:** 01 Jan 2014 – 31 Dec 2023
- **Inclusion period:** 01 Jan 2019 – 31 Dec 2023
- **Index Date:** First dispensing of benralizumab over the inclusion period = initiation of benralizumab
- **Inclusion Criteria:** At least one dispensing of benralizumab over the inclusion period and age ≥ 18 years at index date

Benralizumab

- Primary drug exposure identified in the SNDS database using its ATC and / or CIP codes

ATC = Anatomical Therapeutic Chemical ; CIP = presentation identifier code

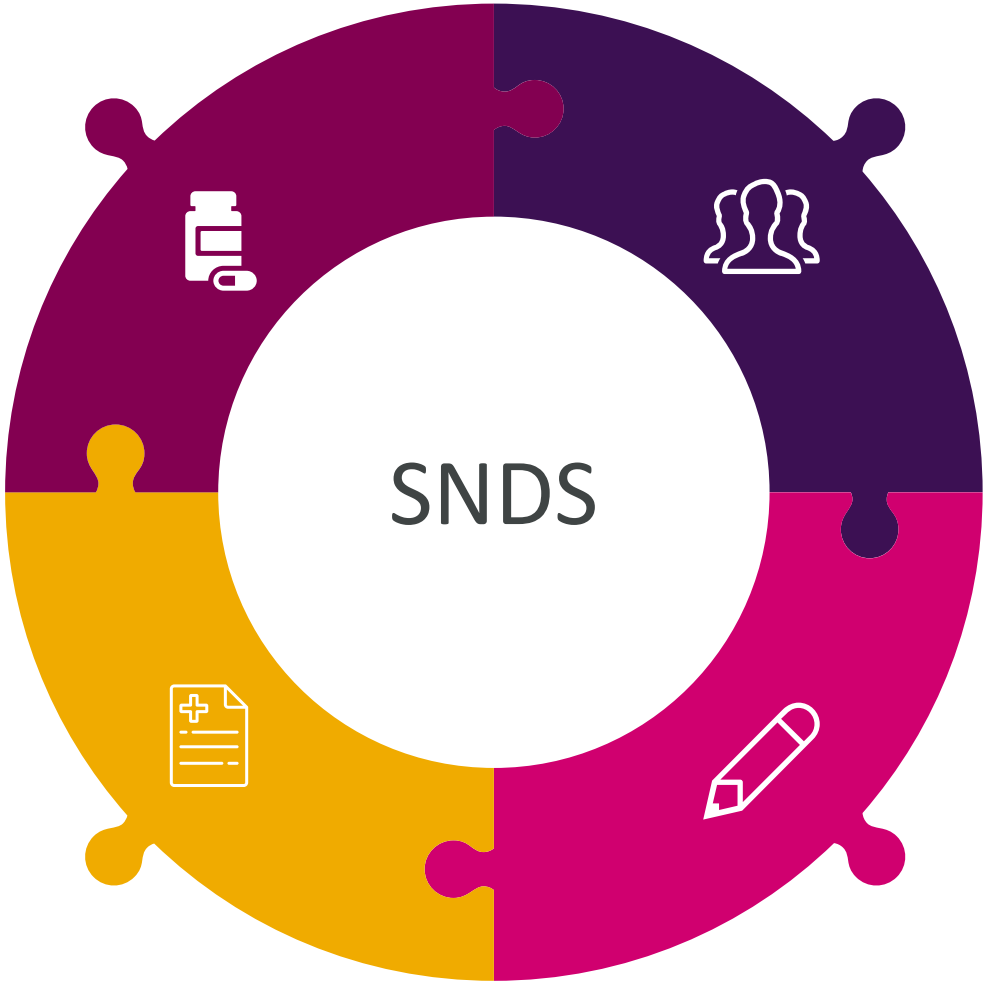
Data Source: French National claims database

Healthcare consumption

Reimbursement information: medical procedures, visits and consultations, biological act, drugs

Healthcare services

Practitioner information and location



Patient characteristics and medical information

Gender / Date of birth / Date of death / City and department of residence
Long-term medical condition

Hospital care

PMSI: Hospitalizations in public and private hospitals, Duration of stays

Nationally representative database covering complete French population

↳ 66 million of people covered by the SNDS (≈98% of the French population)

GHG emissions evaluation

GHG emission values

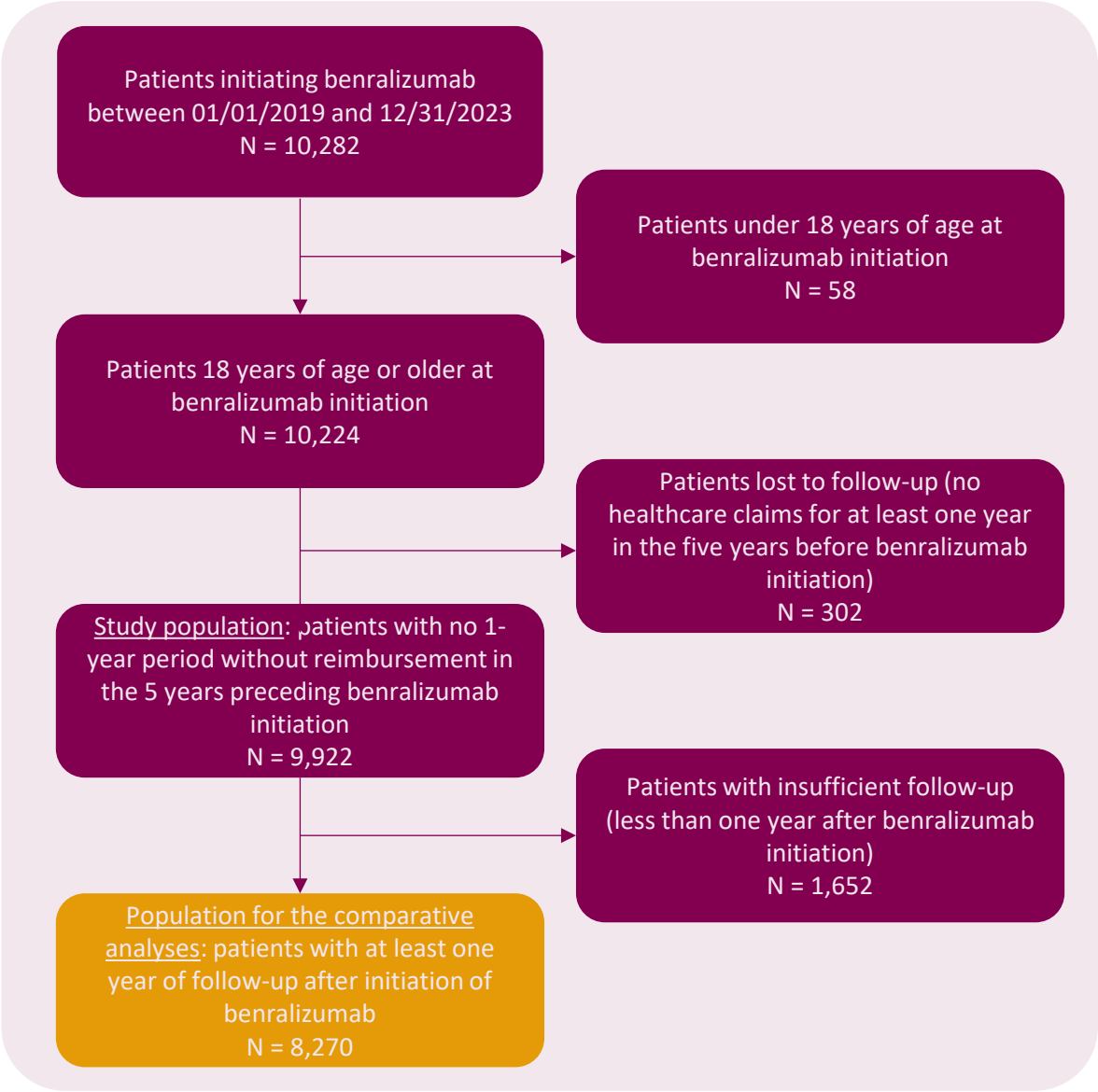
GHG emission values **from the literature** [1-5] were assigned to asthma therapies, consultations, asthma-related hospital stays according to duration, emergency room visits, medical procedures, and biological acts including transport, with priority given first to French data and then to UK data.

Statistical analysis

GHG emissions associated with asthma management was compared using a **Wilcoxon test** over the pre- and post-initiation periods.

1. Alzaabi A, et al. Greenhouse Gas Emissions from Respiratory Treatments: Results from the SABA CARBON International Study. Advances in therapy. 2023;40(11):4836-56.
2. Sustainable Healthcare Coalition. [Available from: https://shcoalition.org/carbon-factors-table/#dipipopup-11338859.
3. de Maisoncelle I. Guide méthodologique – Carebone : calcul de l'empreinte carbone d'un parcours patient. APHP; 2024.
4. Kponee-Shovein K, et al. Carbon footprint and associated costs of asthma exacerbation care among UK adults. Journal of medical economics. 2022;25(1):524-31.
5. NHS Business Services Authority. National medicines optimisation opportunities [Available from: https://www.nhsbsa.nhs.uk/access-our-data-products/epact2/dashboards-and-specifications/national-medicines-optimisation-opportunities].

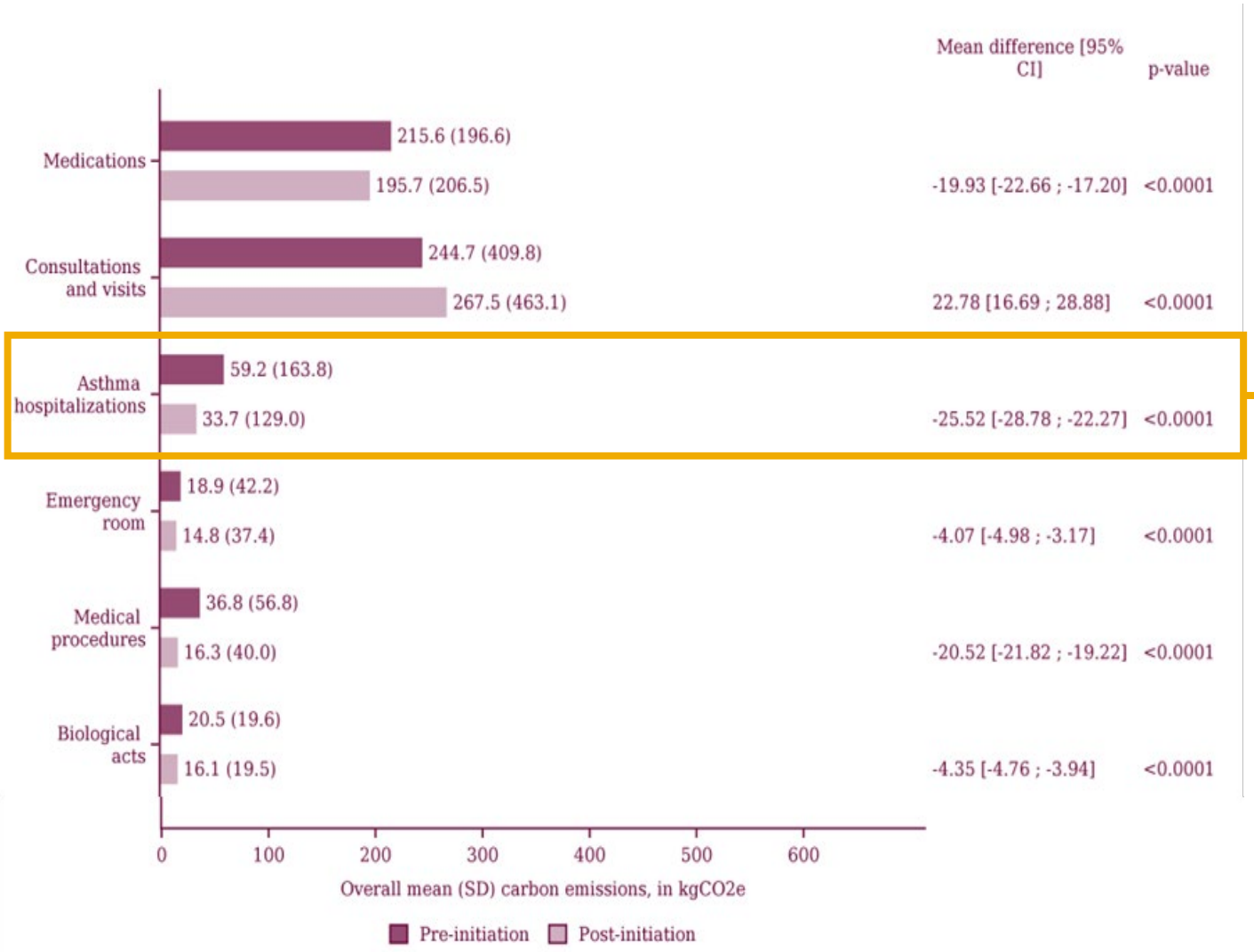
Results – Flow chart and characteristics



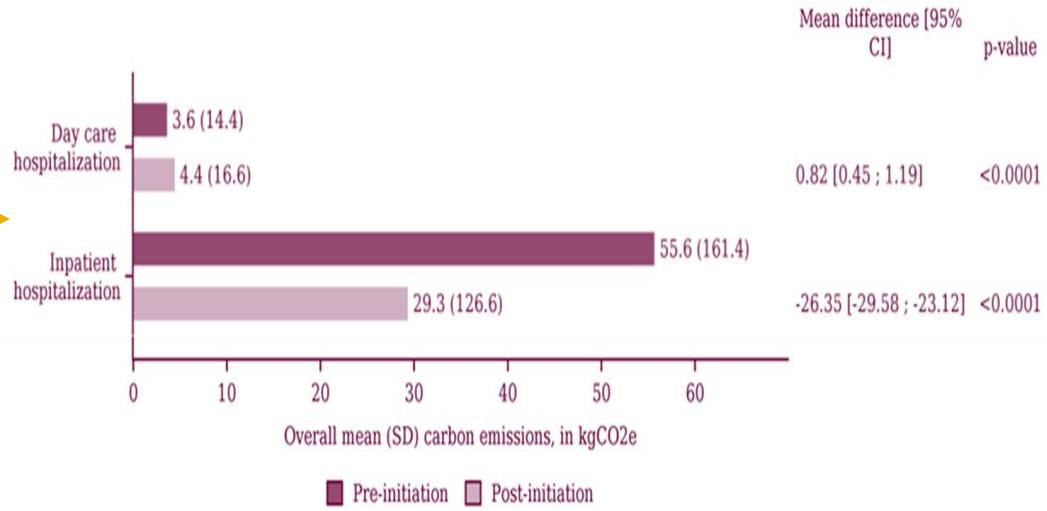
	Patients with at least 12 months of follow-up after benralizumab initiation (N = 8,270)
Male, n(%)	3,390 (41.0%)
Mean (SD) age at initiation (yr)	58.7 (15.2)
Discontinuation, n(%)	1651 (19,9%)
Asthma history in the 5 years before benralizumab initiation, n(%)	8,172 (98.8%)
LTD status of asthma	5,599 (67.7%)
Asthma related hospitalization	3,103 (37.5%)
Asthma controller therapy	8,139 (98.4%)
Comorbidities identified in the 5 years prior to initiation, n(%)	
Cardiovascular diseases	2,861 (34.6%)
Depression	2,689 (32.5%)
Diabetes	1,213 (14.7%)
Obesity	1,267 (15.3%)
Ophthalmologic comorbidities	1,558 (18.8%)
Osteoporosis / Osteopenia	286 (3.5%)
Pneumonia	1,179 (14.3%)
Sleep apnea	961 (11.6%)

LTD = Long-term Disability

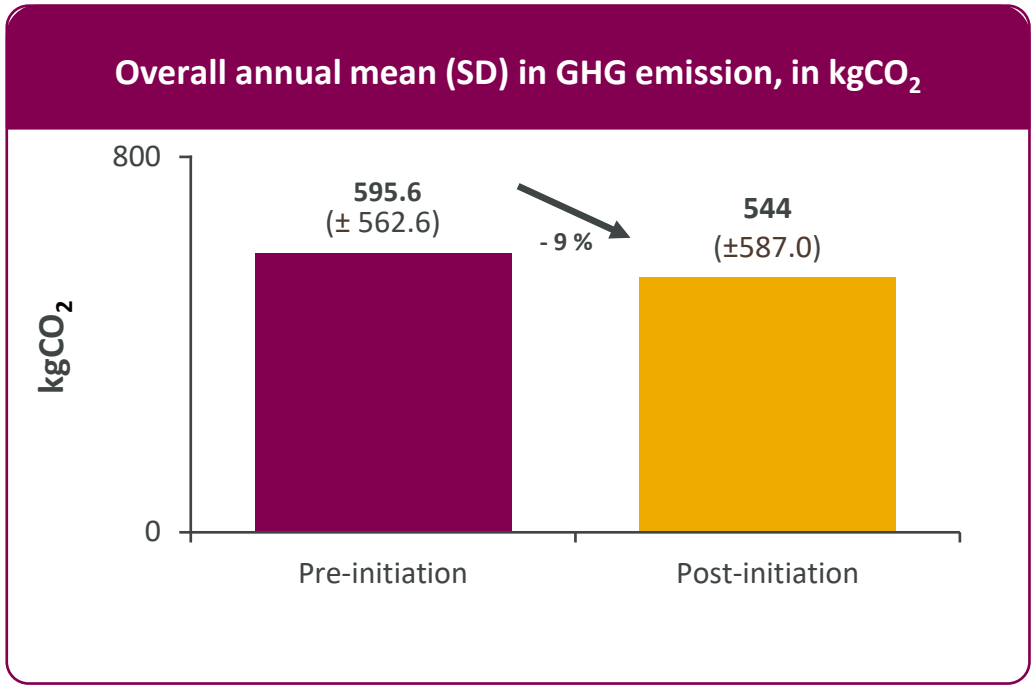
Results – Annual mean difference in GHG emissions



Focus on hospitalizations



Overall annual mean difference in GHG emissions



The annual mean reduction is

51.6 $kgCO_2e$/patient

X 8 270 patients

~427 tons

Of CO_2e / year

3.81 million kilometers driven in a conventional car =

1,700 round trips between Paris and Glasgow[1]

1. ADEME. Car Labelling. 2023 [Available from: https://carlabelling.ademe.fr/chiffrescles]

Conclusion

These findings indicate a notable reduction in the environmental impact of care, highlighting the potential added benefits of asthma-related biological therapies in the management of severe asthma.

In France, benralizumab led to a significant reduction in the GHG emissions associated with severe asthma management within a year of its initiation.

The GHG emissions of the biologic therapies themselves was not assessed, as this information was not available at the time of the study.

Thank you!

Contact information

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Backup slides

GHG emission per MRU product or exacerbation

HCRU	kgCO2e / unit	Assumptions	References
Medications (other than inhalers)			
OCS	5.15		(1)
LTRA	0.35		(1)
Theophylline	6.42		(1)
Consultations and visits			
Teleconsultations	1.14	visit only	(1, 2)
Consultations/visits in person: GP	2.26	1.14 (visit) + 0.56 * 2 (outbound and return journeys)	(1, 2)
Consultations/visits in person: other outpatient visit	6.94	1.14 (visit) + 2.9 * 2 (outbound and return journeys)	(1, 2)
Consultations/visits in person: HP	16.94	1.14 (visit) + 7.9 * 2 (outbound and return journeys)	(1-3)
Hospitalizations			
Day care hospitalizations	20.14	4.34 (visit) + 7.9 * 2 (outbound and return journeys)	(1-3)
Inpatient hospitalizations	number of nights * 12.84 + 42.46 OR number of days * 12.84 + 29.62	12.61 / hospitalization day 0.23 / hospitalization night (50% * 36 + 50% * 7.9) (outbound journey) + 7.9 (return journey) = 29.85	(1-3)
Emergency room visit without subsequent hospital admission	39.4	13.77 (visit) + ((35% * 36 + 65% * 7.9) (outbound journey) + 7.9 (return journey) = 25.64)	(1, 2)
Medical procedures			
CCAM: Chest CT Scan	25	9.2 (procedure) + 7.9 * 2 (outbound and return journeys)	(1, 2)
CCAM: Chest X-ray	16.6	0.8 (procedure) + 7.9 * 2 (outbound and return journeys)	(1, 2)
Biological acts	5.99	0.19 (acte) + 2.9 * 2 (outbound and return journeys)	(1, 3)

1. Alzaabi A, Bell JP, Montero-Arias F, Price DB, Jackson DJ, Wang HC, et al. Greenhouse Gas Emissions from Respiratory Treatments: Results from the SABA CARBON International Study. Advances in therapy. 2023;40(11):4836-56.
2. Sustainable Healthcare Coalition. [Available from: https://shcoalition.org/carbon-factors-table/#dipipopup-11338859.
3. de Maisoncelle I. Guide méthodologique – Carebone : calcul de l'empreinte carbone d'un parcours patient. APHP; 2024.

GHG emission per inhalers

Product				GHG emission (kgCO2e) / product	Reference
Drug	Drug class	ATC class	Device		
Beclomethasone dipropionate	ICS	R03BA01	DPI	0.60	(1)
Beclomethasone dipropionate	ICS	R03BA01	pMDI	16.00	(1)
Budesonide	ICS	R03BA02	pMDI	26.88	(1)
Budesonide	ICS	R03BA02	DPI	0.98	(1)
Ciclesonide	ICS	R03BA08	pMDI	10.50	(1)
Fluticasone propionate	ICS	R03BA05	DPI	0.70	(1)
Fluticasone propionate	ICS	R03BA05	pMDI	18.60	(1)
Mometasone furoate	ICS	R03BA07	DPI	0.60	(1)
Mometasone furoate	ICS	R03BA07	pMDI	47.90	(1)
Beclomethasone dipropionate/formoterol fumarate dihydrate	ICS/LABA	R03AK08	DPI	0.70	(1)
Beclomethasone dipropionate/formoterol fumarate dihydrate	ICS/LABA	R03AK08	pMDI	13.65	(1)
Budesonide/formoterol fumarate dihydrate	ICS/LABA	R03AK07	DPI	0.65	(1)
Budesonide/formoterol fumarate dihydrate	ICS/LABA	R03AK07	pMDI	29.85	(1)
Fluticasone propionate/salmeterol xinafoate	ICS/LABA	R03AK06	DPI	0.90	(1)
Fluticasone propionate/salmeterol xinafoate	ICS/LABA	R03AK06	pMDI	18.70	(1)
Fluticasone furoate/Vilanterol	ICS/LABA	R03AK10	DPI	0.84	(1)
Fluticasone propionate/Formoterol fumarate dihydrate	ICS/LABA	R03AK11	pMDI	27.66	(1)
Fluticasone furoate/vilanterol trifenatate/umeclidinium bromide	ICS/LABA/LAMA	R03AL08	DPI	0.80	(1)
Formoterol fumarate dihydrate	LABA	R03AC13	DPI	0.55	(1)
Formoterol fumarate dihydrate	LABA	R03AC13	pMDI	12.00	(1)
Salmeterol xinafoate	LABA	R03AC12	DPI	0.75	(1)
Salmeterol xinafoate	LABA	R03AC12	pMDI	19.75	(1)
Indacaterol maleate	LABA	R03AC18	DPI	0.78	(1)
Olodaterol hydrochloride	LABA	R03AC19	pMDI	16.30	(1)
Indacaterol maleate/glycopyrronium bromide	LABA/LAMA	R03AL04	DPI	0.60	(1)
Olodaterol hydrochloride/tiotropium bromide	LABA/LAMA	R03AL06	pMDI	16.30	(1)
Vilanterol trifenatate/umeclidinium bromide	LABA/LAMA	R03AL03	DPI	0.85	(1)
Glycopyrronium bromide	LAMA	R03BB06	DPI	0.75	(1)
Umeclidinium bromide	LAMA	R03BB07	DPI	0.80	(1)
Tiotropium bromide	LAMA	R03BB04	pMDI	16.33	(1)
Tiotropium bromide	LAMA	R03BB04	DPI	0.76	(1)
Salbutamol sulphate	SABA	R03AC02	DPI	0.70	(1)
Salbutamol sulphate	SABA	R03AC02	pMDI	18.45	(1)
Terbutaline sulphate	SABA	R03AC03	pMDI	37.00	(1)
Terbutaline sulphate	SABA	R03AC03	DPI	0.60	(1)
Ipratropium bromide	SAMA	R03BB01	pMDI	17.00	(1)
Salbutamol sulphate	SABA	R03AC04	pMDI	17.34	(2)
Formoterol	LABA	R03AK14	DPI	0.40	(2)
Budesonide/Formoterol	ICS/LABA	R03AL09	pMDI	17.34 or 14.20	(2)
Fluticasone Propionate / Salmeterol	ICS/LABA	R03AL11	pMDI	13.50	(2)
Budesonide / Formoterol	ICS/LABA	R03AL12	DPI	0.44	(2)

* French data, other are UK Data

1. Alzaabi A, Bell JP, Montero-Arias F, Price DB, Jackson DJ, Wang HC, et al. Greenhouse Gas Emissions from Respiratory Treatments: Results from the SABA CARBON International Study. Advances in therapy. 2023;40(11):4836-56.

2. NHS Business Services Authority. National medicines optimisation opportunities [Available from: https://www.nhsbsa.nhs.uk/access-our-data-products/epact2/dashboards-and-specifications/national-medicines-optimisation-opportunities].