

# Le fardeau de l'asthme

Bibliographie thématique

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## En guise d'introduction

L'asthme est une maladie non transmissible de première importance qui touche les enfants et les adultes. L'inflammation et le rétrécissement des voies respiratoires fines dans les poumons sont à l'origine des symptômes de l'asthme qui peuvent prendre la forme d'une toux, d'un sifflement, d'un essoufflement, d'une gêne respiratoire ou d'une association de plusieurs de ces symptômes. En 2019, on estimait à 262 millions le nombre de personnes qui souffraient d'asthme et que cette maladie avait entraîné 461 000 décès<sup>1</sup>. Grâce à des médicaments par inhalation, les symptômes de l'asthme peuvent être maîtrisés et les personnes souffrant de cette maladie peuvent avoir une vie normale. Il est également possible de réduire les symptômes de l'asthme en évitant ce qui les déclenche. La plupart des décès liés à l'asthme surviennent dans les pays à revenu faible ou intermédiaire où le sous-diagnostic et l'insuffisance des traitements restent problématiques.

Depuis trente ans, de nombreuses études ont montré une très forte augmentation de l'asthme dans tous les pays industrialisés, particulièrement chez les sujets jeunes. Cette fréquence croissante s'inscrit dans une progression globale de la prévalence des maladies allergiques (rhinite allergique, dermatite atopique et allergies alimentaires), les différentes maladies atopiques étant interdépendantes. Les résultats de l'Enquête européenne sur la santé respiratoire ([European Community Respiratory Health Survey \[ECRHS\]](#)) montrent ainsi que le risque d'asthme est 6 fois plus élevé en cas de rhinite allergique. De même, l'existence d'une dermatite atopique précoce associée à des sensibilisations alimentaires multiples est un facteur de risque de sa persistance à l'âge adulte et d'apparition d'un asthme. Globalement, on estime qu'environ la moitié de la population mondiale souffrira d'une forme d'allergie d'ici à 2050.

De nombreux facteurs différents sont associés à un risque accru d'asthme, mais il est souvent difficile de trouver une cause directe et unique :

- La probabilité de souffrir d'asthme est plus élevée si d'autres membres de la famille sont atteints de cette maladie, notamment des membres de la famille proche comme un parent, un frère ou une sœur.
- L'asthme est plus fréquent chez les personnes présentant d'autres manifestations allergiques telles que l'eczéma et la rhinite (rhume des foies).
- L'urbanisation est associée à une augmentation de la prévalence de l'asthme, probablement en raison de plusieurs facteurs liés au mode de vie.
- Certains événements qui se produisent au début de la vie entraînent des conséquences sur les poumons en développement et peuvent augmenter le risque d'asthme. C'est le cas notamment d'un faible poids de naissance, de la prématurité, de l'exposition à la fumée du tabac et à d'autres sources de pollution de l'air ainsi que des infections respiratoires virales.
- On pense également que l'exposition à différents allergènes et produits irritants de l'environnement augmente le risque d'asthme, notamment l'exposition à la pollution de l'air intérieur et extérieur, aux acariens, aux moisissures ainsi que l'exposition à des produits chimiques, à des fumées ou à la poussière sur le lieu de travail.
- Les enfants et les adultes en surpoids ou obèses sont plus exposés au risque d'asthme.

En France, la maladie touche plus de 4 millions de personnes<sup>2</sup>. Ses premières manifestations surviennent le plus souvent pendant l'enfance. Depuis 2012 une enquête nationale<sup>3</sup> est effectuée tous les deux ans en milieu scolaire, alternativement en CM2, troisième et maternelle. Elle indique une prévalence de la maladie allant de 10 à 16% selon les classes. La prévalence diminue ensuite chez l'adulte, étant estimée à 6,7%. La maladie peut être grave quand elle n'est pas prise en charge correctement ou lorsqu'elle échappe au contrôle des traitements. L'asthme sévère est directement associé à plus de 60 000 hospitalisations et à près de 900 décès par an. En outre, la maladie altère considérablement la qualité de vie. Elle entraîne des insomnies, une baisse d'activité et un absentéisme à l'école ou au travail. Le coût social de cette maladie est important car elle est responsable de 7 millions de journées d'arrêt de travail par an.

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<sup>1</sup> Global burden of 369 diseases and injuries in 204 countries and territories, 1990-2019: a systematic analysis for the Global Burden of Disease Study 2019. *Lancet*. 2020;396(10258):1204-22.

<sup>2</sup> [Site de Santé publique France](#)

<sup>3</sup> Delmas, M. C., Guignon, N., Leynaert, B., et al. (2014). "Évolution de la prévalence de l'asthme chez l'enfant en France : enquêtes nationales de santé en milieu scolaire 2003-2008." *Bulletin Épidémiologique Hebdomadaire*(20): 360-365.

Pôle documentation de l'Irdes - Marie-Odile Safon

Réalisée dans le cadre du projet Ecenvir<sup>45</sup>, cette bibliographie s'intéresse plus particulièrement aux aspects épidémiologiques et économiques de l'asthme ainsi qu'aux interventions réalisées par des professionnels (Conseillers d'environnement intérieur en France, community health worker, home based environmental interventions dans les pays anglo-saxons) -au domicile des patients. Elle a été réalisée à partir de l'interrogation des bases et portails suivants : Pubmed, Econlit, Science direct, Web of science, Cairn, bases documentaires de l'Irdes, de l'Ehesp et de Santé publique France. Elle porte sur la période 2000-2022/06.

## Epidémiologie

### ÉTUDES FRANÇAISES

Al-ani, S., Spigt, M., Hofset, P., et al. (2013). "Predictors of exacerbations of asthma and COPD during one year in primary care." *Fam Pract* **30**(6): 621-628.  
<https://www.ncbi.nlm.nih.gov/pubmed/24115012>

AIMS: To investigate the incidence of asthma and chronic obstructive pulmonary disease (COPD) exacerbations in primary care during one year and to identify risk factors for such events. METHODS: The study was carried out at seven general practice offices in Norway. Patients aged 40 years or more registered with a diagnosis of asthma and/or COPD the previous 5 years were included. After a baseline examination, the participants consulted their GP during exacerbations for the following 12 months. A questionnaire on exacerbations during the follow-up year was distributed to all. Univariable and multivariable logistic regression was performed to determine predictors of future exacerbations. RESULTS: Three hundred and eighty patients attended the baseline examination and complete follow-up data were retrieved from 340 patients. COPD as defined by forced expiratory volume in the first second of expiration/forced vital capacity (FEV1/FVC) < 0.7, was found in 132 (38.8%) patients. One hundred and fifty-nine patients (46.8%) experienced one exacerbation or more and 101 (29.7%) two exacerbations or more. Patients who had an exacerbation treated with antibiotics or systemic corticosteroids or leading to hospitalization the year before baseline (N = 88) had the highest risk of getting an exacerbation during the subsequent year (odds ratio 9.2), whether the FEV1/FVC was below 0.7 or not. Increased risk of future exacerbations was also related to age  $\geq$  65 years and limitations in social activities, but not to the FEV1. CONCLUSIONS: The study confirms that previous exacerbations strongly predict future exacerbations in patients with COPD or asthma. Identification and a closer follow-up of patients at risk of such events could promote earlier treatment when necessary and prevent a rapid deterioration of their condition.

Annesi-Maesano, I. (2011). "[Epidemiology of asthma in the world and in France]." *J Asthma* **61**(3): 329-335.

Multicentre studies conducted in large general populations indicate that asthma is a disease extremely prevalent with up to 1 out of 10 adults and 1 out of 3 children who suffer from asthma worldwide. In spite of that, the control of asthma remains poorly documented in the general population. The prevalence of asthma is experiencing significant spatio-temporal variations that depend on exposure to environmental factors such as allergens (because of new conditions of exposure), parental smoking, air pollution and excess of hygiene. The latest data on temporal trends in the prevalence of asthma are in favour of stagnation or decrease of the number of asthmatics in high-income countries due to the cessation of environmental influences. Recently, several arguments are in favour of the involvement of host susceptibility in the development and worsening of asthma, which could contribute to explain temporal trends in asthma prevalence. Gene-environment interactions starting in early life using the epigenetic approach should be explored to better understand asthma epidemiological evolution.

<sup>4</sup> Gangneux, J. P., Morel, B., Blans, F. X., et al. (2022). Evaluation multicentrique et randomisée de l'impact des conseillers en environnement intérieur sur le contrôle de l'asthme: l'étude Ecenvir : poster. Rennes : CHU.

<sup>5</sup> Ecenvir. Programme de recherche de l'Irdes 2021-203. [Site de l'Irdes](http://www.irdes.fr)

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[www.irdes.fr/documentation/syntheses/le-fardeau-de-l-asthme.epub](http://www.irdes.fr/documentation/syntheses/le-fardeau-de-l-asthme.epub)

Bocquier, A., El-Haik, Y., Jardin, M., et al. (2015). "[Relevance of the health insurance databases to study spatial disparities in asthma prevalence: A study in southeastern France]." *Rev Epidemiol Sante Publique* **63**(3): 155-162.

<http://www.sciencedirect.com/science/article/pii/S0398762015002904>

**BACKGROUND:** Data on asthma prevalence at a small-area level would be useful to set up and monitor French local public health policies. This study, based on drug reimbursement databases in southeastern France, aimed to (1) compare asthma-like disorders prevalence estimated by using three different indicators; (2) study sociodemographic characteristics associated with these indicators; (3) verify whether these indicators are equivalent to study geographical disparities of the asthma-like disorders prevalence at a small-area level. **METHODS:** The study was conducted among the beneficiaries of the National Health Insurance Fund aged 18-44 years residing in southeastern France in 2010 (n=1,371,816). Using data on asthma drugs reimbursements (therapeutic class R03), we built three indicators to assess asthma-like disorders prevalence: at least 1, 2 or 3 purchase(s) in 2010. We analyzed sociodemographic characteristics associated with these indicators, and their geographical disparities at a small-area level using multilevel logistic regression models. **RESULTS:** The crude asthma-like disorders prevalence varied between 2.6 % and 8.4 % depending on the indicator. It increased with age, was higher for women than for men, and among low-income people for all three indicators. We measured significant geographical disparities. Areas with high prevalence rates were the same regardless of the indicator. **CONCLUSION:** The indicators built in this study can be useful to identify high prevalence areas. They could contribute to launch discussion on environmental health issues at the local level.

Bourdin, A., Fabry-Vendrand, C., Ostinelli, J., et al. (2019). "The Burden of Severe Asthma in France: A Case-Control Study Using a Medical Claims Database." *J Allergy Clin Immunol Pract* **7**(5): 1477-1487.

**BACKGROUND:** Severe asthma (SA) is defined by treatment intensity. The availability of national databases allows accurate estimation of the prevalence, long-term outcomes, and costs of SA. **OBJECTIVE:** To provide accurate information on SA, focusing on comorbidities, mortality, health care resource consumption, and associated costs. **METHODS:** A cohort of patients with SA identified in 2012 was extracted from a French representative claims database and followed for 3 years. Their characteristics, comorbidities, mortality, and direct costs were compared with a matched control group without asthma. **RESULTS:** A total of 690 patients with SA were matched to 2070 patients without asthma (mean age, 61 years; 65.7% women). The prevalence of SA was estimated to be 0.18% to 0.51% of the French adult population. Comorbidities were more frequent in patients with SA (73.9% suffered from cardiovascular disease vs 54.3% in controls;  $P < .001$ ). A total of 58.7% of patients with SA used oral corticosteroids (OCS) in 2012 with a mean intake of 3.3 boxes/year/patient and 9% received  $\geq 6$  dispensings of OCS. A total of 6.7% were treated by omalizumab. Patients with SA were more frequently hospitalized (33.2% vs 19.7%;  $P < .001$ ), more frequently consulted a general practitioner (97.8% vs 83.9%;  $P < .001$ ) ( $9.8 \pm 6.8$  vs  $6.2 \pm 5.3$  consultations/year;  $P < .001$ ), and 31% have consulted a private respiratory physician. Compared with controls, 3-year cumulative mortality was higher in SA (7.1% vs 4.5%;  $P = .007$ ). Direct medical cost was \$9227 versus \$3950 ( $P < .001$ ) mostly driven by medication costs. **CONCLUSIONS:** The prevalence of SA in the French adult population is at least 18 of 10,000. Burden of disease is high with respect to comorbidities, mortality, and asthma-related health care resource use.

Delmas, M. C., Bénézet, L., Ribet, C., et al. (2021). "Prévalence de l'asthme chez l'adulte en France, données de la cohorte Constances." *Rev Mal Respir* **38**(8): 797-806.

Introduction : nos objectifs étaient d'estimer la prévalence de l'asthme chez l'adulte en France et d'étudier les effets du sexe dans les associations entre d'une part, l'asthme et d'autre part, la corpulence et le statut socio-économique des individus. Méthodes : nous avons estimé la prévalence de l'asthme actuel (crise d'asthme dans les 12 derniers mois ou traitement actuel pour asthme) à partir des données d'inclusion dans la cohorte Constances en 2013-2014. Les analyses ont été

effectuées séparément chez les hommes et chez les femmes, à l'aide de régression de Poisson à variance robuste pour l'analyse multivariée. Résultats : à partir des données de 34 100 participants de la cohorte (hommes : 47,7 % ; âge moyen : 44,6 ans), la prévalence de l'asthme actuel a été estimée à 5,8 % (hommes : 5,1 % ; femmes : 6,4 %). Le risque d'asthme était augmenté chez les femmes ayant un indice de masse corporelle (IMC) ou un tour de taille élevés. Chez les hommes, seul un tour de taille élevé était associé à un risque accru d'asthme. Une association avec un faible niveau socio-économique était observée uniquement chez les femmes. Conclusion : les associations entre, d'une part, l'asthme et, d'autre part, l'obésité et le statut socio-économique différaient selon le sexe. Des analyses complémentaires des données de la cohorte devraient permettre de mieux en comprendre les différents mécanismes.

Delmas, M. C. et Fuhrman, C. (2010). "[Asthma in France: a review of descriptive epidemiological data]." Rev Mal Respir **27**(2): 151-159.

This article presents a review of the most recent data on descriptive epidemiology of asthma in France. The latest national surveys show a cumulative prevalence of asthma of more than 10% in children aged 10 years or more and a prevalence of current asthma from 6 to 7% in adults. In 2006, 1038 deaths from asthma were registered (64 deaths among people aged less than 45 years). After the peak observed in the 1980s, mortality from asthma has decreased. The decrease is also observed among children and young adults. According to data from the French discharge database (PMSI), there were 54 130 admissions for asthma (asthma as the principal diagnosis) in 2007. Between 1998 and 2007, the annual rate of admission for asthma decreased. However, no decreasing trend was observed in children and, in adults, admission rates seem to have been stable since 2004. The increase in the rate of admission for acute respiratory failure (ARF) associated with asthma (ARF as the principal diagnosis and asthma as an associated diagnosis) does not compensate for the decrease in the admission rate for asthma that was observed in adults. Data on emergency department visits show evidence of strong seasonal variations in asthma exacerbations.

Delmas, M. C. et Fuhrman, C. (2012). Corrélations entre asthme déclaré et remboursements de médicaments dans l'enquête ESPS 2006. Peut-on proposer des indicateurs de suivi de la prise en charge de l'asthme basés sur les remboursements de médicaments ? Saint-Maurice, Institut de veille sanitaire : 46 p.

De nombreuses études montrent que la prise en charge de l'asthme est insuffisante. Les données de remboursement de l'assurance maladie pourraient s'avérer intéressantes dans la surveillance de l'asthme. Cependant, contrairement aux données disponibles dans d'autres pays, les diagnostics portés lors des consultations de ville ne sont pas mentionnés. À partir des données l'enquête santé et protection sociale (ESPS) 2006, la qualité d'indicateurs basés sur les remboursements de médicaments a été étudiée afin de proposer des indicateurs de surveillance de la prise en charge de l'asthme. L'enquête ESPS est conduite tous les deux ans auprès d'un échantillon de ménages dont l'un des membres est assuré social. Un appariement avec les données de l'assurance maladie de l'année en cours permet de récupérer les consommations médicales. En 2006, l'auto-questionnaire sur la santé a inclus un module sur l'asthme et un appariement complémentaire avec les données de remboursement de 2004 et 2005 a été effectué pour les personnes enquêtées affiliées au régime général. La validité de différents algorithmes basés sur les remboursements de médicaments pour identifier les asthmes (ou les asthmes persistants) a été étudiée en calculant la sensibilité, la spécificité et les valeurs prédictives positive (VPP) et négative (VPN) au regard des données déclarées par les personnes enquêtées. Les corrélations entre les remboursements de bronchodilatateurs de courte durée d'action (BDCD) inhalés et le contrôle de l'asthme ont également été étudiées. Il est difficile de définir un indicateur basé sur les consommations médicamenteuses qui ait à la fois une bonne VPP et une bonne sensibilité vis-à-vis de l'asthme persistant et, en conséquence, de proposer des indicateurs de surveillance de la qualité de la prise en charge des asthmes persistants. Il est donc proposé de suivre, à partir de l'échantillon généraliste de bénéficiaires (EGB) de l'assurance maladie, deux populations qui correspondent à deux situations de non-contrôle de l'asthme : - les forts consommateurs de BDCD et forts consommateurs de corticoïdes inhalés (CI) (asthmes difficiles à

traiter) ; - les forts consommateurs de BDCD et non, ou faibles, consommateurs de CI (asthmes insuffisamment traités). (R.A.)

Delmas, M. C., Guignon, N., Leynaert, B., et al. (2012). "Prévalence et contrôle de l'asthme chez le jeune enfant en France." *Revue Des Maladies Respiratoires* 29(5): 688-696.  
<http://www.em-consulte.com/article/727769/article/prevalence-et-controle-de-lasthme-chez-le-jeune-en>

Peu de données sont disponibles sur les disparités régionales de la prévalence de l'asthme en France. Cette enquête a été effectuée au cours de l'année scolaire 2005-2006 auprès d'un échantillon tiré au sort de plus de 20 000 enfants de grande section de maternelle. La prévalence cumulée de l'asthme et les prévalences des symptômes évocateurs d'asthme et du traitement pour crise de sifflements ou d'asthme dans les 12 derniers mois ont été estimées pour la France entière et pour chaque région. Pour l'ensemble de la France, la prévalence cumulée de l'asthme était de 9,8 % et la prévalence des sifflements dans l'année écoulée de 10,7 %. Selon la région, on observait un gradient croissant d'Est en Ouest et des prévalences élevées dans les départements d'outre-mer. Ces variations selon la région persistaient après ajustement sur le sexe de l'enfant, la structure de la famille et la taille de la fratrie. Parmi les enfants qui avaient eu des sifflements ou un traitement dans l'année écoulée, 42 % avaient eu des symptômes fréquents ou sévères.

Delmas, M. C., Guignon, N., Leynaert, B., et al. (2014). "Évolution de la prévalence de l'asthme chez l'enfant en France : enquêtes nationales de santé en milieu scolaire 2003-2008." *Bull Epidemiol Hebd*(20): 360-365.

Contexte : les données sur les tendances de la prévalence de l'asthme chez l'enfant en France sont rares. Méthodes : les enquêtes nationales de santé en milieu scolaire sont effectuées sur des échantillons d'élèves tirés au sort, alternativement en grande section de maternelle, cours moyen 2e année (CM2) et troisième. La prévalence cumulée de l'asthme et les prévalences des symptômes d'asthme au cours des 12 derniers mois ont été estimées à partir des données des enquêtes effectuées en classe de CM2 en 2007-2008 et en troisième en 2008-2009. Elles ont été comparées aux prévalences estimées lors des précédentes enquêtes (CM2 en 2004-2005 et troisième en 2003-2004). Résultats : la prévalence cumulée de l'asthme était de 14% en CM2 et de 16% en troisième. Dans chaque niveau scolaire, la prévalence des sifflements dans l'année écoulée était de 10%. Par rapport aux précédentes enquêtes, on observait une augmentation de la prévalence cumulée de l'asthme et de la prévalence au cours de l'année écoulée de certains symptômes d'asthme. En revanche, la proportion d'élèves asthmatiques ayant eu des symptômes fréquents ou graves dans l'année écoulée était restée stable quel que soit le niveau scolaire. Conclusion : les tendances observées devront être confirmées par les données des enquêtes à venir. Les données disponibles à ce jour ne montrent pas d'amélioration du contrôle de l'asthme chez l'enfant. (R.A.)

Delmas, M. C., Guignon, N., Leynaert, B., et al. (2017). "[Increase in asthma prevalence among young children in France]." *Rev Mal Respir* 34(5): 525-534.

INTRODUCTION: Few data on change over time of asthma prevalence in French children are available. METHODS: Data from the 2012-2013 national health survey of schoolchildren conducted in a random sample of almost 20,000 children in the last year of nursery school were compared to those which had been collected in 2005-2006 in the same grade level using the same methodology. RESULTS: In the 2012-2013 survey, children had a lifetime prevalence of asthma of 11.0% with 11.8% reporting wheezing in the preceding year. Asthma was more frequent and more often uncontrolled in children from families with low socioeconomic status. Compared to the survey conducted in the same grade level in 2005-2006, the prevalence ratios adjusted for children's gender and obesity, family structure, parental unemployment and region were 1.13 [1.05-1.21] for lifetime asthma and 1.12 [1.05-1.17] for past-year wheezing. CONCLUSION: In France, the prevalence of asthma in young children increased between 2005 and 2012. The socioeconomic status of children's parents affects both asthma prevalence and control.

Delmas, M. C., Marguet, C., Raheison, C., et al. (2011). "Readmissions for asthma in France in 2002-2005." Rev Mal Respir **28**(9): e115-122.

**INTRODUCTION:** Most admissions for asthma are preventable. The objective of this study was to describe readmissions for asthma. **METHODS:** We used the nationwide hospital database to identify readmissions for asthma in patients aged two to 44 years recorded in metropolitan France between 2002 and 2005. We selected patients having a main diagnosis of asthma or asthma-related acute respiratory failure. Readmission rates at seven days and one year were estimated using the Kaplan-Meier method. **RESULTS:** The 1-year readmission rate was 15.0% and varied with age (being higher in patients aged two to four years and 35-44 years) and sex (being higher in females aged ten to 34 years). The 1-year readmission rate increased with index stay length. The 7-day readmission rate was 1.1% and was higher in patients with shorter index hospital stays. **CONCLUSION:** The rate of readmission of asthma patients is a relevant indicator for monitoring asthma and, more specifically, the clinical management of the disease. In the future, the accumulation of data from consecutive years and the linkage of admission data to asthma medication claims data can be expected to improve our understanding of severe asthma in France.

Delmas, M. C., Marguet, C., Raheison, C., et al. (2013). "Les hospitalisations pour asthme chez l'enfant en France, 2002 2010." Arch Pediatr **20**(7): 739-747.

**Introduction.** Les hospitalisations pour asthme sont considérées comme en grande partie évitables grâce à une prise en charge adaptée. L'objectif de cette étude était de décrire, à partir de la base nationale du programme de médicalisation des systèmes d'information (PMSI), les hospitalisations pour asthme de l'enfant. **Méthodes.** Les séjours survenus entre 2002 et 2010 chez des enfants (âge < 15 ans) résidant en France (Guyane exclue) et ayant un diagnostic principal d'asthme ou d'asthme aigu grave, ou d'insuffisance respiratoire aiguë (IRA) avec en diagnostic associé un code d'asthme ou d'asthme aigu grave ont été sélectionnés. **Résultats.** En 2010, 35 004 séjours pour asthme et 1381 séjours pour IRA associée à un asthme ont été enregistrés (taux d'hospitalisation : 30,1/10 000 enfants) ; la durée moyenne des séjours avait été de 2 j. Le taux de létalité intra-hospitalière avait été de 0,01 % à 0,03 % selon l'année. Le taux annuel d'hospitalisation standardisé sur l'âge avait augmenté entre 2002 et 2010 (+2,5 % par an en moyenne en France métropolitaine). En 2010, 11,8 % des enfants hospitalisés pour asthme ou pour IRA associée à un asthme avaient été réadmis pour ces mêmes motifs au moins une fois au cours de la même année, et 1,3 % dans les 7 j. La proportion d'enfants de moins de 5 ans réadmis au cours de la même année calendaire avait augmenté entre 2002 et 2010. **Conclusion.** L'augmentation des taux d'hospitalisation et de réadmission témoigne d'une prise en charge non optimale de l'asthme chez l'enfant en France. (R.A.)

Demoly, P., Godard, P. et Bousquet, J. (2005). "Une synthèse sur l'épidémiologie de l'asthme." Revue Française D'allergologie Et D'immunologie Clinique **45**: 464-475.

Fuhrman, C., Delmas, M. C., Jouglà, E., et al. (2011). "Asthme et BPCO : taux d'hospitalisation et de mortalité dans les départements d'outre-mer et en France métropolitaine, 2005-2007." Bulletin Epidemiologique Hebdomadaire(13-14): 168-172.

[BDSP. Notice produite par InVS nElkR0xk. Diffusion soumise à autorisation]. Objectif - Cet article fournit les taux d'hospitalisation et de mortalité par asthme et BPCO à La Réunion et aux Antilles et les compare à ceux de France métropolitaine. **Méthodes** - L'analyse a concerné les séjours hospitaliers (PMSI) et les décès (CépiDc) survenus en 2005-2007. Les analyses ont été effectuées chez les personnes âgées de 2 ans ou plus, le diagnostic d'asthme étant difficile avant cet âge. **Résultats** - En 2005-2007, les taux d'hospitalisation pour asthme étaient plus élevés dans les DOM qu'en métropole. Les taux les plus élevés étaient observés aux Antilles pour les 2-44 ans et à La Réunion pour les adultes de 45 ans ou plus. Comparativement à la métropole, les taux d'hospitalisations pour BPCO étaient plus élevés à La Réunion et moins élevés aux Antilles. Les données de mortalité étaient concordantes avec les données d'hospitalisation. Toutefois, les faibles effectifs ne permettaient pas d'étudier les disparités régionales de mortalité pour les personnes âgées de moins de 45 ans. **Conclusion** - Les taux



d'hospitalisation par asthme sont élevés dans les départements d'outre-mer, en rapport avec une prévalence plus élevée, mais également un moins bon contrôle de la maladie. Des efforts doivent être entrepris pour améliorer la prise en charge des personnes asthmatiques dans les DOM. (R.A.).

Iwatsubo, Y. et Lauzeille, D. (2012). Surveillance épidémiologique de l'asthme au sein de la population des artisans et commerçants affiliés au Régime social des indépendants (RSI). Synthèse des résultats de l'étude pilote. Saint-Maurice, Institut de veille sanitaire: 6p.

La part attribuable à des facteurs professionnels dans la survenue de l'asthme de l'adulte a été estimée par certains auteurs entre 10 et 20 %. Parmi les populations au travail, la maladie asthmatique chez les artisans et les commerçants n'est pas bien connue en France. Une collaboration a été mise en place entre le Régime social des indépendants (RSI) et l'Institut de veille sanitaire (InVS) pour conduire une surveillance épidémiologique de l'asthme dans cette population. Une étude pilote a été conduite avec pour objectif principal l'utilisation des données de remboursements de médicaments pour repérer les asthmatiques et décrire prévalence et risque selon les secteurs d'activité. Un échantillon d'affiliés du RSI a été tiré au sort dans trois régions en fonction de leur remboursement de médicaments antiasthmatiques. Des modèles prédictifs ont été élaborés avec les variables disponibles dans les bases du RSI (sexe, âge, remboursement de médicaments antiasthmatiques, type de prescripteurs) en prenant comme référence les réponses à un questionnaire standardisé issu d'une enquête européenne. Le modèle sélectionné présente une sensibilité de 80 % et une spécificité de 86 %. Les secteurs d'activité les plus à risque sont la boulangerie-pâtisserie chez les hommes et les secteurs des transports de voyageurs par taxi ou les écoles de conduite chez les femmes. Il est nécessaire de valider ce modèle sur une autre population. Si les étapes de finalisation du modèle s'avèrent concluantes, il sera possible de conduire une surveillance épidémiologique de l'asthme selon l'activité professionnelle à partir de données issues des bases médico-administratives sans interroger les personnes. (R.A.)

Mazalovic, K., Jacoud, F., Dima, A., et al. (2017). "Asthma exacerbations and socio-economic status in French adults with persistent asthma: A prospective cohort study." *Journal of Asthma* **55**: 00-00.

Introduction: Adults disadvantaged by poor socio-economic status (SES) are more severely affected by asthma compared to those with better SES. We aimed to determine whether the frequency of asthma exacerbations (AEx), as well as aspects related to AEx management, differed based on SES in patients treated with daily treatments. Methods: This study, part of the prospective observational cohort ASTRO-LAB, included French adult patients with persistent asthma. Patients were considered as low SES if they benefited from publicly funded special health insurance and/or were perceived as low SES by their general practitioner. AEx was defined as at least one of the following: asthma-related oral corticosteroid course, medical contact, hospitalization, and death. We examined associations between SES and AEx frequency, perceived triggering factors and type of medical contact after AEx. Results: In our sample of 255 patients, 11.40% were considered as low SES. Patients with low SES did not report significantly more AEx than medium/high SES patients during one-year follow-up (0.79 versus 0.55,  $p = 0.38$ ). The type of medical contact during AEx differed significantly between the two groups ( $p = 0.03$ ): patients with medium/high SES consulted their general practitioner more frequently (OR = 2.23, 95% CI = 0.91-5.50,  $p = 0.08$ ) and were less likely to visit an emergency department or be hospitalized (OR = 0.27, 95% CI = 0.09-0.84,  $p = 0.02$ ). Conclusions: AEx frequency did not differ significantly between low and medium/high SES patients, but differences were found in the management of AEx. Studies are needed to better understand the relation between precariousness and management of asthma.

Paris, C., Ngatchou-Wandji, J., Luc, A., et al. (2012). "Work-related asthma in France: recent trends for the period 2001-2009." *Occup Environ Med* **69**(6): 391-397.

OBJECTIVE: Knowledge on the time-course (trends) of work-related asthma (WRA) remains sparse. The aim of this study was to describe WRA trends in terms of industrial activities and the main causal agents in France over the period 2001-2009. METHOD: Data were collected from the French national network of occupational health surveillance and prevention (Réseau National de Vigilance et de

Prévention des Pathologies Professionnelles (RNV3P)). Several statistical models (non-parametric test, zero-inflated negative binomial, logistic regression and time-series models) were used and compared with assess trends. RESULTS: Over the study period, 2914 WRA cases were included in the network. A significant decrease was observed overall and for some agents such as isocyanates ( $p = 0.007$ ), aldehydes ( $p = 0.01$ ) and latex ( $p = 0.01$ ). Conversely, a significant increase was observed for cases related to exposure to quaternary ammonium compounds ( $p = 0.003$ ). The health and social sector demonstrated both a growing number of cases related to the use of quaternary ammonium compounds and a decrease of cases related to aldehyde and latex exposure. CONCLUSIONS: WRA declined in France over the study period. The only significant increase concerned WRA related to exposure to quaternary ammonium compounds. Zero-inflated negative binomial and logistic regression models appear to describe adequately these data.

Provost, D., Delmas, M. C., Chastang, J. F., et al. (2019). "Asthme et itinéraire professionnel à partir des données de l'enquête SIP, 2006 et 2010" *Asthma and career path in the French SIP Survey, 2006 and 2010.* Archives des Maladies Professionnelles et de l'Environnement **80**(4): 241-249.

Objectif : le devenir professionnel des asthmatiques est souvent défavorable avec des conséquences fréquentes de l'asthme sur le statut socioéconomique (diminution de revenus et/ou perte de l'emploi). L'objectif de ce travail était d'étudier l'itinéraire socioprofessionnel des asthmatiques à partir des données de l'enquête Santé et itinéraire professionnel. Méthodes : en 2006, 13 648 individus de 20 à 74 ans vivant en France métropolitaine en ménage ordinaire ont participé à l'enquête. En 2010, ils ont été recontactés et 11 220 individus ont été réinterrogés. La présente analyse a porté sur les 11 068 individus ayant participé aux deux vagues de l'enquête et ayant un itinéraire professionnel. L'asthme aux différents moments de la vie a été repéré par les déclarations des individus. Les antécédents professionnels et médicaux ont été recueillis. Résultats : chez les femmes, après ajustement sur l'âge, la probabilité d'être asthmatique était plus élevée chez celles ayant eu au moins une période de chômage au cours de leur itinéraire professionnel, une durée de périodes de chômage de plus d'un an et une durée d'emploi plus courte, et était plus faible chez celles ayant les revenus les plus élevés. Entre 2006 et 2010, les femmes asthmatiques ont connu plus fréquemment des périodes de chômage et des arrêts maladie que les non-asthmatiques. Aucune différence statistiquement significative n'était observée chez les hommes. Conclusions : ces résultats suggèrent que les femmes asthmatiques comparées au non-asthmatiques, connaissent des parcours professionnels plus instables et ont des revenus inférieurs, ce qui n'est pas observé chez les hommes. Les cohortes Coset et Constances devraient permettre d'étudier plus en détail l'impact de l'asthme sur la carrière professionnelle des travailleurs.

Prudhomme, A., Kouchner, B. p., Bourdillon, F., et al. (2008). Maladies respiratoires, BCPO et asthme. Traité de santé publique, Paris : Médecine Sciences Flammarion: 363-368.

Rajaoarifetra, J. et Charpin, D. (2015). "[Epidemiology of asthma]." Pulm Ther **65**(9): 1189-1197.

Epidemiology of asthma. Asthma related death rate was halved in the last 20 years in France. Asthma prevalence was stable or moderately increasing. Asthma control is still incomplete and hospitalization rates are on the increase in asthmatic children. Risk factors include genetic and environmental components. Recently, epigenetic has shed a bridge between both chapters. Pollen allergens behave as a risk factor for seasonal allergic rhinitis occurrence and worsening. The picture is less clear about asthma. In like manner, the relationship between exposure to indoor allergens and asthma occurrence is subject to debate. Thus primary prevention of allergic diseases through allergen avoidance is questionable. By contrast, indoor allergen exposure is indeed an aggravating factor for rhinitis and asthma but secondary prevention is not easy, probably because air contaminants are many and their concentration linked to building characteristics. Indoor chemical and particulate air pollution is a triggering factor for rhinitis and asthmatic symptoms but studies on this topic are still few. By contrast, passive smoking has a well-known deleterious respiratory impact.

Riviere, S., Delmas, M.-C. et Iwatsubo, Y. (2018). "Asthme et caractéristiques socioprofessionnelles en France en 2012." *Rev Mal Respir* **35**(3): 287-294.

Introduction : l'asthme de l'adulte, dont la prévalence est de 6 à 7 % en France, relève de causes multifactorielles, notamment professionnelles. L'objectif de cette étude était de décrire la prévalence de l'asthme en France selon les caractéristiques socioprofessionnelles à partir de l'enquête santé et protection sociale (ESPS) 2012. Méthodes : cette étude concerne la population des 15 ans et plus. La prévalence de l'asthme actuel, défini par la déclaration d'asthme au cours des 12 derniers mois, a été étudiée selon les variables socioprofessionnelles recueillies dans ESPS. Résultats : sur les 23 047 personnes enquêtées, 12 565 ont été incluses dans cette étude. La prévalence de l'asthme actuel était de 7,4 %. La probabilité de présenter un asthme était plus élevée chez les personnes au chômage ou en inactivité, sans diplôme, aux revenus les plus faibles, ou bénéficiant de la couverture maladie universelle complémentaire. Concernant les professions, chez les hommes, les employés de commerce et de services aux particuliers et les employés administratifs avaient une probabilité plus élevée d'asthme. Conclusions : les constats concernant les inégalités sociales de santé pour l'asthme restent actuels. À l'avenir, les associations entre caractéristiques socioprofessionnelles et asthme devraient pouvoir être étudiées plus précisément grâce aux cohortes en cours de développement en France.

Sanyal, S., Rochereau, T., Maesano, C. N., et al. (2018). "Long-Term Effect of Outdoor Air Pollution on Mortality and Morbidity: A 12-Year Follow-Up Study for Metropolitan France." *International Journal of Environmental Research and Public Health* **15**: 1-8.

<https://www.mdpi.com/1660-4601/15/11/2487>

Short-term effects of air pollution are documented more than long-term effects. We investigated 12-year impacts of ambient air pollutants on cardiovascular and respiratory morbidity and mortality at the departmental level in metropolitan France.

Schuers, M., Chopinaud, P. A., Guihard, H., et al. (2016). "[Prevalence of asthma consultations in general practice]." *Rev Mal Respir* **33**(9): 781-788.

INTRODUCTION: Few data from primary care settings are available about asthma prevalence. The aim of this study was to evaluate the prevalence of asthma consultations in general practice, and to describe their characteristics. METHODS: This was a multicenter, cross-sectional national study, conducted in general practice. Investigators were 54 interns from 27 medical schools. Between December 2011 and April 2012, they collected and entered variables specific to each consultation over a period of 20 days from a structured electronic health record using the International classification of primary care (ICPC-2) together with data about their trainer(s). RESULTS: Data were recorded for 20,613 consultations with 45,582 consultation outcomes described. Asthma represented 348 (1.69%) of consultations. The presence of an asthma code was associated with fewer reasons for the consultation, but with more processes of care. Forty-two percent of other consultation results associated with asthma in the same consultation concerned chronic diseases. CONCLUSION: Our findings suggest that asthma remains underdiagnosed in general practice in France. In order to address this problem, the development of validated diagnostic tools that can be used in general practice settings, and a better access to spirometry, may be directions to explore in future research.

Taille, C. (2010). "Asthme : quelques concepts revisités." *Revue Des Maladies Respiratoires Actualites* **2**(5): 444-447.

Taille, C., Pison, C., Nocent, C., et al. (2018). "[Patients in the IDEAL cohort: A snapshot of severe asthma in France]." *Rev Mal Respir*.

INTRODUCTION: This paper reports the French data from a post-hoc analysis of the international IDEAL study, which aimed to describe a recent cohort of patients with severe asthma, the impact of the disease on quality of life, as well as the population of patients eligible for treatment with omalizumab, mepolizumab and reslizumab. METHODS: Eligible patients were  $\geq 12$  years of age, with

severe asthma (GINA steps 4 and 5). RESULTS: A total of 129 patients were included in this post-hoc analysis. Their mean age was 53 years, the majority were overweight, they were mainly women (64%) and had at least one medical comorbidity (85%). More than half had suffered from asthma for more than 25 years and were non-smokers. Lung function was moderately impaired. Blood eosinophil count was  $\geq 150$  cells/ $\mu\text{L}$  in 66% of patients,  $\geq 300$  cells/ $\mu\text{L}$  in 34% of patients, and  $\geq 500$  cells/ $\mu\text{L}$  in 12% of patients. One out of three patients was currently treated with omalizumab and 24% had maintenance oral corticosteroids. Asthma was poorly controlled with a negative impact on quality of life (ACQ  $\geq 1.5$ ) in 67% of patients. In this population 40% of patients were eligible for omalizumab, 27% for mepolizumab and 2% for reslizumab. CONCLUSIONS: These findings show that a considerable proportion of patients with severe asthma remain uncontrolled and are not eligible for any of the available biological treatments. This underlines the need for therapeutic innovations in this disease.

Taillé, C., Pison, C., Nocent, C., et al. (2019). "[Patients in the IDEAL cohort: A snapshot of severe asthma in France]." *Rev Mal Respir* **36**(2): 179-190.

INTRODUCTION: This paper reports the French data from a post-hoc analysis of the international IDEAL study, which aimed to describe a recent cohort of patients with severe asthma, the impact of the disease on quality of life, as well as the population of patients eligible for treatment with omalizumab, mepolizumab and reslizumab. METHODS: Eligible patients were  $\geq 12$  years of age, with severe asthma (GINA steps 4 and 5). RESULTS: A total of 129 patients were included in this post-hoc analysis. Their mean age was 53 years, the majority were overweight, they were mainly women (64%) and had at least one medical comorbidity (85%). More than half had suffered from asthma for more than 25 years and were non-smokers. Lung function was moderately impaired. Blood eosinophil count was  $\geq 150$  cells/ $\mu\text{L}$  in 66% of patients,  $\geq 300$  cells/ $\mu\text{L}$  in 34% of patients, and  $\geq 500$  cells/ $\mu\text{L}$  in 12% of patients. One out of three patients was currently treated with omalizumab and 24% had maintenance oral corticosteroids. Asthma was poorly controlled with a negative impact on quality of life (ACQ  $\geq 1.5$ ) in 67% of patients. In this population 40% of patients were eligible for omalizumab, 27% for mepolizumab and 2% for reslizumab. CONCLUSIONS: These findings show that a considerable proportion of patients with severe asthma remain uncontrolled and are not eligible for any of the available biological treatments. This underlines the need for therapeutic innovations in this disease.

Tual, S., Godard, P., Bousquet, J., et al. (2010). "The decrease in asthma-related mortality in France." *Rev Mal Respir* **27**(7): e1-5.

BACKGROUND: Asthma-related morbidity, mortality and socioeconomic cost represent significant public health problems. Despite efficient therapies, in 1999 asthma still killed around 2000 people in France. METHODS: This study investigated the changes in asthma-related mortality in metropolitan France between 1980 and 2005 and examined its regional disparities. Annual age- and gender-specific mortality rates for asthma were calculated, as well as age-standardized rates. The change in asthma-related mortality was estimated by the annual average rate of change fitted using a log-linear regression model. Lastly, regional disparities were mapped. RESULTS: After having levelled off between 1990 and 1995, asthma-related mortality significantly decreased. From 2000 onwards the drop was more rapid in men than in women. The observed decrease was significant only in people over 35. In 2005, there were 1129 deaths due to asthma. Moreover, regional disparities could be seen. CONCLUSIONS: The decline of asthma-related mortality that started in 1986 continued until 2005. Possible explanations could be better patient care, including the use of inhaled corticosteroids and therapeutic education, and improvement in the recording of deaths.

## ÉTUDES ÉTRANGÈRES

(2017). "Global, regional, and national deaths, prevalence, disability-adjusted life years, and years lived with disability for chronic obstructive pulmonary disease and asthma, 1990-2015: a systematic analysis for the Global Burden of Disease Study 2015." *Lancet Respir Med* **5**(9): 691-706.

**BACKGROUND:** Chronic obstructive pulmonary disease (COPD) and asthma are common diseases with a heterogeneous distribution worldwide. Here, we present methods and disease and risk estimates for COPD and asthma from the Global Burden of Diseases, Injuries, and Risk Factors (GBD) 2015 study. The GBD study provides annual updates on estimates of deaths, prevalence, and disability-adjusted life years (DALYs), a summary measure of fatal and non-fatal disease outcomes, for over 300 diseases and injuries, for 188 countries from 1990 to the most recent year. **METHODS:** We estimated numbers of deaths due to COPD and asthma using the GBD Cause of Death Ensemble modelling (CODEm) tool. First, we analysed data from vital registration and verbal autopsy for the aggregate category of all chronic respiratory diseases. Subsequently, models were run for asthma and COPD relying on covariates to predict rates in countries that have incomplete or no vital registration data. Disease estimates for COPD and asthma were based on systematic reviews of published papers, unpublished reports, surveys, and health service encounter data from the USA. We used the Global Initiative of Chronic Obstructive Lung Disease spirometry-based definition as the reference for COPD and a reported diagnosis of asthma with current wheeze as the definition of asthma. We used a Bayesian meta-regression tool, DisMod-MR 2.1, to derive estimates of prevalence and incidence. We estimated population-attributable fractions for risk factors for COPD and asthma from exposure data, relative risks, and a theoretical minimum exposure level. Results were stratified by Socio-demographic Index (SDI), a composite measure of income per capita, mean years of education over the age of 15 years, and total fertility rate. **FINDINGS:** In 2015, 3.2 million people (95% uncertainty interval [UI] 3.1 million to 3.3 million) died from COPD worldwide, an increase of 11.6% (95% UI 5.3 to 19.8) compared with 1990. There was a decrease in age-standardised death rate of 41.9% (37.7 to 45.1) but this was counteracted by population growth and ageing of the global population. From 1990 to 2015, the prevalence of COPD increased by 44.2% (41.7 to 46.6), whereas age-standardised prevalence decreased by 14.7% (13.5 to 15.9). In 2015, 0.40 million people (0.36 million to 0.44 million) died from asthma, a decrease of 26.7% (-7.2 to 43.7) from 1990, and the age-standardised death rate decreased by 58.8% (39.0 to 69.0). The prevalence of asthma increased by 12.6% (9.0 to 16.4), whereas the age-standardised prevalence decreased by 17.7% (15.1 to 19.9). Age-standardised DALY rates due to COPD increased until the middle range of the SDI before reducing sharply. Age-standardised DALY rates due to asthma in both sexes decreased monotonically with rising SDI. The relation between with SDI and DALY rates due to asthma was attributed to variation in years of life lost (YLLs), whereas DALY rates due to COPD varied similarly for YLLs and years lived with disability across the SDI continuum. Smoking and ambient particulate matter were the main risk factors for COPD followed by household air pollution, occupational particulates, ozone, and secondhand smoke. Together, these risks explained 73.3% (95% UI 65.8 to 80.1) of DALYs due to COPD. Smoking and occupational asthmagens were the only risks quantified for asthma in GBD, accounting for 16.5% (14.6 to 18.7) of DALYs due to asthma. **INTERPRETATION:** Asthma was the most prevalent chronic respiratory disease worldwide in 2015, with twice the number of cases of COPD. Deaths from COPD were eight times more common than deaths from asthma. In 2015, COPD caused 2.6% of global DALYs and asthma 1.1% of global DALYs. Although there are laudable international collaborative efforts to make surveys of asthma and COPD more comparable, no consensus exists on case definitions and how to measure disease severity for population health measurements like GBD. Comparisons between countries and over time are important, as much of the chronic respiratory burden is either preventable or treatable with affordable interventions. **FUNDING:** Bill & Melinda Gates Foundation.

(2020). "Prevalence and attributable health burden of chronic respiratory diseases, 1990-2017: a systematic analysis for the Global Burden of Disease Study 2017." *Lancet Respir Med* 8(6): 585-596.  
[https://www.thelancet.com/pdfs/journals/lanres/PIIS2213-2600\(20\)30105-3.pdf](https://www.thelancet.com/pdfs/journals/lanres/PIIS2213-2600(20)30105-3.pdf)

**BACKGROUND:** Previous attempts to characterise the burden of chronic respiratory diseases have focused only on specific disease conditions, such as chronic obstructive pulmonary disease (COPD) or asthma. In this study, we aimed to characterise the burden of chronic respiratory diseases globally, providing a comprehensive and up-to-date analysis on geographical and time trends from 1990 to 2017. **METHODS:** Using data from the Global Burden of Diseases, Injuries, and Risk Factors Study (GBD) 2017, we estimated the prevalence, morbidity, and mortality attributable to chronic respiratory diseases through an analysis of deaths, disability-adjusted life-years (DALYs), and years of life lost (YLL)

by GBD super-region, from 1990 to 2017, stratified by age and sex. Specific diseases analysed included asthma, COPD, interstitial lung disease and pulmonary sarcoidosis, pneumoconiosis, and other chronic respiratory diseases. We also assessed the contribution of risk factors (smoking, second-hand smoke, ambient particulate matter and ozone pollution, household air pollution from solid fuels, and occupational risks) to chronic respiratory disease-attributable DALYs. FINDINGS: In 2017, 544.9 million people (95% uncertainty interval [UI] 506.9-584.8) worldwide had a chronic respiratory disease, representing an increase of 39.8% compared with 1990. Chronic respiratory disease prevalence showed wide variability across GBD super-regions, with the highest prevalence among both males and females in high-income regions, and the lowest prevalence in sub-Saharan Africa and south Asia. The age-sex-specific prevalence of each chronic respiratory disease in 2017 was also highly variable geographically. Chronic respiratory diseases were the third leading cause of death in 2017 (7.0% [95% UI 6.8-7.2] of all deaths), behind cardiovascular diseases and neoplasms. Deaths due to chronic respiratory diseases numbered 3 914 196 (95% UI 3 790 578-4 044 819) in 2017, an increase of 18.0% since 1990, while total DALYs increased by 13.3%. However, when accounting for ageing and population growth, declines were observed in age-standardised prevalence (14.3% decrease), age-standardised death rates (42.6%), and age-standardised DALY rates (38.2%). In males and females, most chronic respiratory disease-attributable deaths and DALYs were due to COPD. In regional analyses, mortality rates from chronic respiratory diseases were greatest in south Asia and lowest in sub-Saharan Africa, also across both sexes. Notably, although absolute prevalence was lower in south Asia than in most other super-regions, YLLs due to chronic respiratory diseases across the subcontinent were the highest in the world. Death rates due to interstitial lung disease and pulmonary sarcoidosis were greater than those due to pneumoconiosis in all super-regions. Smoking was the leading risk factor for chronic respiratory disease-related disability across all regions for men. Among women, household air pollution from solid fuels was the predominant risk factor for chronic respiratory diseases in south Asia and sub-Saharan Africa, while ambient particulate matter represented the leading risk factor in southeast Asia, east Asia, and Oceania, and in the Middle East and north Africa super-region. INTERPRETATION: Our study shows that chronic respiratory diseases remain a leading cause of death and disability worldwide, with growth in absolute numbers but sharp declines in several age-standardised estimators since 1990. Premature mortality from chronic respiratory diseases seems to be highest in regions with less-resourced health systems on a per-capita basis. FUNDING: Bill & Melinda Gates Foundation.

Asher, M. I., García-Marcos, L., Pearce, N. E., et al. (2020). "Trends in worldwide asthma prevalence." *Eur Respir J* **56**(6).

<https://erj.ersjournals.com/content/56/6/2002094>

This review of trends in worldwide asthma prevalence starts with defining how asthma prevalence is measured in populations and how it is analysed. Four population studies of asthma across at least two regions are described: European Community Respiratory Health Survey (ECRHS), the International Study of Wheezing in Infants (EISL), the International Study of Asthma and Allergies in Childhood (ISAAC) and the World Health Survey (WHS). Two of these (ISAAC and WHS) covered all the regions of the world; each using its own standardised questionnaire-based methodology with cross-sectional study design, suitable for large populations. EISL (2005 and 2012) and ISAAC (1996-1997 and 2002-2003) have undertaken a second cross-sectional population survey from which trends are available: EISL in three centres in two countries; ISAAC 106 centres in 56 countries (13-14 year olds) and 66 centres in 37 countries (6-7 year olds). Key results from these studies are presented. Unfortunately, there is no new worldwide data outside of EISL since 2003. Global Burden of Disease estimates of asthma prevalence have varied greatly. Recent reliable worldwide data on asthma prevalence and trends is needed; the Global Asthma Network Phase I will provide this in 2021.

Asher, M. I., Rutter, C. E., Bissell, K., et al. (2021). "Worldwide trends in the burden of asthma symptoms in school-aged children: Global Asthma Network Phase I cross-sectional study." *Lancet* **398**(10311): 1569-1580.

[https://www.thelancet.com/pdfs/journals/lancet/PIIS0140-6736\(21\)01450-1.pdf](https://www.thelancet.com/pdfs/journals/lancet/PIIS0140-6736(21)01450-1.pdf)

**BACKGROUND:** Asthma is the most common chronic disease in children globally. The Global Asthma Network (GAN) Phase I study aimed to determine if the worldwide burden of asthma symptoms is changing. **METHODS:** This updated cross-sectional study used the same methods as the International study of Asthma and Allergies in Childhood (ISAAC) Phase III. Asthma symptoms were assessed from centres that completed GAN Phase I and ISAAC Phase I (1993-95), ISAAC Phase III (2001-03), or both. We included individuals from two age groups (children aged 6-7 years and adolescents aged 13-14 years) who self-completed written questionnaires at school. We estimated the 10-year rate of change in prevalence of current wheeze, severe asthma symptoms, ever having asthma, exercise wheeze, and night cough (defined by core questions in the questionnaire) for each centre, and we estimated trends across world regions and income levels using mixed-effects linear regression models with region and country income level as confounders. **FINDINGS:** Overall, 119 795 participants from 27 centres in 14 countries were included: 74 361 adolescents (response rate 90%) and 45 434 children (response rate 79%). About one in ten individuals of both age groups had wheeze in the preceding year, of whom almost half had severe symptoms. Most centres showed a change in prevalence of 2 SE or more between ISAAC Phase III to GAN Phase I. Over the 27-year period (1993-2020), adolescents showed a significant decrease in percentage point prevalence per decade in severe asthma symptoms (-0.37, 95% CI -0.69 to -0.04) and an increase in ever having asthma (1.25, 0.67 to 1.83) and night cough (4.25, 3.06 to 5.44), which was also found in children (3.21, 1.80 to 4.62). The prevalence of current wheeze decreased in low-income countries (-1.37, -2.47 to -0.27], in children and -1.67, -2.70 to -0.64, in adolescents) and increased in lower-middle-income countries (1.99, 0.33 to 3.66, in children and 1.69, 0.13 to 3.25, in adolescents), but it was stable in upper-middle-income and high-income countries. **INTERPRETATION:** Trends in prevalence and severity of asthma symptoms over the past three decades varied by age group, country income, region, and centre. The high worldwide burden of severe asthma symptoms would be mitigated by enabling access to effective therapies for asthma. **FUNDING:** International Union Against Tuberculosis and Lung Disease, Boehringer Ingelheim New Zealand, AstraZeneca Educational Grant, National Institute for Health Research, UK Medical Research Council, European Research Council, and Instituto de Salud Carlos III.

Bahadori, K., Doyle-Waters, M. M., Marra, C., et al. (2009). "Economic burden of asthma: a systematic review." *Bmc Pulmonary Medicine* 9(1): 24.  
<https://doi.org/10.1186/1471-2466-9-24>

Asthma is associated with enormous healthcare expenditures that include both direct and indirect costs. It is also associated with the loss of future potential earnings related to both morbidity and mortality. The objective of the study is to determine the burden of disease costs associated with asthma.

Chorniy, A., Currie, J. et Sonchak, L. (2017). Exploding Asthma and ADHD Caseloads: The Role of Medicaid Managed Care. *NBER Working Paper Series ; 23983*. Cambridge NBER: 52 , tabl., fig.  
<http://www.nber.org/papers/w23983.pdf>

In the U.S., nearly 11% of school-age children have been diagnosed with ADHD, and approximately 10% of children suffer from asthma. In the last decade, the number of children diagnosed with these conditions has inexplicably been on the rise. This paper proposes a novel explanation of this trend. First, the increase is concentrated in the Medicaid caseload nationwide. Second, nearly 80% of states transitioned their Medicaid programs from fee-for-service (FFS) reimbursement to managed care (MMC) by 2016. Using Medicaid claims from South Carolina, we show that this change contributed to the increase in asthma and ADHD caseloads. Empirically, we rely on exogenous variation in MMC enrollment due a change in the "default" Medicaid plan from FFS or MMC, and an increase in the availability of MMC. We find that the transition from FFS to MMC explains most of the rise in the number of Medicaid children being treated for ADHD and asthma. These results can be explained by the incentives created by the risk adjustment and quality control systems in MMC.

Czira, A., Turner, M., Martin, A., et al. (2022). "A systematic literature review of burden of illness in adults with uncontrolled moderate/severe asthma." *Respir Med* 191: 106670.

**BACKGROUND:** There are limited published data on the burden of moderate/severe uncontrolled asthma. **METHODS:** We conducted a systematic literature review to better understand the impact of moderate-to-severe asthma in the US, the UK, Germany, France, Italy, Spain, Canada, Japan, and Australia in terms of prevalence, clinical measures, health-related quality of life (HRQoL) and economic burden, for patients whose asthma is uncontrolled despite inhaled corticosteroid/long-acting  $\beta(2)$ -agonist (ICS/LABA) therapy. **RESULTS:** The prevalence of uncontrolled asthma among patients with moderate/severe disease varied but was as high as 100% in some subgroups. Patients with uncontrolled asthma generally had poor lung function (mean/median pre-bronchodilator forced expiratory volume in 1 second [FEV(1)]: 1.69-2.45 L; mean/median pre-bronchodilator percent predicted FEV(1): 57.2-79.7). There was also a substantial but variable exacerbation burden associated with uncontrolled asthma, with the annualised rate of exacerbations ranging from 1.30 to 7.30 when considering various patient subgroups. Furthermore, the annualised rate of severe exacerbations ranged from 1.66 to 3.60. The HRQoL burden measured using disease-specific and generic instruments consistently demonstrated substantial impairment of HRQoL for those with uncontrolled asthma; Asthma Quality of Life Questionnaire scores ranged from 3.00 to 5.20, whilst EurQoL-5 Dimensions index scores ranged from 0.53 to 0.59. Direct, indirect and total costs together with consumption of other healthcare resources associated with managing uncontrolled asthma were also substantial in the population studied; no caregiver burden was identified. **CONCLUSIONS:** Our findings suggest that significant unmet needs exist for patients with uncontrolled asthma despite the availability of ICS/LABA therapy. Novel treatments are needed to help reduce the burden to patients, healthcare systems and society.

Ebmeier, S., Thayabaran, D., Braithwaite, I., et al. (2017). "Trends in international asthma mortality: analysis of data from the WHO Mortality Database from 46 countries (1993-2012)." *The Lancet* **390**(10098): 935-945.  
[http://dx.doi.org/10.1016/S0140-6736\(17\)31448-4](http://dx.doi.org/10.1016/S0140-6736(17)31448-4)

Background International time trends in asthma mortality have been strongly affected by changes in management and in particular drug treatments. However, little is known about how asthma mortality has changed over the past decade. In this study, we assessed these international trends.

Ganay, D. (2018). The Global Asthma Report 2018. Auckland Global Asthma Network: 92.  
[http://globalasthmareport.org/resources/Global\\_Asthma\\_Report\\_2018.pdf](http://globalasthmareport.org/resources/Global_Asthma_Report_2018.pdf)

The Global Asthma Report 2018 is the third such report prepared by the Global Asthma Network (GAN). GAN builds upon the work of the International Study of Asthma and Allergies in Childhood (ISAAC) and The International Union Against Tuberculosis and Lung Disease (The Union) to monitor asthma and improve asthma care, particularly in low- and middle-income countries (LMICs). This report brings together in one document an up to date account on where the major gaps lie in asthma information and management. It is intended to influence those in authority to act promptly and wisely to reduce the global burden of asthma.

Khreis, H., Alotaibi, R., Horney, J., et al. (2021). "The impact of baseline incidence rates on burden of disease assessment of air pollution and onset childhood asthma: analysis of data from the contiguous United States." *Ann Epidemiol* **53**: 76-88.e10.  
<https://www.sciencedirect.com/science/article/pii/S1047279720303446?via%3Dihub>

**PURPOSE:** Burden of disease (BoD) assessments typically rely on national-level incidence rates for the health outcomes of interest. The impact of using a constant national-level incidence rate, versus a more granular spatially varying rate, remains unknown and understudied in the literature. There has been an increasing number of publications estimating the BoD of childhood asthma attributable to air pollution, as emerging evidence demonstrates that traffic-related air pollution (TRAP) leads to onset of the disease. In this study, we estimated the burden of incident childhood asthma cases which may be attributable to nitrogen dioxide (NO<sub>2</sub>), a criteria pollutant and a good marker of TRAP, in the contiguous United States. We used both a national-level and newly generated state-specific asthma



incidence rates and compared results from the two approaches. METHODS: We estimated incident childhood asthma cases which may be attributable to NO<sub>2</sub> using standard BoD assessment methods. We combined child (<18 years) counts with 2010 NO<sub>2</sub> exposures at the census block level, concentration-response function, and state-specific asthma incidence rates. NO<sub>2</sub> concentrations were obtained from a previously validated land-use regression model. We sourced the concentration-response function from a meta-analysis on TRAP and risk of childhood asthma. We estimated incidence rates using raw data collected in the 2006-2010 Behavioral Risk Factor Surveillance System and Asthma Call-back Surveys. We stratified the estimated BoD by urban versus rural status and by median household income, explored trends in BoD across 48 states and the District of Columbia, and compared our results with a published BoD analysis which used a constant national-level incidence rate across all states. RESULTS: The overall mean (min-max) NO<sub>2</sub> concentration(s) was 13.2 (1.5-58.3) ug/m<sup>3</sup> and was highest in urbanized areas. The estimated national aggregate asthma incidence rate was 11.6 per 1000 at-risk children and ranged from 4.3 (Montana) to 17.7 (District of Columbia) per 1000 at-risk children. The 17 states that did not have data to estimate an incidence rate were assigned the national aggregate asthma incidence rate. Using the state-specific incidence rates, we estimated a total of 134,166 (95% confidence interval: 75,177-193,327) childhood asthma incident cases attributable to NO<sub>2</sub>, accounting for 17.6% of all childhood asthma incident cases. Using the national-level incidence rate, we estimated a total of 141,931 (95% confidence interval: 119,222-163,505) incident cases attributable to NO<sub>2</sub>, accounting for 17.9% of all childhood asthma incident cases. Using the state-specific incidence rates therefore reduced the attributable number of cases by 7,765 (5.5% relative reduction), compared with estimates using the national-level incidence rate. Across states, the change in the attributable number of cases ranged from -64.1% (Montana) to +33.8% (Texas). California had the largest absolute decrease (-6,190) in attributable cases, whereas Texas had the largest increase (+3,615). Stratifying by socioeconomic status and urban versus rural status produced new trends compared with the previously published BoD analysis showing high heterogeneity across the states. CONCLUSIONS: We estimated new state-specific asthma incidence rates for the contiguous United States. Using state-specific incidence rates versus a constant national incidence rate resulted in a small change in the NO<sub>2</sub> attributable BoD at the national level, but had a more prominent impact at the state level.

Kocks, J. W. H., van Boven, J. F. M., Loftus, P. A., et al. (2016). "Epidemiology of asthma." *Expert Rev Pharmacoecon Outcomes Res* **24**(3): 245-249.  
<https://www.tandfonline.com/doi/full/10.1080/14737167.2020.1819793>

PURPOSE OF REVIEW: This article reports the findings of recently published research articles and Centers for Disease Control (CDC) data on the epidemiology of asthma. Numerous otolaryngologic diseases are associated with asthma, such as allergic rhinitis, chronic rhinosinusitis, and obstructive sleep apnea. In addition, asthma causes a significant health burden and its prevalence is increasing. RECENT FINDINGS: Currently, 8.4% of persons in the United States have asthma as compared with 4.3% of the population worldwide, and both numbers are on the rise. The average annual asthma prevalence is higher in children (9.5%) than adults (7.7%). The prevalence of asthma is higher in black persons than white persons, and the ethnicity most affected is the Puerto Rican population. Asthma prevalence increases with each successive lower poverty level group. There are interesting relationships between asthma and certain otolaryngologic diseases. The impact of asthma on both morbidity and mortality is particularly noteworthy. SUMMARY: The prevalence of asthma is increasing both domestically and globally. The impact is most significant in the minority and lower socioeconomic populations. Future research should work to elucidate the reasons for this increase in asthma and promote better access to care for persons across all ethnic and socioeconomic classes.

Mattiuzzi, C. et Lippi, G. (2020). "Worldwide asthma epidemiology: insights from the Global Health Data Exchange database." *Int Forum Allergy Rhinol* **10**(1): 75-80.  
<https://onlinelibrary.wiley.com/doi/abs/10.1002/alr.22464>

Background Enhanced focus on primary care provision is essential for lowering the risk of asthma exacerbation and complications, as well as for decreasing asthma-related hospitalizations and deaths.

This article provides an update on current worldwide epidemiology of asthma. Methods Worldwide epidemiologic information on asthma was obtained through electronic searches in the Global Health Data Exchange (GHDx) database. Results In 2017, the incidence of asthma was 43.12 million new cases/year (0.56%), while in that same year, prevalence and mortality accounted for 272.68 million cases (3.57%) and 0.49 million deaths (0.006%), respectively. Although the number of asthma cases significantly increased during the last 25 years, disability-adjusted life years (DALYs) and deaths constantly declined. After adjustment of asthma incidence, prevalence, and DALYs for worldwide demographic variation, no significant changes could be seen during the last 25 years, while asthma mortality significantly declined during the same period. Asthma incidence peaks before the age of 5 years, whereas prevalence and DALYs peaks are observed between 0 and 14 years. DALYs also display a second peak, between 45 and 74 years. Asthma mortality increases with aging, reaching the peak after 80 years. The epidemiologic burden and mortality of asthma are constantly higher in women than in men. An inverse, highly significant correlation can be found between sociodemographic index and asthma incidence ( $r = -0.98$ ) or mortality ( $r = -0.96$ ). Conclusion Although the worldwide burden of asthma remains high, incidence and prevalence are not apparently translating into an escalating clinical and economic burden in terms of health loss and deaths.

Oberg, M., Jaakkola, M. S., Peruga, A., et al. (2010). "Worldwide burden of disease from exposure to second-hand smoke : a retrospective analysis data from 192 countries." *The Lancet*: 8 , 4 tab., fig.

Exposure to second-hand smoke is common in many countries but the magnitude of the problem worldwide is poorly described. We aimed to estimate the worldwide exposure to second-hand smoke and its burden of disease in children and adult non-smokers in 2004. The burden of disease from second-hand smoke was estimated as deaths and disability-adjusted life-years (DALYs) for children and adult non-smokers. The calculations were based on disease-specific relative risk estimates and area-specific estimates of the proportion of people exposed to second-hand smoke, by comparative risk assessment methods, with data from 192 countries during 2004. Worldwide, 40% of children, 33% of male non-smokers, and 35% of female non-smokers were exposed to second-hand smoke in 2004. This exposure was estimated to have caused 379 000 deaths from ischaemic heart disease, 165 000 from lower respiratory infections, 36 900 from asthma, and 21 400 from lung cancer. 603 000 deaths were attributable to second-hand smoke in 2004, which was about 17% of worldwide mortality. 47% of deaths from second-hand smoke occurred in women, 28% in children, and 26% in men. DALYs lost because of exposure to second-hand smoke amounted to 1079 million, which was about 07% of total worldwide burden of diseases in DALYs in 2004. 61% of DALYs were in children. The largest disease burdens were from lower respiratory infections in children younger than 5 years (5 939 000), ischaemic heart disease in adults (2 836 000), and asthma in adults (1 246 000) and children (651 000). These estimates of worldwide burden of disease attributable to second-hand smoke suggest that substantial health gains could be made by extending effective public health and clinical interventions to reduce passive smoking worldwide.

OCDE (2020). Health at a glance : Europe 2020, state of health in the EU cycle. Paris OCDE.  
[https://www.keepeek.com/Digital-Asset-Management/ocd/social-issues-migration-health/health-at-a-glance-europe-2020\\_82129230-en#page1](https://www.keepeek.com/Digital-Asset-Management/ocd/social-issues-migration-health/health-at-a-glance-europe-2020_82129230-en#page1)

The 2020 edition of Health at a Glance: Europe focuses on the impact of the COVID-19 crisis. Chapter 1 provides an initial assessment of the resilience of European health systems to the COVID-19 pandemic and their ability to contain and respond to the worst pandemic in the past century. Chapter 2 reviews the huge health and welfare burden of air pollution as another major public health issue in European countries, and highlights the need for sustained efforts to reduce air pollution to mitigate its impact on health and mortality. The five other chapters provide an overview of key indicators of health and health systems across the 27 EU member states, 5 EU candidate countries, 3 European Free Trade Association countries and the United Kingdom. Health at a Glance: Europe is the first step in the State of Health in the EU cycle.

Vos, T., Lim, S. S., Abbafati, C., et al. (2020). "Global burden of 369 diseases and injuries in 204 countries and territories, 1990&#x2013;2019: a systematic analysis for the Global Burden of Disease Study 2019." *The Lancet* **396**(10258): 1204-1222.  
[https://doi.org/10.1016/S0140-6736\(20\)30925-9](https://doi.org/10.1016/S0140-6736(20)30925-9)

BackgroundIn an era of shifting global agendas and expanded emphasis on non-communicable diseases and injuries along with communicable diseases, sound evidence on trends by cause at the national level is essential. The Global Burden of Diseases, Injuries, and Risk Factors Study (GBD) provides a systematic scientific assessment of published, publicly available, and contributed data on incidence, prevalence, and mortality for a mutually exclusive and collectively exhaustive list of diseases and injuries.

## Coûts de la maladie

### REVUES DE LITTÉRATURE

Aumann, I., Prenzler, A., Welte, T., et al. (2014). "[Epidemiology and costs of asthma in Germany - a systematic literature review]." *Pneumologie* **68**(8): 557-567.  
<https://www.thieme-connect.com/products/ejournals/pdf/10.1055/s-0034-1377225.pdf>

BACKGROUND: The aim of this study was to identify the prevalence and incidence as well as the health care costs of asthma specifically in the German setting. METHODS: Two systematic literature searches were conducted in PubMed in December 2012 (updated in March 2014). All publications in German and English were included. RESULTS: After review of title, abstracts and full publications, 17 relevant studies included information on the prevalence and incidence of asthma. The 12-month prevalence for adults ranges between 4.6% and 6.34% (children: 3.8% - 11.8%). At younger ages, asthma is more prevalent in boys. In adulthood, more women are affected. We identified seven cost-of-illness studies. The direct costs range between € 690.4 m and 1.36 bn. The reported health care costs depend on the perspective, the severity of disease and the database, so that a comparison of results is difficult. CONCLUSION: All in all, this review underlines the epidemiological and health economic importance of asthma in Germany. Several studies on the prevalence of asthma are available, but there is little information on the current incidence of this disease. Further research is necessary for obtaining a comprehensive picture of the current health care costs.

Bahadori, K., Doyle-Waters, M. M., Marra, C., et al. (2009). "Economic burden of asthma: a systematic review." *BMC Pulm Med* **9**: 24.  
<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2698859/pdf/1471-2466-9-24.pdf>

BACKGROUND: Asthma is associated with enormous healthcare expenditures that include both direct and indirect costs. It is also associated with the loss of future potential earnings related to both morbidity and mortality. The objective of the study is to determine the burden of disease costs associated with asthma. METHODS: We performed a systematic search of MEDLINE, EMBASE, CINAHL, CDSR, OHE-HEED, and Web of Science Databases between 1966 and 2008. RESULTS: Sixty-eight studies met the inclusion criteria. Hospitalization and medications were found to be the most important cost driver of direct costs. Work and school loss accounted for the greatest percentage of indirect costs. The cost of asthma was correlated with comorbidities, age, and disease severity. CONCLUSION: Despite the availability of effective preventive therapy, costs associated with asthma are increasing. Strategies including education of patients and physicians, and regular follow-up are required to reduce the economic burden of asthma.

Bahadori, K., Quon, B. S., Doyle-Waters, M. M., et al. (2010). "A systematic review of economic evaluations of therapy in asthma." *J Asthma Allergy* **3**: 33-42.  
<https://www.dovepress.com/getfile.php?fileID=7376>

**BACKGROUND:** Asthma's cost-effectiveness is a major consideration in the evaluation of its treatment options. Our objective was to perform a systematic review of the cost-effectiveness of asthma medications. **METHODS:** We performed a systematic search of MEDLINE, EMBASE, CINAHL, Cochrane Database of Systematic Reviews, OHE-HEED, Database of Abstracts of Reviews of Effects, Cochrane Central Register of Controlled Trials, Health Technology Assessments Database, NHS Economic Evaluation Database, and Web of Science and reviewed references from key articles between 1990 and Jan 2008. **RESULTS:** A total of 49 RCTs met the inclusion criteria. Maintenance therapy with inhaled corticosteroids was found to be very cost-effective and in uncontrolled asthmatics patients currently being treated with ICS, the combination of an ICS/LABA represents a safe, cost-effective treatment. The simplified strategy using budesonide and formoterol for maintenance and reliever therapy was also found to be as cost-effective as salmeterol/fluticasone plus salbutamol. Omalizumab was found to be cost-effective. An important caveat with regard to the published literature is the relatively high proportion of economic evaluations which are funded by the manufacturers of specific drug treatments. have examined patient preference in these diseases. More research is needed to fill in knowledge gaps.

Bereza, B. G., Troelsgaard Nielsen, A., Valgardsson, S., et al. (2015). "Patient preferences in severe COPD and asthma: a comprehensive literature review." *Int J Chron Obstruct Pulmon Dis* **10**: 739-744.

<https://www.dovepress.com/getfile.php?fileID=24518>

**BACKGROUND:** Management of chronic incurable diseases such as chronic obstructive pulmonary disease (COPD) and asthma is difficult. Incorporation of patient preferences is widely encouraged. **PURPOSE:** To summarize original research articles determining patient preference in moderate-to-severe disease. **METHODS:** Acceptable articles consisted of original research determining preferences for any aspect of care in patients with COPD/asthma. The target population included those with severe disease; however, articles were accepted if they separated outcomes by severity or if the majority had at least moderate-to-severe disease. We also accepted simulation research based on scenarios describing situations involving moderate-to-severe disease that elicited preferences. Two reviewers searched Medline and Embase for articles published from the date of inception of the databases until the end of November 2014, with differences resolved through consensus discussion. Data were tabulated and analyzed descriptively. **RESULTS:** About 478 articles identified, 448 were rejected and 30 analyzed. There were 25 on COPD and five on asthma. Themes identified as most important in COPD were symptom relief (dyspnea/breathlessness), a positive patient-physician relationship, quality-of-life impairments, and information availability. Patients strongly preferred sponsors' inhalers. At end-of-life, 69% preferred receiving CPR, 70% wanted noninvasive, and 58% invasive mechanical intervention. While patients with asthma preferred treatments that increased symptom-free days, they were willing to trade days without symptoms for a reduction in adverse events and greater convenience. Asthma patients were willing to pay for waking up once and not needing their inhaler over waking up once overnight and needing their inhaler. **CONCLUSION:** Few studies have examined patient preference in these diseases. More research is needed to fill in knowledge gaps.

Bhuia, M. R., Islam, M. A., Nwaru, B. I., et al. (2020). "Models for estimating and projecting global, regional and national prevalence and disease burden of asthma: a systematic review." *Int J Chron Obstruct Pulmon Dis* **10**(2): 020409.

<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7774028/pdf/jogh-10-020409.pdf>

**BACKGROUND:** Statistical models are increasingly being used to estimate and project the prevalence and burden of asthma. Given substantial variations in these estimates, there is a need to critically assess the properties of these models and assess their transparency and reproducibility. We aimed to critically appraise the strengths, limitations and reproducibility of existing models for estimating and projecting the global, regional and national prevalence and burden of asthma. **METHODS:** We undertook a systematic review, which involved searching Medline, Embase, World Health Organization Library and Information Services (WHOLIS) and Web of Science from 1980 to 2017 for modelling studies. Two reviewers independently assessed the eligibility of studies for inclusion and then assessed their strengths, limitations and reproducibility using pre-defined quality criteria. Data were

descriptively and narratively synthesised. RESULTS: We identified 108 eligible studies, which employed a total of 51 models: 42 models were used to derive national level estimates, two models for regional estimates, four models for global and regional estimates and three models for global, regional and national estimates. Ten models were used to estimate the prevalence of asthma, 27 models estimated the burden of asthma - including, health care service utilisation, disability-adjusted life years, mortality and direct and indirect costs of asthma - and 14 models estimated both the prevalence and burden of asthma. Logistic and linear regression models were most widely used for national estimates. Different versions of the DisMod-MR- Bayesian meta-regression models and Cause Of Death Ensemble model (CODEm) were predominantly used for global, regional and national estimates. Most models suffered from a number of methodological limitations - in particular, poor reporting, insufficient quality and lack of reproducibility. CONCLUSIONS: Whilst global, regional and national estimates of asthma prevalence and burden continue to inform health policy and investment decisions on asthma, most models used to derive these estimates lack the required reproducibility. There is a need for better-constructed models for estimating and projecting the prevalence and disease burden of asthma and a related need for better reporting of models, and making data and code available to facilitate replication.

Bhuia, M. R., Nwaru, B. I., Weir, C. J., et al. (2017). "Models for estimating and projecting global, regional and national prevalence and disease burden of asthma: protocol for a systematic review." *J Asthma* 7(5): e015441. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5791547/pdf/bmjopen-2016-015441.pdf>

INTRODUCTION: Models that have so far been used to estimate and project the prevalence and disease burden of asthma are in most cases inadequately described and irreproducible. We aim systematically to describe and critique the existing models in relation to their strengths, limitations and reproducibility, and to determine the appropriate models for estimating and projecting the prevalence and disease burden of asthma. METHODS: We will search the following electronic databases to identify relevant literature published from 1980 to 2017: Medline, Embase, WHO Library and Information Services and Web of Science Core Collection. We will identify additional studies by searching the reference list of all the retrieved papers and contacting experts. We will include observational studies that used models for estimating and/or projecting prevalence and disease burden of asthma regarding human population of any age and sex. Two independent reviewers will assess the studies for inclusion and extract data from included papers. Data items will include authors' names, publication year, study aims, data source and time period, study population, asthma outcomes, study methodology, model type, model settings, study variables, methods of model derivation, methods of parameter estimation and/or projection, model fit information, key findings and identified research gaps. A detailed critical narrative synthesis of the models will be undertaken in relation to their strengths, limitations and reproducibility. A quality assessment checklist and scoring framework will be used to determine the appropriate models for estimating and projecting the prevalence and disease burden of asthma. ETHICS AND DISSEMINATION: We will not collect any primary data for this review, and hence there is no need for formal National Health Services Research Ethics Committee approval. We will present our findings at scientific conferences and publish the findings in the peer-reviewed scientific journal.

Chen, K. H., Chen, C. C., Liu, H. E., et al. (2014). "Effectiveness of paediatric asthma clinical pathways: a narrative systematic review." *J Asthma* 51(5): 480-492. <https://www.tandfonline.com/doi/full/10.3109/02770903.2014.887728>

OBJECTIVE: To evaluate the effectiveness of clinical pathways (CPs) for paediatric asthma on length of hospital stay, additional visits due to asthma exacerbations, hospital cost, manpower and workload required for implementing CPs. METHODS: Studies were eligible if they met the following criteria: children ( $\leq 18$  years) with asthma, hospital or emergency department based, and study designs were (1) randomised controlled trial, (2) controlled clinical trial or (3) controlled before and after study. Two reviewers independently screened references, extracted data and assessed the risk of bias. We resolved disagreement by discussion between authors. Due to an insufficient number of studies and the heterogeneity of interventions and outcomes, we conducted a narrative systematic review with

forest plots but did not pool results. RESULTS: About 3155 relevant articles were identified through a literature search, 628 were duplicates removed, 2037 were excluded based on review of titles and abstracts and 117 were excluded because they did not meet inclusion criteria. Seven studies involving 2600 participants met the inclusion criteria. Using asthma CPs may decrease the length of hospital stay; however, CPs did not appear to reduce additional visits due to asthma exacerbations or reduce hospital costs. No eligible studies were found that quantified the manpower and workload for implementing CPs. CONCLUSIONS: Current studies suggest CPs may reduce the length of hospital stay, but insufficient evidence is available on total costs or readmissions to justify extensive uptake of asthma CPs in paediatric inpatient care. Higher quality, large randomised controlled trials are required that measure costs and a wider range of outcomes.

Chen, S., Golam, S., Myers, J., et al. (2018). "Systematic literature review of the clinical, humanistic, and economic burden associated with asthma uncontrolled by GINA Steps 4 or 5 treatment." *Curr Med Res Opin* **34**(12): 2075-2088.

<https://www.tandfonline.com/doi/full/10.1080/03007995.2018.1505352>

OBJECTIVE: This study sought to characterize the epidemiologic, clinical, humanistic, and economic burden of patients with asthma uncontrolled by GINA Steps 4 or 5 treatment (severe, uncontrolled asthma [SUA]). METHODS: A systematic literature review adhering to PRISMA guidelines was performed. Relevant publications were searched for in MEDLINE and EMBASE from January 2004 to September 2016 and in a conference proceedings database from January 2012 to October 2016. Studies were screened using the Population, Intervention, Comparator, Outcomes, Study Design, and Time (PICOS-T) framework. Studies of SUA with observational (prospective and retrospective), randomized, or nonrandomized study designs; adult patient populations; sample sizes  $\geq 20$  patients; epidemiologic or clinical outcomes, patient-reported outcomes (PROs), or economic outcomes were included. For our analysis, SUA was defined as inadequate control of asthma, despite the use of medium- to high-dosage inhaled corticosteroids and at least one additional treatment. RESULTS: A total of 195 articles reporting unique study populations were included. Prevalence of SUA was as great as 87.4% for patients with severe asthma, although values varied depending on the criteria used to define asthma control. Compared with patients with severe asthma who were controlled, patients with SUA experienced more symptoms, night-time awakenings, rescue medication use, and worse PROs. SUA-associated costs were 3-times greater than costs for patients with severe, controlled disease. CONCLUSION: Despite the availability of approved asthma treatments, this literature analysis confirms that SUA poses a substantial epidemiologic, clinical, humanistic, and economic burden. Published data are limited for certain aspects of SUA, highlighting a need for further research.

Chongmelaxme, B. et Chaiyakunapruk, N. (2019). "Incorporating adherence in cost-effectiveness analyses of asthma: a systematic review." **22**(6): 554-566.

<https://www.tandfonline.com/doi/full/10.1080/13696998.2019.1572014>

Aims: Non-adherence is associated with poor clinical outcomes among patients with asthma. While cost-effectiveness analysis (CEA) is increasingly used to inform value assessment of the interventions, most do not take into account adherence in the analyses. This study aims to: (1) Understand the extent of studies considering adherence as part of the economic analyses, and (2) summarize the methods of incorporating adherence in the economic models. Materials and methods: A literature search was performed from the inception to February 2018 using four databases: PubMed, EMBASE, NHS EED, and the Tufts CEA registry. Decision model-based CEA of asthma were identified. Outcomes of interest were the number of studies incorporating adherence in the economic models, and the incorporating methods. All data were extracted using a standardized data collection form. Results: From 1,587 articles, 23 studies were decision model-based CEA of asthma, of which four CEA (17.4%) incorporated adherence in the analyses. Only the method of incorporating adherence by adjusting treatment effectiveness according to adherence levels was demonstrated in this review. Two approaches were used to derive the associations between adherence and effectiveness. The first approach was to apply a mathematical formula, developed by an expert panel, and the second was to extrapolate the associations from previous published studies. The adherence-adjusted effectiveness

was then incorporated in the economic models. Conclusions: A very low number of CEA of asthma incorporated adherence in the analyses. All the CEA adjusted treatment effectiveness according to adherence levels, applied to the economic models.

Codispoti, C. D., Greenhawt, M. et Oppenheimer, J. (2022). "The Role of Access and Cost-Effectiveness in Managing Asthma: A Systematic Review." *J Allergy Clin Immunol Pract.*  
[https://www.jaci-inpractice.org/article/S2213-2198\(22\)00433-0/fulltext](https://www.jaci-inpractice.org/article/S2213-2198(22)00433-0/fulltext)

**BACKGROUND:** Inconsistent and unequal access to medical care is an issue that predates the COVID19 pandemic, which only worsened the problem. Limited access to care from asthma specialists and other specialists treating comorbid diseases may adversely affect asthma. **OBJECTIVE:** The purpose of this review is to identify health disparities associated with access to care for asthma, and cost-effectiveness of therapies and interventions addressing this health disparity. **METHODS:** A narrative systematic review was undertaken using MeSH searches of English language articles published in CINAHL, Scopus, or PubMed. **RESULTS:** A total of 725 articles were identified. Barriers recognized from the literature included access to diagnostic spirometry, access to specialists, medication formulary restrictions, and issues leading to medical nonadherence. Telemedicine, school-based health care interventions, digital applications, and non-office-based digital spirometry could be used to address these gaps in access to asthma care while potentially being cost-effective. **CONCLUSION:** With the widespread adoption of telemedicine because of the pandemic, and adoption of other mobile services, we now have potential tools that can increase access to asthma care, which can help address this health care inequity. Evidence is limited, but favorable, that some of these tools may be cost-effective.

Costello, R. W., Greene, G. et Cividini, S. (2021). "EstablishING the best STEp-up treatments for children with uncontrolled asthma despite INhaled corticosteroids (EINSTEIN): protocol for a systematic review, network meta-analysis and cost-effectiveness analysis using individual participant data (IPD)." *Eur Respir J* **11**(2): e040528.  
<https://erj.ersjournals.com/content/erj/53/5/1802161.full.pdf>

**INTRODUCTION:** Asthma affects millions of children worldwide-1.1 million children in the UK. Asthma symptoms cannot be cured but can be controlled with low-dose inhaled corticosteroids (ICSs) in the majority of individuals. Treatment with a low-dose ICS, however, fails to control asthma symptoms in around 10%-15% of children and this places the individual at increased risk for an asthma attack. At present, there is no clear preferred treatment option for a child whose asthma is not controlled by low-dose ICS and international guidelines currently recommend at least three treatment options. Herein, we propose a systematic review and individual participant data network meta-analysis (IPD-NMA) aiming to synthesise all available published and unpublished evidence from randomised controlled trials (RCTs) to establish the clinical effectiveness of pharmacological treatments in children and adolescents with uncontrolled asthma on ICS and help to make evidence-informed treatment choices. This will be used to parameterise a Markov-based economic model to assess the cost-effectiveness of alternative treatment options in order to inform decisions in the context of drug formularies and clinical guidelines. **METHODS AND ANALYSIS:** We will search in MEDLINE, the Cochrane Library, the Cochrane Central Register of Controlled Trials (CENTRAL), Embase, NICE Technology Appraisals and the National Institute for Health Research (NIHR) Health Technology Assessment series for RCTs of interventions in patients with uncontrolled asthma on ICS. All studies where children and adolescents were eligible for inclusion will be considered, and authors or sponsors will be contacted to request IPD on patients aged <18. The reference lists of existing clinical guidelines, along with included studies and relevant reviews, will be checked to identify further relevant studies. Unpublished studies will be located by searching across a range of clinical trial registries, including internal trial registers for pharmaceutical companies. All studies will be appraised for inclusion against predefined inclusion and exclusion criteria by two independent reviewers with disagreements resolved through discussion with a third reviewer. We will perform an IPD-NMA-eventually supplemented with aggregate data for the RCTs without IPD-to establish both the probability that a treatment is best and the probability that a particular treatment is most likely to be effective for a

specific profile of the patient. The IPD-NMA will be performed for each outcome variable within a Bayesian framework, using the WinBUGS software. Also, potential patient-level characteristics that may modify treatment effects will be explored, which represents one of the strengths of this study. ETHICS AND DISSEMINATION: The Committee on Research Ethics, University of Liverpool, has confirmed that ethics review is not required. The dissemination plan consists of publishing the results in an open-access medical journal, a plain-language summary available for parents and children, dissemination via local, national and international meetings and conferences and the press offices of our Higher Education Institutions (HEIs). A synopsis of results will be disseminated to NICE and British Thoracic Society/Scottish Intercollegiate Guidelines Network (SIGN) as highly relevant to future clinical guideline updates. PROSPERO REGISTRATION NUMBER: CRD42019127599.

Czira, A., Turner, M., Martin, A., et al. (2022). "A systematic literature review of burden of illness in adults with uncontrolled moderate/severe asthma." *Respir Med* **191**: 106670.

<https://njl-admin.nihr.ac.uk/document/download/2004583>

BACKGROUND: There are limited published data on the burden of moderate/severe uncontrolled asthma. METHODS: We conducted a systematic literature review to better understand the impact of moderate-to-severe asthma in the US, the UK, Germany, France, Italy, Spain, Canada, Japan, and Australia in terms of prevalence, clinical measures, health-related quality of life (HRQoL) and economic burden, for patients whose asthma is uncontrolled despite inhaled corticosteroid/long-acting  $\beta(2)$ -agonist (ICS/LABA) therapy. RESULTS: The prevalence of uncontrolled asthma among patients with moderate/severe disease varied but was as high as 100% in some subgroups. Patients with uncontrolled asthma generally had poor lung function (mean/median pre-bronchodilator forced expiratory volume in 1 second [FEV(1)]: 1.69-2.45 L; mean/median pre-bronchodilator percent predicted FEV(1): 57.2-79.7). There was also a substantial but variable exacerbation burden associated with uncontrolled asthma, with the annualised rate of exacerbations ranging from 1.30 to 7.30 when considering various patient subgroups. Furthermore, the annualised rate of severe exacerbations ranged from 1.66 to 3.60. The HRQoL burden measured using disease-specific and generic instruments consistently demonstrated substantial impairment of HRQoL for those with uncontrolled asthma; Asthma Quality of Life Questionnaire scores ranged from 3.00 to 5.20, whilst EurQoL-5 Dimensions index scores ranged from 0.53 to 0.59. Direct, indirect and total costs together with consumption of other healthcare resources associated with managing uncontrolled asthma were also substantial in the population studied; no caregiver burden was identified. CONCLUSIONS: Our findings suggest that significant unmet needs exist for patients with uncontrolled asthma despite the availability of ICS/LABA therapy. Novel treatments are needed to help reduce the burden to patients, healthcare systems and society.

Ehteshami-Afshar, S., Zafari, Z., Hamidi, N., et al. (2019). "A Systematic Review of Decision-Analytic Models for Evaluating Cost-Effectiveness of Asthma Interventions." *Value Health* **22**(9): 1070-1082.

[https://www.valueinhealthjournal.com/article/S1098-3015\(19\)30193-7/pdf](https://www.valueinhealthjournal.com/article/S1098-3015(19)30193-7/pdf)

OBJECTIVE: To demonstrate the landscape of model-based economic studies in asthma and highlight where there is room for improvement in the design and reporting of studies. DESIGN: A systematic review of the methodologies of model-based, cost-effectiveness analyses of asthma-related interventions was conducted. Models were evaluated for adherence to best-practice modeling and reporting guidelines and assumptions about the natural history of asthma. METHODS: A systematic search of English articles was performed in MEDLINE, EMBASE, and citations within reviewed articles. Studies were summarized and evaluated based on their adherence to the Consolidated Health Economic Evaluation Reporting Standards (CHEERS). We also studied the underlying assumptions about disease progression, heterogeneity in disease course, comorbidity, and treatment effects. RESULTS: Forty-five models of asthma were included (33 Markov models, 10 decision trees, 2 closed-form equations). Novel biological treatments were evaluated in 12 studies. Some of the CHEERS' reporting recommendations were not satisfied, especially for models published in clinical journals. This was particularly the case for the choice of the modeling framework and reporting on heterogeneity. Only 13 studies considered any subgroups, and 2 explicitly considered the impact of



comorbidities. Adherence to CHEERS requirements and the quality of models generally improved over time. CONCLUSION: It would be difficult to replicate the findings of contemporary model-based evaluations of asthma-related interventions given that only a minority of studies reported the essential parameters of their studies. Current asthma models generally lack consideration of disease heterogeneity and do not seem to be ready for evaluation of precision medicine technologies.

El Ferkh, K., Nwaru, B. I., Griffiths, C., et al. (2017). "Healthcare costs of asthma comorbidities: a systematic review protocol." *BMJ Open* 7(5).

<Go to ISI>://WOS:000402533300089

<https://bmjopen.bmj.com/content/bmjopen/7/5/e015102.full.pdf>

**Introduction** Asthma is associated with many comorbid conditions that have the potential to impact on its management, control and outcomes. These comorbid conditions have the potential to impact on healthcare expenditure. We plan to undertake a systematic review to synthesise the evidence on the healthcare costs associated with asthma comorbidity. **Methods and analysis** We will systematically search the following electronic databases between January 2000 and January 2017: National Health Service (NHS) Economic Evaluation Database, Google Scholar, Allied and Complementary Medicine Database (AMED), Global Health, PsychINFO, Medline, Embase, Institute for Scientific Information Web of Science and Cumulative Index to Nursing and Allied Health Literature. We will search the references in the identified studies for additional potential papers. Additional literature will be identified by contacting experts in the field and through searching of registers of ongoing studies. The review will include cost-effectiveness and economic modelling/evaluation studies and analytical observational epidemiology studies that have investigated the healthcare costs of asthma comorbidity. Two reviewers will independently screen studies and extract relevant data from included studies. Methodological quality of epidemiological studies will be assessed using the Effective Public Health Practice Project tool, while that of economic evaluation studies will be assessed using the Drummond checklist. This protocol has been published in International Prospective Register of Systematic Reviews (PROSPERO) database (No. CRD42016051005). **Ethics and dissemination** As there are no primary data collected, formal NHS ethical review is not necessary. The findings of this systematic review will be disseminated in a peer-reviewed journal and presented at relevant conferences.

Farzandipour, M., Nabovati, E., Sharif, R., et al. (2017). "Patient Self-Management of Asthma Using Mobile Health Applications: A Systematic Review of the Functionalities and Effects." *Applied Clinical Informatics* 8(4): 1068-1081.

<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5802317/pdf/10-4338-ACI-2017-07-R-0116.pdf>

**Objective** The aim of this systematic review was to summarize the evidence regarding the effects of mobile health applications (mHealth apps) for self-management outcomes in patients with asthma and to assess the functionalities of effective interventions. **Methods** We systematically searched Medline, Scopus, and the Cochrane Central Register of Controlled Trials. We included English-language studies that evaluated the effects of smartphone or tablet computer apps on self-management outcomes in asthmatic patients. The characteristics of these studies, effects of interventions, and features of mHealth apps were extracted. **Results** A total of 10 studies met all the inclusion criteria. Outcomes that were assessed in the included studies were categorized into three groups (clinical, patient-reported, and economic). mHealth apps improved asthma control (five studies) and lung function (two studies) from the clinical outcomes. From the patient-reported outcomes, quality of life (three studies) was statistically significantly improved, while there was no significant impact on self-efficacy scores (two studies). Effects on economic outcomes were equivocal, so that the number of visits (in two studies) and admission and hospitalization-relevant outcomes (in one study) statistically significantly improved; and in four other studies, these outcomes did not improve significantly. mHealth apps features were categorized into seven categories (inform, instruct, record, display, guide, remind/alert, and communicate). Eight of the 10 mHealth apps included more than one functionality. Nearly all interventions had the functionality of recording user-entered data and half of them had the functionality of providing educational information and reminders to patients. **Conclusion**

Multifunctional mHealth apps have good potential in the control of asthma and in improving the quality of life in such patients compared with traditional interventions. Further studies are needed to identify the effectiveness of these interventions on outcomes related to medication adherence and costs.

Feenstra, T. L., Rutten-Van Mölken, M. P., Jager, J. C., et al. (2002). "Cost effectiveness of guideline advice for children with asthma: a literature review." *Pediatr Pulmonol* **34**(6): 442-454.

<https://onlinelibrary.wiley.com/doi/abs/10.1002/ppul.10177?sid=nlm%3Apubmed>

Asthma is an important chronic disease among children. This study reviews the cost effectiveness of interventions in the long-term care of asthmatic children and compares these results with treatment advice in four current guidelines. Cost-effectiveness studies were searched for in Medline, Embase, Healthstar, Biosis, and the Office of Health Economics-Health Economic Evaluations Database (OHE-HEED), and the Cochrane Library was searched for meta-analyses of clinical trials. In the four reviewed guidelines, cost effectiveness is not explicitly used as a criterion. The cost-effectiveness studies show sufficient evidence for the cost effectiveness of treatment with inhaled steroids and for self-management programs for severe asthmatic patients. Inclusion of these results in the guidelines would not lead to significant changes in current treatment advice. The effectiveness of various measures for trigger avoidance is not fully proven, and hence neither is their cost effectiveness. Available information on the cost effectiveness of cromolyn could be used to focus the guidelines. Finally, evidence exists that organizational interventions, e.g., the employment of asthma nurses, can result in cost savings, but it is unclear to what extent these results can be generalized. More cost-effectiveness studies are needed, especially on long-acting bronchodilators and self-management programs for mild and moderate asthma, in order to help make the guidelines more informative and reduce the differences between them.

Ferikh, K. E., Nwaru, B. I., Griffiths, C., et al. (2017). "Healthcare costs of asthma comorbidities: a systematic review protocol." *BMJ Open* **7**(5): e015102.

<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5730013/pdf/bmjopen-2016-015102.pdf>

**INTRODUCTION:** Asthma is associated with many comorbid conditions that have the potential to impact on its management, control and outcomes. These comorbid conditions have the potential to impact on healthcare expenditure. We plan to undertake a systematic review to synthesise the evidence on the healthcare costs associated with asthma comorbidity. **METHODS AND ANALYSIS:** We will systematically search the following electronic databases between January 2000 and January 2017: National Health Service (NHS) Economic Evaluation Database, Google Scholar, Allied and Complementary Medicine Database (AMED), Global Health, PsychINFO, Medline, Embase, Institute for Scientific Information Web of Science and Cumulative Index to Nursing and Allied Health Literature. We will search the references in the identified studies for additional potential papers. Additional literature will be identified by contacting experts in the field and through searching of registers of ongoing studies. The review will include cost-effectiveness and economic modelling/evaluation studies and analytical observational epidemiology studies that have investigated the healthcare costs of asthma comorbidity. Two reviewers will independently screen studies and extract relevant data from included studies. Methodological quality of epidemiological studies will be assessed using the Effective Public Health Practice Project tool, while that of economic evaluation studies will be assessed using the Drummond checklist. This protocol has been published in International Prospective Register of Systematic Reviews (PROSPERO) database (No. CRD42016051005). **ETHICS AND DISSEMINATION:** As there are no primary data collected, formal NHS ethical review is not necessary. The findings of this systematic review will be disseminated in a peer-reviewed journal and presented at relevant conferences. **PROSPEROREGISTRATION NUMBER:** CRD42016051005.

Halmai, L. A., Neilson, A. R. et Kilonzo, M. (2020). "Economic evaluation of interventions for the treatment of asthma in children: A systematic review." *Pediatr Allergy Immunol* **31**(2): 150-157.

[https://www.pure.ed.ac.uk/ws/files/114277101/AAM\\_Economic\\_evaluation\\_of\\_interventions....pdf](https://www.pure.ed.ac.uk/ws/files/114277101/AAM_Economic_evaluation_of_interventions....pdf)

**OBJECTIVES:** This systematic review aimed to identify and critique full economic evaluations (EEs) of childhood asthma treatments with the intention to guide researchers and commissioners of pediatric asthma services toward potentially cost-effective strategies. **METHODS:** "MEDLINE," "Embase," "EconLit," "NHS EED," and "CEA" databases were searched to identify relevant EEs published between 2005 and May 2017. Quality of included studies was assessed with a published checklist. **RESULTS:** Eighteen studies were identified and comprised one cost-benefit analysis, 11 cost-effectiveness analyses, one cost-minimization analysis, and six cost-utility analyses. Treatments included pharmaceutical (n = 11) and non-pharmaceutical (n = 7) interventions. Fourteen studies identified cost-effective strategies. The quality of the studies varied and there were uncertainties due to the methods and relevance of data used. **CONCLUSION:** Good-quality economic evaluation studies of pediatric asthma treatments are lacking. EE of new technologies adapted to local settings is recommended and can result in cost savings.

Hounsome, N., Fitzsimmons, D., Phillips, C., et al. (2017). "Developing core economic outcome sets for asthma studies: a protocol for a systematic review." *BMJ Open* 7(8): e017054.  
<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5724145/pdf/bmjopen-2017-017054.pdf>

**INTRODUCTION:** Core outcome sets are standardised lists of outcomes, which should be measured and reported in all clinical studies of a specific condition. This study aims to develop core outcome sets for economic evaluations in asthma studies. Economic outcomes include items such as costs, resource use or quality-adjusted life years. The starting point in developing core outcome sets will be conducting a systematic literature review to establish a preliminary list of reporting items to be considered for inclusion in the core outcome set. **METHODS AND ANALYSIS:** We will conduct literature searches of peer-reviewed studies published from January 1990 to January 2017. These will include any comparative or observational studies (including economic models) and systematic reviews reporting economic outcomes. All identified economic outcomes will be tabulated together with the major study characteristics, such as population, study design, the nature and intensity of the intervention, mode of data collection and instrument(s) used to derive an outcome. We will undertake a 'realist synthesis review' to analyse the identified economic outcomes. The outcomes will be summarised in the context of evaluation perspectives, types of economic evaluation and methodological approaches. Parallel to undertaking a systematic review, we will conduct semistructured interviews with stakeholders (including people with personal experience of asthma, health professionals, researchers and decision makers) in order to explore additional outcomes which have not been considered, or used, in published studies. The list of outcomes generated from the systematic review and interviews with stakeholders will form the basis of a Delphi survey to refine the identified outcomes into a core outcome set. **ETHICS AND DISSEMINATION:** The review will not involve access to individual-level data. Findings from our systematic review will be communicated to a broad range of stakeholders including clinical guideline developers, research funders, trial registries, ethics committees and other regulators.

Hutter, N., Knecht, A. et Baumeister, H. (2011). "Health care costs in persons with asthma and comorbid mental disorders: a systematic review." *Gen Hosp Psychiatry* 33(5): 443-453.

**OBJECTIVE:** The aim of this study was to systematically review the impact of comorbid mental disorders on health care costs in adult persons with asthma. **METHOD:** A comprehensive search for studies investigating adult persons ( $\geq 18$  years) with asthma was conducted. All studies were included, which allowed a comparison of health care utilization and costs between asthma patients with mental disorders and asthma patients without. **RESULTS:** The literature search revealed 1977 potentially relevant studies. Eighteen primary studies (20 publications) fulfilled the inclusion criteria. Mood disorders (n=14) and anxiety disorders (n=9) were studied most often. Increased rates of hospitalizations (odds ratio range, 0.9-6.1; n=7), emergency department visits (odds ratio range, 1.8-17.2; n=7) and general practitioner visits (standardized mean difference range, 0.1-1.1; n=6) were found in asthma patients with mental comorbidity. Indirect costs of work absence were investigated in two studies pointing in the same direction of increased costs. Evidence is sparse regarding other outcomes due to a lack of primary studies. **CONCLUSION:** The present systematic review highlights a

meaningful impact of comorbid mental disorders on health care utilization and costs in adult patients with asthma. Thus, psychodiagnostic routines and appropriate mental health treatments are needed to reduce health care costs in asthma care.

Ismaila, A. S., Sayani, A. P., Marin, M., et al. (2013). "Clinical, economic, and humanistic burden of asthma in Canada: a systematic review." *BMC Pulm Med* **13**: 70.

<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4235031/pdf/1471-2466-13-70.pdf>

**BACKGROUND:** Asthma, one of the most common chronic respiratory diseases, affects about 3 million Canadians. The objective of this study is to provide a comprehensive evaluation of the published literature that reports on the clinical, economic, and humanistic burden of asthma in Canada. **METHODS:** A search of the PubMed, EMBASE, and EMCare databases was conducted to identify original research published between 2000 and 2011 on the burden of asthma in Canada. Controlled vocabulary with "asthma" as the main search concept was used. Searches were limited to articles written in English, involving human subjects and restricted to Canada. Articles were selected for inclusion based on predefined criteria like appropriate study design, disease state, and outcome measures. Key data elements, including year and type of research, number of study subjects, characteristics of study population, outcomes evaluated, results, and overall conclusions of the study, were abstracted and tabulated. **RESULTS:** Thirty-three of the 570 articles identified by the clinical and economic burden literature searches and 14 of the 309 articles identified by the humanistic burden literature searches met the requirements for inclusion in this review. The included studies highlighted the significant clinical burden of asthma and show high rates of healthcare resource utilization among asthma patients (hospitalizations, ED, physician visits, and prescription medication use). The economic burden is also high, with direct costs ranging from an average annual cost of \$366 to \$647 per patient and a total annual population-level cost ranging from ~ \$46 million in British Columbia to ~ \$141 million in Ontario. Indirect costs due to time loss from work, productivity loss, and functional impairment increase the overall burden. Although there is limited research on the humanistic burden of asthma, studies show a high (31%-50%) prevalence of psychological distress and diminished QoL among asthma patients relative to subjects without asthma. **CONCLUSIONS:** As new therapies for asthma become available, economic evaluations and assessment of clinical and humanistic burden will become increasingly important. This report provides a comprehensive resource for health technology assessment that will assist decision making on asthma treatment selection and management guidelines in Canada.

Khaw, S. M., Li, S. C. et Mohd Tahir, N. A. (2022). "A systematic review of the cost-effectiveness of medication adherence-enhancing intervention for asthma." *BMJ Open* **59**(4): 697-711.

<https://bmjopen.bmj.com/content/bmjopen/11/2/e040528.full.pdf>

**Objective:** This systematic review aimed to evaluate the cost-effectiveness of medication adherence-improving interventions in patients with asthma. **Data source:** Search engines including PubMed, Scopus and EBSCOhost were used to locate relevant studies from the inception of the databases to 19 October 2018. Drummond's checklist was used to appraise the quality of the economic evaluation. **Study selection:** Economic studies evaluating the cost-effectiveness of medication adherence enhancing interventions for asthmatic patients were selected. Relevant information including study characteristics, quality assessment, health outcomes and costs of intervention were narratively summarized. The primary outcome of interest was cost-effectiveness (CE) values and the secondary outcomes were costs, medication adherence and clinical consequences. **Results:** Twenty studies including 11 randomized controlled trials, 6 comparative studies and 3 modeled studies using Markov models were included in the review. Among these, 15 studies evaluated an educational intervention with 13 showing cost-effectiveness in improving health outcomes. The CE of an internet-based intervention showed similar results between groups, while 3 studies of simplified drug regimens and adding a technology-based training program achieved the desirable cost-effectiveness outcome. **Conclusion:** Overall, our results would support that all of the identified medication adherence-enhancing interventions were cost-effective considering the increased adherence rate, improved clinical effectiveness and the reduced costs of asthma care. However, it was not possible to

identify the most cost-effective intervention. More economic studies with sound methodological conduct will be needed to provide stronger evidence in deciding the best approach to improve medication adherence.

Li, X., Song, P., Zhu, Y., et al. (2020). "The disease burden of childhood asthma in China: a systematic review and meta-analysis." *Turk Thorac J* **10**(1): 010801.

<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7101212/pdf/jogh-10-010801.pdf>

**BACKGROUND:** In China, childhood asthma prevalence showed a remarkable increase in the past decades. An updated epidemiological assessment of childhood asthma in China with a focus on prevalence and time trends is required. **METHODS:** We systematically searched three main Chinese databases and one English database to identify epidemiological studies of the prevalence of childhood asthma in China. Asthma cases were defined according to one of the five sets of Chinese diagnostic criteria which were established by the Children Respiratory Disease Group. We estimated age- and sex-specific prevalence of asthma using a multilevel mixed-effects logistic regression. We presented the time trends of asthma prevalence between 1990 and 2020 by age, sex and setting (urban vs rural), and also estimated the number of children affected by asthma in 2010. **RESULTS:** In 1990, the prevalence of asthma ranged from 0.13% (95% confidence interval (CI) = 0.10-0.20) in rural girls aged 14 years to 1.34% (95% CI = 1.11-1.67) in urban boys aged five years. In 2010, the overall prevalence of asthma in Chinese children aged 0-14 years was 2.12% (95% CI = 1.83-2.51), corresponding to 5.16 million children living with asthma. Children aged 5-9 years were with the highest prevalence estimate of 2.65% (95% CI = 2.31-3.12) and those aged 10-14 years were with the lowest (1.48%, 95% CI = 1.26-1.78). In 2020, it is expected that this disparity will continue, with the prevalence of asthma being at the lowest level among rural girls aged 14 years (1.11%, 95% CI = 0.82-1.54) and at the highest level among urban boys aged four years (10.27%, 95% CI = 8.61-12.18). Over the 30 years (1990-2020), the prevalence of asthma in children aged 0-14 years has increased in both sexes and settings, which was consistently the lowest in rural girls and the highest in urban boys. **CONCLUSIONS:** This study shows that childhood asthma has been increasingly prevalent in China. Asthma is more frequent in boys and in rural areas. The detailed and systematic estimates of asthma prevalence in this study constitute the best currently available basis for policymaking, planning, and allocation of health and welfare resources related to the burden of childhood asthma in China.

McGrady, M. E., Ryan, J. L., Gutierrez-Colina, A. M., et al. (2015). "The impact of effective paediatric adherence promotion interventions: systematic review and meta-analysis." *Child Care Health and Development* **41**(6): 789-802.

Understanding the impact of effective paediatric adherence promotion interventions on patients, families and the healthcare system is necessary to inform efforts to improve healthcare quality and control costs. Building on previous research suggesting that improving adherence may have far-reaching benefits, the objective of this study was to quantify the impact of effective adherence promotion interventions for children and adolescents with a chronic medical condition on patients, families and the healthcare system. Authors systematically reviewed articles indexed in PubMed, PsycINFO and CINAHL to identify randomized controlled trials of paediatric adherence promotion interventions. Interventions that improved paediatric adherence and examined patient-level, family-level or healthcare system-level outcomes in children and adolescents (M age <= 18 years) with a chronic medical condition were included. Two authors independently extracted and classified outcome variables as patient-level (quality of life and disease-related activity restrictions), micro-level (family functioning, family conflict, caregiver quality of life, caregiver sleep interruption, caregiver days away from work and patient missed school days) or macro-level variables (emergency department visits, hospitalizations, outpatient visits and urgent care visits). Outcome variables detailed in previously published reviews (i.e. disease severity) were excluded. Twenty studies representing 19 unique samples met inclusion criteria. An additional eight articles representing trials that did not significantly improve adherence were included in post hoc analyses. Compared with control interventions, effective paediatric adherence promotion interventions improved patient quality of life and family-level outcomes and decreased healthcare utilization among children and adolescents with a chronic

medical condition. Interdisciplinary efforts to improve healthcare quality and reduce spending among children and adolescents with a chronic medical condition may be enhanced by incorporating effective paediatric adherence promotion interventions. As relatively few chronic medical conditions were represented in included studies, future research should examine the impact of paediatric adherence promotion interventions in other populations.

McLean, S., Chandler, D., Nurmatov, U., et al. (2011). "Telehealthcare for asthma: a Cochrane review." *Canadian Medical Association Journal* **183**(11): E733-E742.  
<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3153544/pdf/183e733.pdf>

**Background:** Telehealthcare has the potential to provide care for long-term conditions that are increasingly prevalent, such as asthma. We conducted a systematic review of studies of telehealthcare interventions used for the treatment of asthma to determine whether such approaches to care are effective. **Methods:** We searched the Cochrane Airways Group Specialised Register of Trials, which is derived from systematic searches of bibliographic databases including CENTRAL (the Cochrane Central Register of Controlled Trials), MEDLINE, Embase, CINAHL (Cumulative Index to Nursing and Allied Health Literature) and PsycINFO, as well as other electronic resources. We also searched registers of ongoing and unpublished trials. We were interested in studies that measured the following outcomes: quality of life, number of visits to the emergency department and number of admissions to hospital. Two reviewers identified studies for inclusion in our meta-analysis. We extracted data and used fixed-effect modelling for the meta-analyses. **Results:** We identified 21 randomized controlled trials for inclusion in our analysis. The methods of telehealthcare intervention these studies investigated were the telephone and video- and Internet-based models of care. Meta-analysis did not show a clinically important improvement in patients' quality of life, and there was no significant change in the number of visits to the emergency department over 12 months. There was a significant reduction in the number of patients admitted to hospital once or more over 12 months (risk ratio 0.25 [95% confidence interval 0.09 to 0.66]). **Interpretation:** We found no evidence of a clinically important impact on patients' quality of life, but telehealthcare interventions do appear to have the potential to reduce the risk of admission to hospital, particularly for patients with severe asthma. Further research is required to clarify the cost-effectiveness of models of care based on telehealthcare.

McQueen, R. B., Sheehan, D. N., Whittington, M. D., et al. (2018). "Cost-Effectiveness of Biological Asthma Treatments: A Systematic Review and Recommendations for Future Economic Evaluations." *Pharmacoeconomics* **36**(8): 957-971.  
<https://link.springer.com/article/10.1007/s40273-018-0658-x>

**BACKGROUND:** Recently developed asthma biological therapies have been shown to provide relief for severe asthma patients not controlled by inhaled treatment. Given the relatively high costs of biological therapies, cost-effectiveness analyses (CEAs) may be required as a prerequisite for coverage and reimbursement. **OBJECTIVE:** We aimed to systematically review published literature on the economic impact of biological asthma therapies and to identify key drivers that impact cost-effectiveness in order to provide recommendations for future economic evaluations. **METHODS:** We conducted a systematic literature search in PubMed and Google Scholar. We included studies that assessed the cost-effectiveness of asthma biologics and were published in English between 2000 and 2018. The Quality of Health Economic Studies (QHES) instrument was used to evaluate quality. **RESULTS:** Twenty asthma biological CEAs were identified. Nineteen studies analyzed the cost-effectiveness of omalizumab, and one study analyzed mepolizumab. Ten studies concluded that omalizumab was cost-effective in base-case scenarios, four studies concluded omalizumab was not cost-effective, and the remaining studies concluded omalizumab or mepolizumab was cost-effective only when targeted to specific severe subgroups or given considerable price discounts. Key drivers of cost-effectiveness included day-to-day health-related quality of life (HRQoL), asthma-related mortality, acquisition price of the biological therapy, and time horizon. **CONCLUSIONS:** Most studies recommended carefully targeting biological therapy to specific populations such as responders or discounting acquisition price in order to further improve value. The quality of the studies was generally satisfactory, but improved evidence is needed linking HRQoL to utilities as well as

understanding interventions' impact on asthma-related mortality. Key recommendations from this review may allow for greater comparability across future cost-effectiveness studies.

Milton, B., Whitehead, M., Holland, P., et al. (2004). "The social and economic consequences of childhood asthma across the lifecourse: a systematic review." *Child Care Health Dev* **30**(6): 711-728.  
<https://onlinelibrary.wiley.com/doi/abs/10.1111/j.1365-2214.2004.00486.x?sid=nlm%3Apubmed>

**BACKGROUND:** Asthma prevalence rates are high, and may be increasing in the Western world, particularly among children. The aim of this study was to evaluate the longer-term social and economic consequences of having asthma as a child and to determine whether adverse consequences are more severe for poorer children. **METHODS:** Results from published and unpublished, quantitative and qualitative studies were synthesized narratively to examine the impact of childhood-onset asthma on school attendance, academic achievement and employment in adulthood. The question of whether the impact differed for different social groups was also examined. **FINDINGS:** Twenty-nine good quality studies were identified, including in total 12 183 children with asthma or wheeze. Compared with asymptomatic children, those with asthma missed more days of school (additional absence as a result of asthma ranged from 2.1 to 14.8 days). Studies of academic achievement found that children with asthma performed as well as their healthy peers. The existing evidence on labour market performance is sparse, but there is an indication that people with asthma during childhood experience disadvantage in later employment. In an examination of consequences by social position, children with asthma from deprived areas were more likely to miss school than their more affluent peers, and minority ethnic children were also more likely to have poor school attendance. The only qualitative study suggested that children with asthma strove to participate fully in every aspect of their daily lives. **INTERPRETATION:** Although asthma limits children's daily activities and affects their social activities, this research synthesis found little evidence of major, adverse long-term social and economic consequences in studies reviewed. Further longitudinal research using comparison groups is needed to fill key gaps in the existing evidence base.

Mokoka, M. C., McDonnell, M. J., MacHale, E., et al. (2019). "Inadequate assessment of adherence to maintenance medication leads to loss of power and increased costs in trials of severe asthma therapy: results from a systematic literature review and modelling study." **53**(5).  
<https://bmcpulmed.biomedcentral.com/track/pdf/10.1186/s12890-019-0878-7.pdf>

Adherence to inhaled maintenance therapy in severe asthma is rarely adequately assessed, and its influence on trial outcomes is unknown. We systematically determined how adherence to maintenance therapy is assessed in clinical trials of "add-on" therapy for severe asthma. We model the improvement in trial power that could be achieved by accurately assessing adherence. A systematic search of six major databases identified randomised trials of add-on therapy for severe asthma. The relationship between measuring adherence and study outcomes was assessed. An estimate of potential improvements in statistical power and sample size was derived using digitally recorded adherence trial data. 87 randomised controlled trials enrolling 22 173 participants were included. Adherence assessment was not reported in 67 trials (n=13 931, 63%). Studies that reported adherence used a range of self-report and subjective methods. None of the studies employed an objective assessment of adherence. Studies that reported adherence had a significantly reduced pooled variance in forced expiratory volume in 1 s (FEV(1)) compared to those that did not assess adherence:  $s(2)=0.144$  L(2) versus  $s(2)=0.168$  L(2),  $p<0.0001$ . Power to detect clinically relevant changes in FEV(1) was significantly higher in trials that reported adherence assessment (mean power achieved 59% versus 49%). Modelling suggests that up to 50% of variance in FEV(1) outcomes is attributable to undetected variations in adherence. Controlling for such variations could potentially halve the required sample size. Few trials of add-on therapy monitor adherence to maintenance inhaled therapy, resulting in a greater variance in trial outcomes and inadequate power for determining efficacy.

Narasimhan, K. (2021). "Difficult-to-Treat and Severe Asthma: Management Strategies." *American Family Physician* **103**(5): 286-290.  
<https://www.aafp.org/dam/brand/aafp/pubs/afp/issues/2021/0301/p286.pdf>

Asthma is a common chronic inflammatory disease in the United States. Up to 17% of asthma cases are classified as difficult to treat, and 3.7% of these are considered severe. Uncontrolled asthma is characterized by poor symptom control or frequent exacerbations. In difficult-to-treat asthma, the asthma is uncontrolled despite adherence to inhaled corticosteroid therapy in combination with a second controller, an oral corticosteroid is needed to achieve control, or it is uncontrolled despite oral corticosteroid therapy. Severe asthma is a subset of difficult-to-treat asthma in which the disease is uncontrolled despite adherence to optimal management or it worsens when high-intensity therapy is decreased. The diagnosis of asthma should be confirmed and modifiable factors and comorbidities addressed in patients with difficult-to-treat asthma. An adequate trial of an inhaled corticosteroid and long-acting beta agonist should be implemented with nonbiologic add-on therapies, such as a long-acting muscarinic agent or leukotriene receptor antagonist. Evaluation of severe asthma involves assessment of asthma phenotype. Evidence of type 2 inflammation indicates that the patient may benefit from newer biologic agents. Breathing exercises may improve quality of life, asthma symptoms, lung function, and number of exacerbations. Vitamin D and soy supplementation are ineffective. Bronchial thermoplasty is a procedural option that may be considered if there is inadequate response to other therapies. (Copyright (C) 2021 American Academy of Family Physicians.)

Parker, G., Bhakta, P., Lovett, C. A., et al. (2002). "A systematic review of the costs and effectiveness of different models of paediatric home care." *J Med Internet Res* **6**(35): iii-108.  
<https://njl-admin.nih.ac.uk/document/download/2004583>

Perry, R., Braileanu, G., Palmer, T., et al. (2019). "The Economic Burden of Pediatric Asthma in the United States: Literature Review of Current Evidence." *Pharmacoeconomics* **37**(2): 155-167.  
[https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6386052/pdf/40273\\_2018\\_Article\\_726.pdf](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6386052/pdf/40273_2018_Article_726.pdf)

Asthma is a chronic respiratory disease that is widespread throughout the US population and disproportionately affects children. This literature review aimed to identify recent information regarding the economic burden of pediatric asthma in the US. MEDLINE, EMBASE, Econlit, and PsycINFO databases and gray literature sources were searched from January 2012 to January 2018 to capture relevant publications. Publications reporting on healthcare resource utilization and/or healthcare costs of pediatric asthma were included (n = 8). Total direct costs of pediatric asthma were US\$5.92 billion in 2013. Average annual costs per child ranged from US\$3076 to US\$13612. Across studies, pharmacy (US\$1027-2120), inpatient (US\$337-2016) and outpatient (US\$1049-8039) costs were the primary contributors to healthcare costs. Inpatient and emergency department (ED) visits exerted a high economic burden. For instance, the national annual cost of asthma-related hospitalizations was estimated at US\$1.59 billion in 2009, while estimates of costs-per-hospitalization (2010) and charges-per-discharge (2009) were US\$3600 and US\$8406, respectively. The total cost of ED visits to Medicaid was estimated at US\$272 million in 2010. In a mixed-insurance population, ED cost estimates ranged from US\$152 to US\$172 annually per patient. Invariably, costs for children with asthma were significantly greater than for children without. Pediatric asthma imposes a significant economic burden to the US healthcare system. Children with asthma have significantly higher healthcare resource utilization and costs than children without asthma.

Peters, J., Stevenson, M., Beverley, C., et al. (2002). "The clinical effectiveness and cost-effectiveness of inhaler devices used in the routine management of chronic asthma in older children: a systematic review and economic evaluation." *Health Technol Assess* **6**(5): 1-167.  
<https://core.ac.uk/download/55751.pdf>

Pinnock, H., Parke, H. L., Panagioti, M., et al. (2017). "Systematic meta-review of supported self-management for asthma: a healthcare perspective." *Thorax* **15**(1): 64.  
[https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5356253/pdf/12916\\_2017\\_Article\\_823.pdf](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5356253/pdf/12916_2017_Article_823.pdf)

**BACKGROUND:** Supported self-management has been recommended by asthma guidelines for three decades; improving current suboptimal implementation will require commitment from professionals, patients and healthcare organisations. The Practical Systematic Review of Self-Management Support



(PRISMS) meta-review and Reducing Care Utilisation through Self-management Interventions (RECURSIVE) health economic review were commissioned to provide a systematic overview of supported self-management to inform implementation. We sought to investigate if supported asthma self-management reduces use of healthcare resources and improves asthma control; for which target groups it works; and which components and contextual factors contribute to effectiveness. Finally, we investigated the costs to healthcare services of providing supported self-management. METHODS: We undertook a meta-review (systematic overview) of systematic reviews updated with randomised controlled trials (RCTs) published since the review search dates, and health economic meta-analysis of RCTs. Twelve electronic databases were searched in 2012 (updated in 2015; pre-publication update January 2017) for systematic reviews reporting RCTs (and update RCTs) evaluating supported asthma self-management. We assessed the quality of included studies and undertook a meta-analysis and narrative synthesis. RESULTS: A total of 27 systematic reviews (n = 244 RCTs) and 13 update RCTs revealed that supported self-management can reduce hospitalisations, accident and emergency attendances and unscheduled consultations, and improve markers of control and quality of life for people with asthma across a range of cultural, demographic and healthcare settings. Core components are patient education, provision of an action plan and regular professional review. Self-management is most effective when delivered in the context of proactive long-term condition management. The total cost (n = 24 RCTs) of providing self-management support is offset by a reduction in hospitalisations and accident and emergency visits (standard mean difference 0.13, 95% confidence interval -0.09 to 0.34). CONCLUSIONS: Evidence from a total of 270 RCTs confirms that supported self-management for asthma can reduce unscheduled care and improve asthma control, can be delivered effectively for diverse demographic and cultural groups, is applicable in a broad range of clinical settings, and does not significantly increase total healthcare costs. Informed by this comprehensive synthesis of the literature, clinicians, patient-interest groups, policy-makers and providers of healthcare services should prioritise provision of supported self-management for people with asthma as a core component of routine care. SYSTEMATIC REVIEW REGISTRATION: RECURSIVE: PROSPERO CRD42012002694 ; PRISMS: PROSPERO does not register meta-reviews.

Puig-Junoy, J. et Pascual-Argenté, N. (2017). "[Socioeconomic Costs of Asthma in the European Union, United States and Canada: A Systematic Review]." Rev Esp Salud Publica **91**.

BACKGROUND: Asthma is responsible for a large number of doctor and emergency visits due to exacerbations and inadequate control of the disease, which give rise to very high associated economic costs. The social cost of asthma comprises both the healthcare and non-healthcare costs. The purpose of this study was to analyse up-to-date estimates of the social cost of asthma, with special reference to the influence of level of severity and degree of control. METHODS: A systematic review of original cost-of-illness studies of asthma published in English or Spanish between January 2004 and December 2014 and indexed in PubMed, IBECs or IME was conducted. RESULTS: 29 cost-of-illness studies of asthma were identified, 21 of which used the societal perspective. Only 10 studies estimated the incremental cost of asthma with a control group, and none of them refers to EU countries. Of these 10, only 4 were regarded as high-quality evidence, insofar as they combined a matched control with regression models. The annual incremental cost of asthma in adults ranged from €416 to €5,317. The incremental healthcare cost of asthma increased with level of severity, from €964 for intermittent asthma to €11,703 for severe persistent asthma in adults. In adults, the incremental non-healthcare cost of asthma ranged from €136 to €3,461. CONCLUSIONS: Selected studies in this review show great heterogeneity due to different population characteristics, study designs and valuation methods, which limits their comparability. However, it can be concluded that incremental healthcare costs of asthma, compared to people without asthma, exceeds seven hundred Euros (valued in 2013) in most of the reviewed estimation for several countries. This figure is greater for studies from the United States. The incremental cost per patient increases very rapidly with level of severity and decreases with asthma patient control.

Rodriguez-Martinez, C. E. (2018). "Cost Effectiveness of Pharmacological Treatments for Asthma: A Systematic Review." J Med Econ **36**(10): 1165-1200.

<https://link.springer.com/article/10.1007/s40273-018-0668-8>

**OBJECTIVE:** The objective of this article was to summarize the findings of all the available studies on alternative pharmacological treatments for asthma and assess their methodological quality, as well as to identify the main drivers of the cost effectiveness of pharmacological treatments for the disease.

**METHODS:** A systematic review of the literature in seven electronic databases was conducted in order to identify all the available health economic evidence on alternative pharmacological treatments for asthma published up to April 2017. The reporting quality of the included studies was assessed using the Consolidated Health Economic Evaluation Reporting Standards (CHEERS) statement.

**RESULTS:** A total of 72 studies were included in the review, classified as follows: medications for acute asthma treatment (n = 5, 6.9%); inhaled corticosteroids (ICS) administered alone or in conjunction with long-acting  $\beta$ -agonists (LABA) or tiotropium for chronic asthma treatment (n = 38, 52.8%); direct comparisons between different combinations of ICS, ICS/LABA, leukotriene receptor antagonists (LTRA), and sodium cromoglycate for chronic asthma treatment (n = 14, 19.4%); and omalizumab for chronic asthma treatment (n = 15, 20.8%). ICS were reported to be cost effective when compared with LTRA for the management of persistent asthma. In patients with inadequately controlled asthma taking ICS, the addition of long-acting  $\beta$ -agonist (LABA) preparations has been demonstrated to be cost effective, especially when combinations of ICS/LABA containing formoterol are used for both maintenance and reliever therapy. In patients with uncontrolled severe persistent allergic asthma, omalizumab therapy could be cost effective in a carefully selected subgroup of patients with the more severe forms of the disease. The quality of reporting in the studies, according to the CHEERS checklist, was very uneven. The main cost-effectiveness drivers identified were the cost or rate of asthma exacerbations, the cost or rate of the use of asthma medications, the asthma mortality risk, and the rate of utilization of health services for asthma.

**CONCLUSIONS:** The present findings are in line with the pharmacological recommendations for stepwise management of asthma given in the most recent evidence-based clinical practice guidelines for the disease. The identified reporting quality of the available health economic evidence is useful for identifying aspects where there is room for improvement in future asthma cost-effectiveness studies.

Sanders, D. L. et Aronsky, D. (2006). "Biomedical informatics applications for asthma care: a systematic review." *J Am Med Inform Assoc* **13**(4): 418-427.

<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC1513670/pdf/418.06000648.pdf>

Asthma is a common condition associated with significant patient morbidity and health care costs. Although widely accepted evidence-based guidelines for asthma management exist, unnecessary variation in patient care remains. Application of biomedical informatics techniques is one potential way to improve care for asthmatic patients. We performed a systematic literature review to identify computerized applications for clinical asthma care. Studies were evaluated for their clinical domain, developmental stage and study design. Additionally, prospective trials were identified and analyzed for potential study biases, study effects, and clinical study characteristics. Sixty-four papers were selected for review. Publications described asthma detection or diagnosis (18 papers), asthma monitoring or prevention (13 papers), patient education (13 papers), and asthma guidelines or therapy (20 papers). The majority of publications described projects in early stages of development or with non-prospective study designs. Twenty-one prospective trials were identified, which evaluated both clinical and non-clinical impacts on patient care. Most studies took place in the outpatient clinic environment, with minimal study of the emergency department or inpatient settings. Few studies demonstrated evidence of computerized applications improving clinical outcomes. Further research is needed to prospectively evaluate the impact of using biomedical informatics to improve care of asthmatic patients.

Silva, N., Carona, C., Crespo, C., et al. (2015). "Quality of life in pediatric asthma patients and their parents: a meta-analysis on 20 years of research." *Expert Rev Pharmacoecon Outcomes Res* **15**(3): 499-519.

<Go to ISI>://WOS:000354557000016

<https://www.tandfonline.com/doi/full/10.1586/14737167.2015.1008459>

**Introduction:** This meta-analytic review was conducted to estimate the magnitude of quality of life (QoL) impairments in children/adolescents with asthma and their parents. **Method:** A systematic search in four electronic databases revealed 15 quantitative studies published between 1994-2013 that directly compared the QoL of 7- to 18-year-old asthma patients/parents to community/healthy controls. Pooled mean differences (MD) with 95% CI were estimated using the inverse-variance random-effects method.

Results: Pediatric asthma patients (n = 1797) presented lower overall QoL (MD = -7.48, CI: -10.67/-4.29), physical functioning (MD = -9.36, CI: -11.85/-6.86), psychological functioning (MD = -5.00, CI: -7.17/-2.82) and social functioning (MD = -3.76, CI: -5.80/-1.72), compared to controls (n = 13,266). For parents (666 cases and 7328 controls), asthma was associated with lower physical functioning (MD = -10.15, CI: -12.21/-8.08). Between-studies heterogeneity was explained by type of informant and selection of controls. Conclusion: The ascertainment of the magnitude of QoL impairments and the most affected QoL dimensions for pediatric asthma patients/parents may contribute to the outlining of realistic goals for multidisciplinary interventions in healthcare settings and evaluate its cost-effectiveness.

Smith, J. R., Mugford, M., Holland, R., et al. (2005). "A systematic review to examine the impact of psycho-educational interventions on health outcomes and costs in adults and children with difficult asthma." *Health Technol Assess* 9(23): iii-iv, 1-167.

<https://njl-admin.nihr.ac.uk/document/download/2004973>

**OBJECTIVES:** Prior research has highlighted the importance of psychosocial factors in 'difficult' asthma. This study aimed to review the content, effectiveness and cost-effectiveness of psycho-educational interventions designed to address these factors in patients with severe and difficult asthma. **DATA SOURCES:** Thirty-two electronic databases and other sources were searched for studies of educational, self-management, psychosocial and multifaceted interventions. **REVIEW METHODS:** Abstracts were screened in duplicate, against prior definitions, to identify eligible interventions targeted to patients with forms of or risk factors for difficult asthma. Studies were classified by patient group (child, adult) and graded along two dimensions related to study design and relevance in terms of the degree to which they were judged to have targeted difficult asthma. Detailed data were extracted from studies meeting a minimum design and relevance threshold. Characteristics of studies were tabulated and results qualitatively synthesised. Where sufficiently similar studies reported adequate data about comparable outcomes, quantitative syntheses of results were undertaken using a random effects approach to calculate pooled relative risks (RR) or standardised mean differences (SMD), with 95% confidence intervals (CI). **RESULTS:** Searches identified over 23,000 citations. After initial screening and removal of duplicates, 4240 possibly relevant abstracts were assessed. Papers associated with 188 studies were initially obtained and classified. Fifty-seven studies including control groups and those that were judged to have at least 'possible' targeting of difficult asthma (35 in children, 21 in adults, 1 in both) were selected for in-depth review. The delivery, setting, timing and content of interventions varied considerably even within broad types. Reporting of interventions and methodological quality was often poor, but studies demonstrated some success in targeting and following up at-risk patients. Studies reporting data suitable for calculation of summary statistics were of higher quality than those that did not. There was evidence from these that, compared to usual or non-psycho-educational care, psycho-educational interventions reduced admissions when data from the latest follow-ups reported were pooled across nine studies in children (RR = 0.64, CI = 0.46-0.89) and six studies with possible targeting of difficult asthma in adults (RR = 0.57, CI = 0.34-0.93). In children, the greatest and only significant effects were confined to individual studies with limited targeting of difficult asthma and no long-term follow-up. Limited data in adults also suggested effects may not extend to those most at risk. There was no evidence of pooled effects of psycho-educational interventions on emergency attendances from eight studies in children (RR = 0.97, CI = 0.78-1.21) and four in adults (RR = 1.03, CI = 0.82-1.29). There were overall significant reductions in symptoms, similar in different sub-groups of difficult asthma, across four paediatric studies that could be combined (SMD = -0.45, CI = -0.68 to -0.22), but mixed results across individual adult studies. A few individual studies in children showed mainly positive effects on measures of self-care behaviour, but with respect to all other outcomes in adults and children, studies showed mixed results or suggested limited effectiveness of psycho-educational interventions. No studies of psychosocial interventions were included in any quantitative syntheses and it was not possible to draw clear conclusions regarding the relative effectiveness of educational, self-management and multifaceted programmes. Data on costs were very limited. Of the two well-designed economic evaluations identified, both of multifaceted interventions, one in children suggested an additional cost of achieving health gain in terms of symptom-free days. Provisional data from the other study suggested that in adults the significantly increased costs of providing an intervention were not offset by any short-term savings in use of healthcare resources or associated with improvements in health outcomes. **CONCLUSIONS:** There was some evidence of overall positive effects of psycho-educational interventions on hospital admissions in

adults and children, and on symptoms in children, but limited evidence of effects on other outcomes. The majority of research and greatest effects, especially in adults, were confined to patients with severe disease but who lacked other characteristics indicative of difficult asthma or likely to put them at risk. A lack of good-quality research limited conclusions about cost-effectiveness. Although psycho-educational interventions may be of some benefit to patients with severe disease, there is currently a lack of evidence to warrant significant changes in clinical practice with regard to the care of patients with more difficult asthma. Further research is needed to: (1) standardise reporting of complex interventions; (2) extend and update this review; (3) improve identification of patients at risk from their asthma; (4) develop and test appropriate outcome measures for this group; and (5) design and evaluate, via the conduct of high-quality pragmatic RCTs, more powerful psycho-educational interventions that are conceptualised in terms of the ways in which psychosocial factors and asthma interact.

Song, X. et Hallensleben, C. (2021). "Blended Self-Management Interventions to Reduce Disease Burden in Patients With Chronic Obstructive Pulmonary Disease and Asthma: Systematic Review and Meta-analysis." *23*(3): e24602. <https://njl-admin.nihr.ac.uk/document/download/2004973>

**BACKGROUND:** Chronic obstructive pulmonary disease (COPD) and asthma have a high prevalence and disease burden. Blended self-management interventions, which combine eHealth with face-to-face interventions, can help reduce the disease burden. **OBJECTIVE:** This systematic review and meta-analysis aims to examine the effectiveness of blended self-management interventions on health-related effectiveness and process outcomes for people with COPD or asthma. **METHODS:** PubMed, Web of Science, COCHRANE Library, Emcare, and Embase were searched in December 2018 and updated in November 2020. Study quality was assessed using the Cochrane risk of bias (ROB) 2 tool and the Grading of Recommendations, Assessment, Development, and Evaluation. **RESULTS:** A total of 15 COPD and 7 asthma randomized controlled trials were included in this study. The meta-analysis of COPD studies found that the blended intervention showed a small improvement in exercise capacity (standardized mean difference [SMD] 0.48; 95% CI 0.10-0.85) and a significant improvement in the quality of life (QoL; SMD 0.81; 95% CI 0.11-1.51). Blended intervention also reduced the admission rate (relative ratio [RR] 0.61; 95% CI 0.38-0.97). In the COPD systematic review, regarding the exacerbation frequency, both studies found that the intervention reduced exacerbation frequency (RR 0.38; 95% CI 0.26-0.56). A large effect was found on BMI (d=0.81; 95% CI 0.25-1.34); however, the effect was inconclusive because only 1 study was included. Regarding medication adherence, 2 of 3 studies found a moderate effect (d=0.73; 95% CI 0.50-0.96), and 1 study reported a mixed effect. Regarding self-management ability, 1 study reported a large effect (d=1.15; 95% CI 0.66-1.62), and no effect was reported in that study. No effect was found on other process outcomes. The meta-analysis of asthma studies found that blended intervention had a small improvement in lung function (SMD 0.40; 95% CI 0.18-0.62) and QoL (SMD 0.36; 95% CI 0.21-0.50) and a moderate improvement in asthma control (SMD 0.67; 95% CI 0.40-0.93). A large effect was found on BMI (d=1.42; 95% CI 0.28-2.42) and exercise capacity (d=1.50; 95% CI 0.35-2.50); however, 1 study was included per outcome. There was no effect on other outcomes. Furthermore, the majority of the 22 studies showed some concerns about the ROB, and the quality of evidence varied. **CONCLUSIONS:** In patients with COPD, the blended self-management interventions had mixed effects on health-related outcomes, with the strongest evidence found for exercise capacity, QoL, and admission rate. Furthermore, the review suggested that the interventions resulted in small effects on lung function and QoL and a moderate effect on asthma control in patients with asthma. There is some evidence for the effectiveness of blended self-management interventions for patients with COPD and asthma; however, more research is needed. **TRIAL REGISTRATION:** PROSPERO International Prospective Register of Systematic Reviews CRD42019119894; [https://www.crd.york.ac.uk/prospero/display\\_record.php?RecordID=119894](https://www.crd.york.ac.uk/prospero/display_record.php?RecordID=119894).

Sossa-Briceño, M. P., Castro-Rodriguez, J. A., Li, X., et al. (2020). "The disease burden of childhood asthma in China: a systematic review and meta-analysis." *Pharmacoeconomics* **10**(1): 010801. <https://link.springer.com/article/10.1007/s40273-018-0668-8>

**BACKGROUND:** In China, childhood asthma prevalence showed a remarkable increase in the past decades. An updated epidemiological assessment of childhood asthma in China with a focus on prevalence and time trends is required. **METHODS:** We systematically searched three main Chinese

databases and one English database to identify epidemiological studies of the prevalence of childhood asthma in China. Asthma cases were defined according to one of the five sets of Chinese diagnostic criteria which were established by the Children Respiratory Disease Group. We estimated age- and sex-specific prevalence of asthma using a multilevel mixed-effects logistic regression. We presented the time trends of asthma prevalence between 1990 and 2020 by age, sex and setting (urban vs rural), and also estimated the number of children affected by asthma in 2010. RESULTS: In 1990, the prevalence of asthma ranged from 0.13% (95% confidence interval (CI) = 0.10-0.20) in rural girls aged 14 years to 1.34% (95% CI = 1.11-1.67) in urban boys aged five years. In 2010, the overall prevalence of asthma in Chinese children aged 0-14 years was 2.12% (95% CI = 1.83-2.51), corresponding to 5.16 million children living with asthma. Children aged 5-9 years were with the highest prevalence estimate of 2.65% (95% CI = 2.31-3.12) and those aged 10-14 years were with the lowest (1.48%, 95% CI = 1.26-1.78). In 2020, it is expected that this disparity will continue, with the prevalence of asthma being at the lowest level among rural girls aged 14 years (1.11%, 95% CI = 0.82-1.54) and at the highest level among urban boys aged four years (10.27%, 95% CI = 8.61-12.18). Over the 30 years (1990-2020), the prevalence of asthma in children aged 0-14 years has increased in both sexes and settings, which was consistently the lowest in rural girls and the highest in urban boys. CONCLUSIONS: This study shows that childhood asthma has been increasingly prevalent in China. Asthma is more frequent in boys and in rural areas. The detailed and systematic estimates of asthma prevalence in this study constitute the best currently available basis for policymaking, planning, and allocation of health and welfare resources related to the burden of childhood asthma in China.

Stirbulov, R., Lopes da Silva, N., Maia, S. C., et al. (2016). "Cost of severe asthma in Brazil-systematic review." *J Asthma* **53**(10): 1063-1070.

<https://www.tandfonline.com/doi/full/10.3109/02770903.2016.1171338>

INTRODUCTION: Severe asthma is characterized by frequent exacerbations, symptoms limiting daily activities and nocturnal symptoms. It requires the continuous use of medications, at high doses, and, sometimes, continuous use of oral corticosteroids, representing a significant burden to health system and society. This systematic review sought to address economic data related to severe asthma in Brazil. METHOD: In June 2014, electronic searches were conducted to identify relevant publications. Quality criteria were developed and applied to each selected study. In order to compare results across the selected studies, costs were refined to an annual basis, grouped according to the study perspective, inflated and converted to 2014 USD. RESULTS: Cost analyses from the Brazilian public health system perspective were derived from two studies and showed an average annual hospital cost per patient of 135 USD and 733 USD, respectively. From the family perspective, average annual direct costs per patient varied from 764 USD to 929 USD. CONCLUSION: Hospitalizations and medications seem to be the most important resources funded by the Brazilian public health system and by patients and their families. Although further studies are necessary, as information on cost of this disease is scarce in Brazil, these findings suggest that there is a potential room for improving severe asthma care among Brazilian patients.

van Eeden, M., van Heugten, C. M., van Mastrigt, G., et al. (2016). "Economic evaluation studies of self management interventions in chronic diseases. A systematic disease." *Int J Technol Assess Health Care* **32**(1-2): 16-28.

Background: To our knowledge, there has been no overall systematic review focusing on the methodological quality of full economic evaluation studies of self-management interventions. Our objective was to systematically review the literature of full economic evaluation studies of self-management interventions in adult chronic patients and to investigate their methodological quality and cost-effectiveness. Methods: A data extraction form was developed to assess general and randomized controlled trial (RCT) -related characteristics, quality, of the RCTs, economic information and quality of the economic evaluation studies by means of a quality assessment (CHEC-list for trial-based studies, adjusted CHEC-list for model-based studies). Results: Twenty-three reports were found. Sixteen studies (73 percent) lack information on the control intervention(s). Only one study fulfilled all three criteria for quality of RCTs and five studies (23 percent) did not meet any of these criteria. This review included one model-based study; the other studies were trial-based economic evaluation studies based on a RCT.

Eight studies (35 percent) used a societal perspective and 12 (60 percent) synthesized costs and effects. Seven studies were categorized into the highest category (<15 score), nine studies into the moderate group (9-14 score), six studies received a low score (<8) on the CHEC-list. Eighteen studies found the self-management intervention(s) to be cost-effective compared with other interventions. Conclusions: Self-management interventions for adult chronic patients were heterogeneous and there was no clear, well-considered definition of self-management. Overall, the methodological quality of the full economic evaluation studies was moderate and, therefore, cost-effectiveness results must be interpreted with caution. Future research will benefit from further improvements in methodological quality of both economic study design and analysis, as well as a taxonomy for describing self-management interventions and their contents.

Willems, D. C., Joore, M. A., Hendriks, J. J., et al. (2006). "Cost-effectiveness of self-management in asthma: a systematic review of peak flow monitoring interventions." *Int J Technol Assess Health Care* **22**(4): 436-442.  
<https://www.cambridge.org/core/journals/international-journal-of-technology-assessment-in-health-care/article/abs/costeffectiveness-of-selfmanagement-in-asthma-a-systematic-review-of-peak-flow-monitoring-interventions/1D675607DD9A5A2689EB5E927136BB93>

**OBJECTIVES:** It is generally accepted that home peak flow monitoring increases patients' self-management and could lead to cost savings. The aim of this review was to analyze costs and the cost-effectiveness of self-management based on peak flow monitoring interventions in asthma. **METHODS:** Twenty-one studies were included in this review. Data were extracted, and methodological and economic quality were assessed. These studies presented economic information regarding self-management interventions based on peak flow monitoring in asthmatics. The mean methodological quality was 4.6 (maximum 8), and the mean economic quality was 12.0 (maximum 15). **RESULTS:** In eighteen studies, the interventions led to net savings compared with usual care or less intensive intervention. Only three studies found the total costs to be higher in the intervention group. In thirteen of the seventeen studies that analyzed health outcomes, at least one of the reported health outcomes improved statistically significantly after the intervention. However, the methods of economic evaluation differed among the studies and were not always in line with the standard methodology. **CONCLUSIONS:** The interventions, costs, and outcomes were very diverse. The results emphasize the need for guidelines to increase the comparability of cost-effectiveness evaluations relating to asthma. Only then will it be possible to conclude whether interventions for asthmatics, such as self-management based on peak flow monitoring interventions, are cost-effective.

Zhang, S. et King, D. (2020). "Impact of Single Combination Inhaler versus Multiple Inhalers to Deliver the Same Medications for Patients with Asthma or COPD: A Systematic Literature Review." **15**: 417-438.  
<https://www.dovepress.com/getfile.php?fileID=56374>

With increasing choice of medications and devices for asthma and chronic obstructive pulmonary disease (COPD) treatment, comparative evidence may inform treatment decisions. This systematic literature review assessed clinical and economic evidence for using a single combination inhaler versus multiple inhalers to deliver the same medication for patients with asthma or COPD. In 2016, Embase, PubMed and the Cochrane library were searched for publications reporting studies in asthma or COPD comparing a single-inhaler combination medicine with multiple inhalers delivering the same medication. Publications included English-language articles published since 1996 and congress abstracts since 2013. Clinical, economic and adherence endpoints were assessed. Of 2031 abstracts screened, 18 randomized controlled trials (RCTs) in asthma and four in COPD, nine retrospective and three prospective observational studies in asthma, and four observational studies in COPD were identified. Of these, five retrospective and one prospective study in asthma, and two retrospective studies in COPD reported greater adherence with a single inhaler than multiple inhalers. Nine observational studies reported significantly (n=7) or numerically (n=2) higher rates of adherence with single- versus multiple-inhaler therapy. Economic analyses from retrospective and prospective studies showed that use of single-inhaler therapies was associated with reduced healthcare resource use (n=6) and was cost-effective (n=5) compared with multiple-inhaler therapies. Findings in 18 asthma RCTs and one prospective study reporting lung function, and six RCTs reporting exacerbation rates, showed no significant differences between a single inhaler and multiple inhalers. This was in contrast to several observational studies

reporting reductions in healthcare resource use or exacerbation events with single-inhaler treatment, compared with multiple inhalers. Retrospective and prospective studies showed that single-inhaler use was associated with decreased healthcare resource utilization and improved cost-effectiveness compared with multiple inhalers. Lung function and exacerbation rates were mostly comparable in the RCTs, possibly due to study design.

Zhao, F. L., Xie, F., Hu, H., et al. (2013). "Transferability of indirect cost of chronic disease: a systematic review and meta-analysis." *Pharmacoeconomics* **31**(6): 501-508.

<https://link.springer.com/article/10.1007/s40273-013-0053-6>

**BACKGROUND:** Indirect cost is an important component in economic evaluations. The variation in the magnitude of indirect costs across studies and countries is substantial and affects the transferability of results across jurisdictions. **OBJECTIVE:** This study explored the factors involved in the variation of reported indirect cost and investigated the feasibility of transferring indirect costs across settings. **METHODS:** A systematic literature review was conducted to identify studies estimating indirect costs for four selected chronic diseases, namely, asthma (AS), diabetes (DI), rheumatoid arthritis (RA) and schizophrenia (SC). A multiple linear regression analysis was run to identify the factors that potentially explain the variation in reported indirect costs. Parametric (fixed- and random-effect models) and non-parametric (bootstrapping method) meta-analyses were applied to local gross domestic product (GDP)/capita-adjusted indirect costs for each disease. Results from the three different analytical methods were compared to ascertain the robustness of estimation. **RESULTS:** The systematic literature review identified 77 articles that reported indirect costs of AS (n = 18), DI (n = 20), RA (n = 25) and SC (n = 14) for literature synthesis. Substantial inter- and intra-disease variations among the indirect cost studies were observed with respect to geographic distribution, methodology and magnitude of cost estimation. Regression analysis showed that disease categories and local GDP/capita significantly ( $p < 0.001$ ) contributed to the variance of indirect cost. The range of intra-disease variation in indirect costs was substantially reduced after adjusting by and expressing values as local GDP/capita. The GDP-adjusted indirect cost in terms of percentage of local GDP/capita of AS was the lowest and that of SC was the highest. Bootstrapping estimation was relatively conservative, with slightly wider confidence intervals (CIs) than the parametric method, with a mean (95 % CI) of 2.12 % (1.4089-2.9332) for AS, 10.65 % (7.215-14.7438) for DI, 21.98 % (17.4360-27.0631) for RA, and 79.19 % (52.4243-117.833) for SC. **CONCLUSION:** It would be convenient and feasible to construct a universal reference range of indirect cost for a specific disease based on existing data and present this as a percentage of local GDP to assist local decision making in jurisdictions where indirect cost data are not available.

## ÉTUDES FRANÇAISES

Afsset (2007). Impacts économiques des pathologies liées à la pollution - Étude d'impact sur les coûts que représentent pour l'Assurance maladie certaines pathologies liées à la pollution : Illustration avec l'asthme et le cancer. Maison Alfort Afsset: 139.

<https://www.anses.fr/fr/system/files/AIR2007et9000Ra.pdf>

Cette étude a considéré d'une part l'évaluation des effets des modifications de l'environnement sur la santé, d'autre part l'évaluation économique de ces effets. En fonction des données disponibles, deux pathologies ont été retenues pour cette étude : l'asthme et les cancers. Il a été évalué que le coût de traitement de l'asthme imputable à la pollution atmosphérique extérieure non biologique était compris entre 200 et 800 millions d'euros pour l'année 2006 en estimant que 10 à 35 % des cas d'asthme étaient attribuables à l'environnement et après extrapolation des dépenses estimées pour l'année 1999 (avec un taux de progression de + 43 %) ; le coût de la prise en charge des soins du cancer attribuable à l'environnement est de l'ordre de 100 à 500 millions d'euros en 2004, avec une fraction attribuable à l'environnement pour tous les cancers variant entre 1 et 5 %. Compte tenu des fortes incertitudes portant sur les données disponibles, le groupe d'étude recommande d'approfondir les connaissances autant dans le champ de l'évaluation sanitaire qu'économique avec le développement d'indicateurs synthétiques de santé à l'instar de certains travaux développés au niveau européen ou international. Il recommande également la mise en place d'un processus

d'expertise collective utilisant les compétences spécifiques afin de réaliser des évaluations économiques les plus complètes possibles permettant d'apprécier l'ensemble du retentissement de l'environnement sur la santé, en se concentrant sur les pathologies considérées comme prioritaires par les pouvoirs publics. Les risques liés à l'environnement professionnel devront également être considérés afin de développer des mesures de prévention efficaces.

Belhassen, M., Demoly, P., Bloch-Morot, E., et al. (2017). "Costs of perennial allergic rhinitis and allergic asthma increase with severity and poor disease control." *Allergy* **72**(6): 948-958.

**BACKGROUND:** Perennial allergic rhinitis (PAR) represents a global and public health problem, due to its prevalence, morbidity, and impact on the quality of life. PAR is frequently associated with allergic asthma (AA). Costs of PAR with or without AA are poorly documented. **OBJECTIVE:** Our study aimed to detail medical resource utilization (MRU) and related direct cost for PAR, with or without concomitant AA, in France. **METHODS:** Using Electronic Health Records (EHRs), we identified in 2010 two cohorts of PAR patients, based on General Practitioners' diagnoses and prescribing data, with and without concomitant AA. For each patient, the EHRs were linked to corresponding claims data with MRU and costs during years 2011 to 2013. Predefined subgroup analyses were performed according to severity of PAR and level of AA control. **RESULTS:** The median annual cost reimbursed by social security system for a patient with PAR, and no AA was 159€ in 2013. This varied from 111€ to 188€ depending on PAR severity. For patients with PAR and concomitant AA, the median annual cost varied between 266€ and 375€, and drug treatment accounted for 42-55% of the costs, depending on asthma control. **CONCLUSION:** This study linking diagnoses from EHRs to claims data collected valid information on PAR management, with or without concomitant AA, and on related costs. There was a clear increase in costs with severity of PAR and control of AA.

Bourdin, A., Fabry-Vendrand, C., Ostinelli, J., et al. (2019). "The Burden of Severe Asthma in France: A Case-Control Study Using a Medical Claims Database." *J Allergy Clin Immunol Pract* **7**(5): 1477-1487.

<https://www.tandfonline.com/doi/full/10.1080/02770903.2019.1674330>

**BACKGROUND:** Severe asthma (SA) is defined by treatment intensity. The availability of national databases allows accurate estimation of the prevalence, long-term outcomes, and costs of SA. **OBJECTIVE:** To provide accurate information on SA, focusing on comorbidities, mortality, health care resource consumption, and associated costs. **METHODS:** A cohort of patients with SA identified in 2012 was extracted from a French representative claims database and followed for 3 years. Their characteristics, comorbidities, mortality, and direct costs were compared with a matched control group without asthma. **RESULTS:** A total of 690 patients with SA were matched to 2070 patients without asthma (mean age, 61 years; 65.7% women). The prevalence of SA was estimated to be 0.18% to 0.51% of the French adult population. Comorbidities were more frequent in patients with SA (73.9% suffered from cardiovascular disease vs 54.3% in controls;  $P < .001$ ). A total of 58.7% of patients with SA used oral corticosteroids (OCS) in 2012 with a mean intake of 3.3 boxes/year/patient and 9% received  $\geq 6$  dispensings of OCS. A total of 6.7% were treated by omalizumab. Patients with SA were more frequently hospitalized (33.2% vs 19.7%;  $P < .001$ ), more frequently consulted a general practitioner (97.8% vs 83.9%;  $P < .001$ ) ( $9.8 \pm 6.8$  vs  $6.2 \pm 5.3$  consultations/year;  $P < .001$ ), and 31% have consulted a private respiratory physician. Compared with controls, 3-year cumulative mortality was higher in SA (7.1% vs 4.5%;  $P = .007$ ). Direct medical cost was \$9227 versus \$3950 ( $P < .001$ ) mostly driven by medication costs. **CONCLUSIONS:** The prevalence of SA in the French adult population is at least 18 of 10,000. Burden of disease is high with respect to comorbidities, mortality, and asthma-related health care resource use.

Chouaid, C., Vergnenegre, A., Vandewalle, V., et al. (2004). "Coûts de l'asthme en France : modélisation médico-économique par un modèle de Markov." *Revue Des Maladies Respiratoires* **21**(3): 493-499.

Cnam (2001). *Faits marquants Assurance Maladie : des soins de qualité pour tous : 22 études*. Paris Cnamts: 167, ann., tabl.



L'Assurance Maladie présente pour la deuxième année consécutive son édition des « Faits marquants ». Ces publications ont pour finalité d'apporter un éclairage objectif sur des sujets de santé publique et de partager les observations recueillies dans les enquêtes du Service Médical afin que l'Assurance Maladie puisse engager un dialogue avec ses différents interlocuteurs à partir de données concrètes, vérifiées, plutôt que sur la « base d'opinions ». Ce document rassemble donc une synthèse de 22 études significatives menées ces dernières années par le Régime général de l'Assurance Maladie et les autres régimes afin d'améliorer la qualité des soins : analyse des pratiques des professionnels de santé, des assurés, de l'organisation du système de soins, du respect des textes réglementaires. Ces travaux sont répartis selon cinq chapitres qui correspondent aux types d'activité dans lesquels le Service Médical s'investit en collaboration avec les caisses : les programmes de santé publique, les audits avec retour d'informations, les contrôles, les avis sur les demandes de prestations des bénéficiaires, et les études relatives à la planification et à l'allocation de ressources dans le domaine de l'hospitalisation. Ce document est disponible sur le site de la CNAMTS :

<http://www.cnamts.fr/pre/enq/somenq.htm> => Etudes médicales.

- Voir aussi les « Charges et produits » de la Cnam

Deprez, P. H., Chinaud, F., Clech, S., et al. (2004). "La population traitée par médicaments de la classe des antiasthmatiques en France métropolitaine : données du régime général de l'assurance maladie, 2000." Revue Medicale De L'assurance Maladie(1): 3-11.

[BDSP. Notice produite par CNAMTS 6mR0xOpa. Diffusion soumise à autorisation]. Cet article a pour objectifs d'évaluer et de décrire la population des bénéficiaires du régime général ayant été remboursés de médicaments de la classe des antiasthmatiques en 2000, de connaître les disparités géographiques et d'analyser les pratiques de prescription médicamenteuse. Il en ressort que le recours aux antiasthmatiques est fréquent, plus d'une personne sur dix dans l'année, et que l'importante proportion de délivrance annuelle unique pose les questions du diagnostic, du respect de l'AMM, de l'observance et, plus généralement, de la prise en charge de l'asthme et des broncho-pneumopathies chroniques obstructives.

Dib, F., de Rycke, Y., Guillo, S., et al. (2019). "Impact of a population-based asthma management program in France (Sophia Asthme): A matched controlled before-and-after quasi-experimental study using the French health insurance database (SNDS)." Pharmacoepidemiol Drug Saf **28**(8): 1097-1108.

<https://hal.sorbonne-universite.fr/hal-02289350/document>

**PURPOSE:** Sophia Asthme (SA) is a chronic disease management program of the French national health insurance for adult patients with asthma. We evaluated the early impact of this intervention. **METHODS:** We conducted a matched controlled, before-and-after quasi-experimental study within the French Health Insurance Database (Système National Des Données de Santé [SNDS]). The SA program was implemented in a set of 18 Départements in France and targeted 18- to 44-year-old subjects, with at least two reimbursement dates for asthma drug therapy during the 12-month period prior to program targeting. Change in outcomes was assessed from the "before program" period (January-December 2014) to the "after program implementation" period (March 2015-February 2016) in the program group (eligible to SA program in the 18 Départements) and in the matched controlled group. The main outcome measure was the before-after change in proportion of subjects with a controllers/(controllers+relievers) ratio greater than 50%. **RESULTS:** Of the 99 578 subjects of the program group, 9225 (9.3%) actually participated in SA program. The program had no significant impact on the proportion of subjects with a ratio greater than 50%. However, subjects exposed to SA program were significantly more likely to be dispensed controller medications (OR = 1.04; 95% CI, 1.01-1.07) and to sustain their use of these medications (OR = 1.08; 95% CI, 1.05-1.12). **CONCLUSION:** We did not demonstrate any significant impact of the program on the primary outcome. The modest yet encouraging findings of this early evaluation suggest the need for reformulation of the program and its evaluation.

Gadanne, S., Pribil, C., Chouaid, C., et al. (2011). "Le coût de l'asthme en France et les implications économiques du niveau de contrôle." Revue Des Maladies Respiratoires **28**(4): 419-426.

La prévalence de l'asthme en France est en augmentation et la proportion de cas mal contrôlés demeure importante. Les conséquences économiques de ce problème de santé publique demeurent peu documentées. Une revue de la littérature a été réalisée en ce sens. Les études identifiées les plus anciennes ont cherché à différencier la consommation médicale liée à la prise en charge de l'asthme par niveau de sévérité. Seules les études plus récentes ont considéré le niveau de contrôle de la maladie. Elles s'accordent à estimer que la consommation médicale directement associée à la prise en charge de l'asthme est dépendante de la sévérité de la maladie et de son niveau de contrôle. Les études ont intégré les recommandations disponibles au moment de leur réalisation pour définir la sévérité ou le contrôle, et leur comparabilité est donc délicate. De plus, l'évaluation économique qui porte sur des estimations de coûts annuels est confrontée à la variabilité des niveaux de contrôle au cours du temps. Si les données de la littérature concordent pour estimer qu'un meilleur contrôle de la maladie diminue significativement les coûts, des études économiques s'appuyant sur les définitions récentes et utilisant une méthodologie adéquate seraient utiles.

Huerta, A., Uría, E., Cuesta, M., et al. (2018). "Clinical and economic burden of severe asthma: A French cohort study." *J Asthma* **144**: 42-49.

[https://www.resmedjournal.com/article/S0954-6111\(18\)30307-X/pdf](https://www.resmedjournal.com/article/S0954-6111(18)30307-X/pdf)

**OBJECTIVE:** To describe the clinical and economic burden of severe asthma in France over 12 months. **METHODS:** Data were retrieved from the observational, prospective "Cohorte Obstruction Bronchique et Asthme" (COBRA) cohort, which has enrolled nearly 1000 asthma patients since 2007 from throughout France. Patients undergoing treatment with GINA step-4 or 5 medications uninterrupted for 12 months (thus defining "severe asthma") were identified and their clinical data used to describe the clinical burden of asthma (exacerbations, symptoms outside exacerbations, and level of asthma control). Patients' utilization of healthcare resources was described and used to estimate the direct medical costs incurred to treat severe asthma. **RESULTS:** 155 patients were included in the present study. Over the 12-month period of interest, 128 (83%) patients experienced at least one asthma exacerbation, 22 (14%) patients were hospitalized for asthma, 133 (86%) patients experienced continuous symptoms outside exacerbations, and 77 (50%) patients experienced important limitations in daily life activities. The median number of asthma-related drugs used was 4. The mean estimated annual asthma-related cost was 8,222 euros (standard deviation, SD = 11,886), including 7,229 euros (SD = 11,703) for controller medications. **CONCLUSION:** Symptoms outside exacerbation periods are highly prevalent in severe asthma patients, for whom the main driver of medical costs is controller medication.

Jounieaux, V., Guillaume, G., Malka, M., et al. (2003). "Évaluation médico-économique d'un programme de prise en charge de patients asthmatiques." *Sante Publique* **15**(4): 449-464, fig.

<https://www.cairn.info/revue-sante-publique-2003-4-page-449.html>

[BDSP. Notice produite par ENSP NocGMR0x. Diffusion soumise à autorisation]. Le double objectif de cette étude était de mesurer l'intérêt médico-économique d'un programme de prise en charge des patients asthmatiques dans la région amiénoise (Action Asthme Amiens), tout en comparant différents outils de mesure. Trois outils ont ainsi été comparés : un questionnaire de consommation de soins rempli mensuellement par 305 patients asthmatiques, recrutés par 73 médecins entre novembre 1998 et juillet 1999 ; les données issues des caisses d'assurance maladie en 1998 et 1999 pour les patients inclus à partir de janvier 1999 ; les données, concernant l'ensemble des hospitalisations en 1998 et 1999 au Centre Hospitalier Universitaire, obtenues à partir du Programme de Médicalisation des Systèmes d'information (PMSI). Les données des caisses d'assurance maladie et du PMSI sont primordiales pour l'évaluation des coûts, les patients sous-estimant les soins reçus. Une augmentation des dépenses médicamenteuses et une diminution du nombre d'hospitalisation pour asthme ont été observées après la mise en place du programme.

Laforest, L., Com-Ruelle, L., Devouassoux, G., et al. (2008). "Enjeux économiques de l'asthme sévère." *Presse Médicale (La)* **37**(1): 117-128.

<http://www.masson.fr/masson/portal/editorialproduct/ARTICLE.pdf?CodeRevue=PM&ProductCode=100&PathXML=REVUE/PM/2008/37/1-C2/ARTICLE11992809278.xml&path=REVUE/PM/2008/37/1-C2/07006045/main.pdf>

L'asthme sévère et réfractaire est un problème de santé publique compte tenu des risques de mortalité, de la morbidité qu'il engendre, ainsi que de son impact sur la qualité de vie des patients. Ses conséquences sur le plan économique ne doivent pas être oubliées. L'ensemble des études publiées suggère une augmentation de la consommation de soins en fonction du degré de sévérité de l'asthme. La consommation de soins des asthmatiques sévères pourrait en partie être réduite par certaines mesures (adéquation du traitement, éducation des patients, meilleure coordination des soins, traitement de comorbidités associées), tout en gardant à l'esprit les difficultés spécifiques aux asthmes sévères et réfractaires. Si de nouveaux traitements de l'asthme sévère sont prometteurs d'un point de vue clinique, il convient de se poser la question de leur coût et de leur indication en pratique médicale.

Lebrun, T., Saily, J. C., Leclercq, A., et al. (1994). "Functional and professional repercussions of chronic asthma ; consequences of this disease in terms of using care system." *Revue Des Maladies Respiratoires* **11**: 369-378, 367 tabl.

Leclercq, A., Minne, E. et Burlion, N. (1991). Analyse des conséquences socio-économiques de l'asthme modéré à sévère. Lille CRESGE: 237.

L'asthme est une affection encore mal connue en France, tant au niveau épidémiologique qu'en termes de conséquences socio-économiques. Il s'agit pourtant d'une maladie chronique très répandue aux conséquences économiques et sociales non négligeables. L'objet de cette étude est de dresser un inventaire rétrospectif des répercussions économiques et sociales de l'asthme, afin de mieux cerner le profil médical et social d'un patient asthmatique ; d'évaluer, de façon prospective, le coût de la prise en charge médicale de son atteinte, d'une part, de la Sécurité sociale et, d'autre part, par le patient lui-même ou sa famille ; de relever les implications socio-économiques de cette pathologie en termes d'activité professionnelle et de recours à des services tiers, d'évaluer les répercussions personnelles de l'asthme (capacité fonctionnelle, qualité de vie, santé perçue).

Mével, H. et Demange, V. (2016). "Assessment of work-related asthma prevalence, control and severity: protocol of a field study." *BMC Public Health* **16**(1): 1164.

[https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5112681/pdf/12889\\_2016\\_Article\\_3824.pdf](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5112681/pdf/12889_2016_Article_3824.pdf)

BACKGROUND: There are still uncertainties regarding the respective prevalence, diagnosis and management of occupational asthma (OA) and work-exacerbated asthma (WEA). There is as yet no standardized methodology to differentiate their diagnosis. A proper management of both OA and WEA requires tools for a good phenotyping in terms of control, severity and quality of life in order to propose case-specific therapeutical and preventive measures. Moreover, there is a lack of knowledge concerning their actual costs. METHODS: This project aims at comparing 3 groups of asthmatic subjects at work: subjects with OA, with WEA, and with non-work-related asthma (NWRA) in terms of control, severity and quality of life on the one hand, and estimating the prevalence of OA, WEA and NWRA in active workers and the economic costs of OA and WEA, on the other hand. Control will be assessed using the Asthma Control Test questionnaire and the daily Peak Expiratory Flow variability, severity from the treatment level, and quality of life using the Asthma Quality of Life Questionnaire. A first step will be to apply a standardized diagnosis procedure of WEA and OA. This study includes an epidemiological part in occupational health services by volunteering occupational physicians, and a clinical case-study based on potentially asthmatic subjects referred to ten participating University Hospital Occupational Diseases Departments (UHODD) because of a suspected WEA. The subjects' characterization with respect to OA and WEA is organized in three steps. In Step 1 (epidemiological part), occupational physicians screen for potentially actively asthmatics through a questionnaire given to workers seen in mandatory medical visit. In step 2 (both parts), the subjects with a suspicion of work-related respiratory symptoms answer a detailed questionnaire and perform a two-week OASYS

protocol enabling us, using a specifically developed algorithm, to classify them into probably NWRA, suspected OA, suspected WEA. The two latter groups are referred to UHODD for a final harmonized diagnosis (step 3). Finally, direct and indirect disease-related costs during the year preceding the diagnosis will be explored among WRA cases, as well as these costs and the intangible costs, during the year following the diagnosis. DISCUSSION: This project is an attempt to obtain a global picture of occupational asthma in France thanks to a multidisciplinary approach.

Nordon, C., Grimaldi-Bensouda, L., Pribil, C., et al. (2018). "Clinical and economic burden of severe asthma: A French cohort study." *Respir Med* **144**: 42-49.

[https://www.resmedjournal.com/article/S0954-6111\(18\)30307-X/pdf](https://www.resmedjournal.com/article/S0954-6111(18)30307-X/pdf)

OBJECTIVE: To describe the clinical and economic burden of severe asthma in France over 12 months. METHODS: Data were retrieved from the observational, prospective "Cohorte Obstruction Bronchique et Asthme" (COBRA) cohort, which has enrolled nearly 1000 asthma patients since 2007 from throughout France. Patients undergoing treatment with GINA step-4 or 5 medications uninterruptedly for 12 months (thus defining "severe asthma") were identified and their clinical data used to describe the clinical burden of asthma (exacerbations, symptoms outside exacerbations, and level of asthma control). Patients' utilization of healthcare resources was described and used to estimate the direct medical costs incurred to treat severe asthma. RESULTS: 155 patients were included in the present study. Over the 12-month period of interest, 128 (83%) patients experienced at least one asthma exacerbation, 22 (14%) patients were hospitalized for asthma, 133 (86%) patients experienced continuous symptoms outside exacerbations, and 77 (50%) patients experienced important limitations in daily life activities. The median number of asthma-related drugs used was 4. The mean estimated annual asthma-related cost was 8,222 euros (standard deviation, SD = 11,886), including 7,229 euros (SD = 11,703) for controller medications. CONCLUSION: Symptoms outside exacerbation periods are highly prevalent in severe asthma patients, for whom the main driver of medical costs is controller medication.

Pamuk, G., Le Bourgeois, M., Abou Taam, R., et al. (2021). "The economic burden of severe asthma in children: a comprehensive study." *J Asthma* **58**(11): 1467-1477.

<https://www.tandfonline.com/doi/full/10.1080/02770903.2020.1802747>

OBJECTIVE: The economic burden of severe asthma (SA) in children is poorly described. We aimed to determine the healthcare costs of SA in children for the French national health insurance (NHI). METHODS: Children (6-18 years of age) with physician-confirmed diagnoses of SA or non-SA (NSA) were identified. Direct and indirect expenditures related to asthma and associated co-morbidities in the previous six months were determined, based on a physician-guided parental questionnaire and confirmed by medical records. The costs for the French NHI were assessed per child over a six month period. RESULTS: Data from 74 children, including 48 with SA (22 requiring omalizumab) and 26 with NSA, were analyzed. The global cost of SA was €3,982 per child over a six-month period, including €3,821 direct costs and €161.9 indirect costs. The global cost was €6,716 (4,220) for those requiring omalizumab vs. €1,669 (3,108) for those who did not ( $p < 0.01$ ). For children with SA, 65% of direct costs were attributed to medication. Among those on omalizumab, such treatment accounted for 93% of medication costs. The global cost was 10 times higher for children with SA than those with NSA (€3,982 (4,422) vs. €363.2 (352.6),  $p < 0.01$ ), and 20 times higher for children with SA on omalizumab than those with NSA ( $p < 0.01$ ). CONCLUSION: The economic burden of SA in children for the French NHI is substantial and mainly driven by the most severe children requiring biologics.

Rafenberg, C. (2015). Estimation des coûts pour le système de soins français de cinq maladies respiratoires et des hospitalisations attribuables à la pollution de l'air. *Collection Etudes et documents ; 122*. Paris Ministère chargé de l'Ecologie: 32.

<http://www.auvergne-rhone-alpes.ars.sante.fr/sites/default/files/2016-12/ED122.pdf>

La mauvaise qualité de l'air entraîne une augmentation des maladies du système respiratoire. Les principales d'entre elles sont l'asthme, les bronchites aiguës ou chroniques, les cancers des voies

respiratoires et les broncho-pneumopathies obstructives chroniques (ou BPCO). La qualité de l'air impacte aussi le système cardio-vasculaire. Ces impacts sont source d'une surmortalité et d'une surmortalité. Cette étude a pour objet d'approcher au plus près les coûts dans le système de soin français des hospitalisations et des cinq maladies respiratoires les plus répandues attribuables à la pollution de l'air. Les coûts des maladies attribuables à la pollution de l'air sont générés par la prise en charge du patient par le système de soin. On trouve parmi eux des coûts de consultations, de traitements, d'examens ou encore d'hospitalisation, etc. L'étude approche les coûts des prestations sociales versées aux malades en considérant les arrêts de travail. Elle prend donc en compte les prestations médicales et sociales du malade dans le système de soin.

Rycke, Y. d., Dib, F., Guillo, S., et al. (2017). Evaluation médico-économique du programme d'accompagnement des patients asthmatiques Sophia Asthme. Résultats Vague A. Paris Cnamts: 361, tab., graph., fig. [http://www.ameli.fr/fileadmin/user\\_upload/documents/Rapport\\_Sophia\\_Asthme\\_Vague\\_A.pdf](http://www.ameli.fr/fileadmin/user_upload/documents/Rapport_Sophia_Asthme_Vague_A.pdf)

Ce rapport s'inscrit dans le cadre général d'un mandat que la Caisse Nationale de l'Assurance Maladie des Travailleurs Salariés (Cnamts) a octroyé à l'Inserm Unité 1123 – Epidémiologie Clinique, Evaluation économique, population Vulnérables (ECEVE). Il s'agissait d'évaluer la phase initiale du programme Sophia Asthme 1 à l'aide des données de remboursement de l'assurance maladie (SNIRAM) chaînées aux données du programme de médicalisation des systèmes d'information (PMSI) et de données spécifiques recueillies auprès des participants au programme Sophia Asthme.

Saillily, J. C., Lenne, X., Bercez, C., et al. (2005). "Costs of hospitalization for severe acute asthma of patients not treated according to guidelines and recommendations : French prospective study of 169 cases." European Journal of Health Economics (the) 6(2): 94-101, 102 tabl.

This prospective study of 169 adult patients hospitalized for severe acute asthma in four pneumology wards compared the incidence and costs of patients who were managed (group A) or not managed (group P) before hospitalization, according to the guidelines and international recommendations (11 criteria judged by experts). Ambulatory costs were calculated by questioning patients. Valuation of hospital costs was based DRGs weighted by length of stay. The incidence in group P patients was estimated at 70%; A patients were 14 years younger than those in group P and had less severe asthma. Their annual ambulatory care prior to hospitalization was less costly irrespective of age category or degree of severity ((euro)685 vs. (euro)1,145 in group A); their length of hospital stay was shorter (6.03 vs. 10.78 days), resulting in a lower cost of hospitalization ((euro)2,820 vs. (euro)4,843). In group P a specific education program based on increased understanding, compliance, self-management, and smoking cessation, particularly in young patients should lead to reductions in hospitalizations.

Sannino, N., Martin-Dupont, F., Boisvert, J., et al. (2007). "L'éducation thérapeutique du patient asthmatique en médecine de ville vaut-elle le coût ?" Actualite Et Dossier En Sante Publique(59): 9-14, fig., tabl.

[BDSP. Notice produite par ENSP VbJbIR0x. Diffusion soumise à autorisation]. A Bordeaux, une action d'éducation thérapeutique réalisée auprès de patients asthmatiques a fait l'objet d'une évaluation. Cet article présente les enseignements de cette étude en termes qualitatifs mais aussi économiques.

Taillé, C., Chenivresse, C., Guillo, S., et al. (2019). "Évaluation du programme de soutien aux asthmatiques SOPHIA-ASTHME dans sa 2e année de déploiement." Revue Des Maladies Respiratoires 36: A6. <https://doi.org/10.1016/j.rmr.2018.10.017>

Introduction SOPHIA-asthme est un programme de soutien aux asthmatiques développé par la CNAMTS pour améliorer le contrôle de la maladie, par diffusion d'informations et entretiens téléphoniques avec une infirmière spécialisée. Ce programme est proposé depuis janvier 2015 dans 19 départements. L'objectif de ce travail est d'évaluer son impact médico-économique après 14 mois de déploiement. Méthodes L'étude quasi expérimentale avant-après ici/ailleurs a été conduite à partir des données du SNDS. La population d'intérêt était composée des patients âgés de 18 à 40 ans ayant

reçu au moins 3 délivrances de médicaments de l'asthme en 2013 et en 2012. Chaque patient éligible dans un département participant au programme (exposé) était apparié à un patient d'un département ne participant pas au programme (non exposé), sur un score de propension. Le critère de jugement principal était l'observance de délivrance optimale des corticoïdes inhalés, évaluée par le MRA (Medication refill adherence) sur 12 mois. Résultats L'analyse a porté sur 29 746 paires de sujets. Le MRA à l'inclusion était en moyenne de 40,2 % chez non exposés et 40,6 chez les exposés. Après 1 an, l'évolution du MRA (passage à une classe supérieure parmi <50 %, 50–80 %, ≥80 % ou maintien ≥80 %) entre les deux groupes n'était pas significativement différente (0,26 % [-0,58 % ; 1,11 %],  $p=0,545$ ). L'amélioration du MRA était plus fréquente chez les sujets exposés (OR=1,05 [1,01 ; 1,09],  $p=0,028$ ). Aucun impact du programme n'a été détecté sur la consommation de médicaments et de soins, les arrêts maladie, les exacerbations et les coûts. Chez les 3406 (11,5 %) adhérents au programme (82 % d'asthme léger), on a observé une augmentation faible mais significative des consultations chez le pneumologue et des coûts médicamenteux liés à l'asthme et globaux chez les adhérents, comparés à leurs témoins non exposés. Ces résultats doivent être interprétés avec précaution puisque la procédure d'appariement ne prend pas en compte la propension à adhérer au programme. Conclusion Nous n'avons pas mis en évidence d'impact significatif du programme Sophia sur le critère principal. Chez les adhérents, le programme augmente les coûts relatifs à l'asthme essentiellement par l'augmentation des traitements. Le bénéfice de l'augmentation du traitement sur le contrôle et les exacerbations est difficile à mettre en évidence dans une population d'asthmatiques essentiellement légers. Des patients plus sévères seraient peut-être une meilleure cible pour le programme SOPHIA.

Thaon, I., Wild, P., Mouchot, L., et al. (2008). "Long-term occupational consequences of asthma in a large French cohort of male workers followed up for 5 years." *Am J Ind Med* **51**(5): 317-323.

**OBJECTIVES:** The aim of this study was to describe the long-term occupational consequences of asthma in males of the ESTEV study, a French longitudinal cohort of working subjects aged 37-52 at inclusion. **METHODS:** Medical data, self-perceived health status, sick leave, occupational social class and employment characteristics were recorded twice by occupational physicians in 1990 (12,233 subjects) and 1995 (10,608 subjects). Asthma was characterized as to its onset (childhood, i.e., before age 20 vs. adult) and to its past versus current status by the physician. **RESULTS:** Of the 398 asthmatics, the onset was before age 20 for 226 and the asthma status was classified as current for 159 subjects. Unemployment was not higher before baseline or during follow-up, in asthmatics as compared to non-asthmatics, despite a significantly higher prevalence of sick leave in the previous year among current asthmatics (38.4% vs. 27.0%,  $P = 0.005$ ). Being a blue collar worker in 1990 is negatively related to childhood asthma but not to the current asthma status. In 1995, current adult-onset asthmatics had stopped working due to disability more frequently than never-asthmatics. **CONCLUSION:** Our findings suggest that the major consequence of asthma on employment status is a selective exclusion, observed in childhood asthmatics at the beginning of their working life and in current adult-onset asthmatics at the end of their working life. Past unemployment was shown not to be higher in working asthmatics.

## ÉTUDES ETRANGERES

Accordini, S., Bugiani, M., Arossa, W., et al. (2006). "Poor Control Increases the Economic Cost of Asthma." *International Archives of Allergy and Immunology* **141**(2): 189-198.  
<https://www.karger.com/DOI/10.1159/000094898>

**Background/Aims:** Up to now, few cost-of-illness (COI) studies have estimated the cost of adult asthma at an individual level on general population samples. We sought to evaluate the cost of current asthma from the societal perspective in young Italian adults and the determinants of cost variation. **Methods:** In 2000, a COI study was carried out in the frame of the Italian Study on Asthma in Young Adults on 527 current asthmatics (20–44 years) screened out of 15,591 subjects from the general population in seven centres. Detailed information about direct medical expenditures (DMEs) and indirect costs due to asthma was collected at an individual level over the past 12 months.

**Results:** The mean annual cost per patient was EUR 741 (95% CI: 599–884). DMEs represented 42.8% of the total cost, whereas the remaining 57.2% was indirect costs. The largest component of DMEs was medication costs (47.3%; 23.0% was due to hospitalization). The mean annual cost per patient ranged from EUR 379 (95% CI: 216–541) for well-controlled asthmatics to EUR 1,341 (95% CI: 978–1,706) for poorly controlled cases that accounted for 46.2% of the total cost. Poor control, coexisting chronic cough and phlegm, and low socio-economic status were significantly associated with high DMEs and indirect costs. **Conclusions:** In Italy, asthma-related costs were substantial even in unselected patients and were largely driven by indirect costs. Since about half of the total cost was due to a limited proportion of poorly controlled asthmatics, interventions aimed at these high-cost patients could reduce the economic burden of the disease.

Accordini, S., Corsico, A. G., Braggioni, M., et al. (2013). "The Cost of Persistent Asthma in Europe: An International Population-Based Study in Adults." *International Archives of Allergy and Immunology* **160**(1): 93-101.

<https://www.karger.com/DOI/10.1159/000338998>

**Background:** This study is aimed at providing a real-world evaluation of the economic cost of persistent asthma among European adults according to the degree of disease control [as defined by the 2006 Global Initiative for Asthma (GINA) guidelines]. **Methods:** A prevalence-based cost-of-illness study was carried out on 462 patients aged 30–54 years with persistent asthma (according to the 2002 GINA definition), who were identified in general population samples from 11 European countries and examined in clinical settings in the European Community Respiratory Health Survey II between 1999 and 2002. The cost estimates were computed from the societal perspective following the bottom-up approach on the basis of rates, wages and prices in 2004 (obtained at the national level from official sources), and were then converted to the 2010 values. **Results:** The mean total cost per patient was EUR 1,583 and was largely driven by indirect costs (i.e. lost working days and days with limited, not work-related activities 62.5%). The expected total cost in the population aged 30–54 years of the 11 European countries was EUR 4.3 billion (EUR 19.3 billion when extended to the whole European population aged from 15 to 64 years). The mean total cost per patient ranged from EUR 509 (controlled asthma) to EUR 2,281 (uncontrolled disease). Chronic cough or phlegm and having a high BMI significantly increased the individual total cost. **Conclusions:** Among European adults, the cost of persistent asthma drastically increases as disease control decreases. Therefore, substantial cost savings could be obtained through the proper management of adult patients in Europe.

Asher, I., Haahtela, T., Selroos, O., et al. (2017). "Global Asthma Network survey suggests more national asthma strategies could reduce burden of asthma." *Allergol Immunopathol (Madr)* **45**(2): 105-114.

**BACKGROUND:** Several countries or regions within countries have an effective national asthma strategy resulting in a reduction of the large burden of asthma to individuals and society. There has been no systematic appraisal of the extent of national asthma strategies in the world. **METHODS:** The Global Asthma Network (GAN) undertook an email survey of 276 Principal Investigators of GAN centres in 120 countries, in 2013-2014. One of the questions was: "Has a national asthma strategy been developed in your country for the next five years? For children? For adults?". **RESULTS:** Investigators in 112 (93.3%) countries answered this question. Of these, 26 (23.2%) reported having a national asthma strategy for children and 24 (21.4%) for adults; 22 (19.6%) countries had a strategy for both children and adults; 28 (25%) had a strategy for at least one age group. In countries with a high prevalence of current wheeze, strategies were significantly more common than in low prevalence countries (11/13 (85%) and 7/31 (22.6%) respectively,  $p < 0.001$ ). **INTERPRETATION:** In 25% countries a national asthma strategy was reported. A large reduction in the global burden of asthma could be potentially achieved if more countries had an effective asthma strategy.

Bai, R., Melero Moreno, C. et Quirce, S. (2019). "Economic impact of severe asthma in Spain: multicentre observational longitudinal study." *Policy Polit Nurs Pract* **56**(8): 861-871.

<https://journals.sagepub.com/doi/10.1177/1527154420937659>

**Objective:** Estimate the economic impact of severe asthma from the Spanish social perspective through the estimation of the associated annual direct and indirect costs. **Methods:** Observational, longitudinal, retrospective study carried out in 20 Spanish secondary settings (Pulmonology and Allergy Services) among patients aged  $\geq 18$ , diagnosed with severe asthma according to European Respiratory Society/American Thoracic Society consensus and who have not experienced an exacerbation in the previous 2 months. Asthma-related healthcare resource utilization as well as asthma-related days off work were collected over a retrospective 12-month period from medical records review (inclusion period: June to November 2016). Total costs were calculated by multiplying the natural resource units used within 1 year by the corresponding unit cost. Costs were expressed in Euros for 2018. **Results:** A total of 303 patients were included, mean age was 54 years old and 67% were women. There were 5.7 physician visits per patient (3.3 in secondary care). The most common pharmacologic treatment was fixed dose combination of inhaled corticosteroids/long-acting  $\beta_2$ -adrenergic agonists (96.7%), followed by leukotriene receptor antagonists (57.1%). 134 patients (44.2%) had at least one severe asthma exacerbation (mean: 1.9 exacerbation/patient), of whom 22 patients required hospitalization, with a mean hospital stay of 10.9 days/patient. Mean sick leave due to severe asthma was 9.1 days per patient per year. Mean annual direct cost (confidence interval 95%) was €7472/patient (€6578-8612). The cost per exacerbation was €1410/patient. When indirect costs were added (€1082/patient [€564-1987]), the total annual mean cost rose to €8554/patient (€7411-10199). **Conclusions:** Taking the social perspective, the economic impact of severe asthma in Spain was estimated to be €8554/patient/year.

Barbosa, J. P., Ferreira-Magalhães, M., Sá-Sousa, A., et al. (2017). "Cost of asthma in Portuguese adults: A population-based, cost-of-illness study." *Rev Port Pneumol* (2006) **23**(6): 323-330.  
<https://www.sciencedirect.com/science/article/pii/S2173511517301021?via%3Dihub>

**INTRODUCTION:** Asthma is one of the most frequent chronic diseases, putting a considerable economic burden on societies and individuals. We aimed to estimate the total cost of adult asthma in Portugal, as well as the extent to which direct and indirect costs are influenced by the level of asthma control. **METHODS:** A nationwide, prevalence-based, cost-of-illness study using a bottom-up approach to calculate direct and indirect costs of asthma was conducted, using participant data from the Portuguese National Asthma Survey (INAsma). Direct (healthcare service usage, diagnostic tests and treatment) and indirect (absenteeism and transportation) costs were measured. Decision analytic modelling was used to perform multivariate deterministic sensitivity analysis. **RESULTS:** On average, each adult costs 708.16€ (95%CI: 594.62-839.30) a year, with direct costs representing 93% (658.46€; 95%CI: 548.99-791.29) and indirect costs representing 7% (49.70€; 95%CI: 32.08-71.56). This amounts to a grand total of 386,197,211.25€ (95%CI: 324,279,674.31-457,716,500.18), with direct costs being 359,093,559.82€ (95%CI: 299,391,930.03-431,533,081.07). Asthma direct costs are 2.04% of the total Portuguese healthcare expense in 2010. The major cost domains were acute care usage (30.7%) and treatment (37.4%). Asthma control was significantly associated with higher costs throughout several domains, most notably in acute medical care. **CONCLUSIONS:** Asthma in adults poses a significant economic burden on the Portuguese healthcare system, accounting for over 2% of the total healthcare expenditure in Portugal in 2010. It is important to note that a considerable portion of this burden might be eased by improving asthma control in patients, as uncontrolled patients' costs are more than double those of controlled asthma patients.

Bavbek, S., Malhan, S., Mungan, D., et al. (2021). "Economic burden of severe asthma in Turkey: a cost of illness study from payer perspective." *Eur Ann Allergy Clin Immunol* **53**(3): 128-137.

**Objective.** To estimate economic burden of severe asthma in Turkey from payer perspective based on expert panel opinion on practice patterns in clinical practice. **Methods.** This cost of illness study was based on identification of per patient annual direct medical costs for the management of severe asthma in Turkey from payer perspective. Average per patient direct medical cost was calculated based on cost items related to outpatient visits, laboratory and radiological tests, hospitalizations and interventions, drug treatment and equipment, and co-morbidities/complications. **Results.** Based on



total annual per patient costs calculated for outpatient admission (\$ 177.91), laboratory and radiological tests (\$ 82.32), hospitalizations/interventions (\$ 1,154.55), drug treatment/equipment (\$ 2,289.63) and co-morbidities (\$ 665.39) cost items, total per patient annual direct medical cost related to management of severe asthma was calculated to be \$ 4,369.76 from payer perspective. Drug treatment/equipment (52.4%) was the main cost driver in the management of severe asthma in Turkey, as followed by hospitalizations/interventions (26.4%) and co-morbidities (15.2%). Conclusions. In conclusion, our findings indicate that managing patients with severe asthma pose a considerable burden to health economics in Turkey, with medications as the main cost driver.

Bellon, M. L., Barton, C., McCaffrey, N., et al. (2017). "Seizure-related hospital admissions, readmissions and costs: Comparisons with asthma and diabetes in South Australia." *Seizure* **50**: 73-79.

**PURPOSE:** Seizures are listed as an Ambulatory Care Sensitive Condition (ACSC), where, in some cases, hospitalisation may be avoided with appropriate preventative and early management in primary care. We examined the frequencies, trends and financial costs of first and subsequent seizure-related hospital admissions in the adult and paediatric populations, with comparisons to bronchitis/asthma and diabetes admissions in South Australia between 2012 and 2014. **METHODS:** De-identified hospital separation data from five major public hospitals in metropolitan South Australia were analysed to determine the number of children and adults admitted for the following Australian Refined Diagnosis Related Groups: seizure related conditions; bronchitis/asthma; and diabetes. Additional data included length of hospital stay and type of admission. Demographic data were analysed to identify whether social determinants influence admission, and a macro costing approach was then applied to calculate the financial costs to the Health Care System. **RESULTS:** The rate of total seizure hospitalizations was 649 per 100,000; lower than bronchitis/asthma (751/100,000), yet higher than diabetes (500/100,000). The highest proportions of subsequent separations were recorded by children with seizures regardless of complexity (47% +CSCC; 17% -CSCC) compared with asthma (11% +CSCC; 14% -CSCC) or diabetes (14% +CSCC; 13% -CSCC), and by adults with seizures with catastrophic or severe complications/comorbidity (25%), compared with diabetes (22%) or asthma (14%). The mean cost per separation in both children and adults was highest for diabetes (AU\$4438/\$7656), followed by seizures (AU\$2408/\$5691) and asthma (AU\$2084/\$3295). **CONCLUSIONS:** Following the lead of well-developed and resourced health promotion initiatives in asthma and diabetes, appropriate primary care, community education and seizure management services (including seizure clinics) should be targeted in an effort to reduce seizure related hospitalisations which may be avoidable, minimise costs to the health budget, and maximise health care quality.

Belova, A. et Fann, N. (2020). "Estimating Lifetime Cost of Illness. An Application to Asthma." *Ann Am Thorac Soc* **17**(12): 1558-1569.  
<https://doi.org/10.1513/AnnalsATS.201910-729OC>

**Rationale:** Approximately 8% of the U.S. population suffers from asthma, a chronic condition. It poses a substantial economic burden to society in the form of lost productivity and healthcare costs. **Objectives:** We use the Medical Expenditure Panel Survey 2002-2010 to quantify the lifetime costs of asthma at each age, the impact of adult asthma on earnings and choice of occupation, and the impact of childhood asthma on parental income. **Methods:** We developed a framework to estimate the present discounted value of the cumulative lifetime asthma-related healthcare costs and lost productivity experienced by an individual after onset. This approach allows for age- and asthma duration-related variability in annual costs as well as for the intermittent nature of asthma symptoms. **Results:** Estimated asthma-related annual healthcare expenditures across all life stages are \$700-\$2,200 (2010 U.S. dollars). Lost annual earnings among individuals aged 30-49 are over \$4,000 (2010 U.S. dollars). The present discounted value of the cumulative lifetime healthcare costs and lost productivity for a new case of asthma is estimated at \$36,500 using the 3% discount rate (2010 U.S. dollars). **Conclusions:** The economic burden of asthma is substantial and larger than previously estimated, reflecting expenditures on treatment and lost earnings.

Birnbaum, H. G., Berger, W. E., Greenberg, P. E., et al. (2002). "Direct and indirect costs of asthma to an employer." *J Allergy Clin Immunol* **109**(2): 264-270.

**BACKGROUND:** Asthma is a chronic inflammatory condition of the airways that has a significant effect on the use of health care resources. **OBJECTIVE:** This study is the first of its kind to estimate the overall cost of asthma to a major employer in the United States and to profile the nature of the asthma expenses. **METHODS:** The annual per capita cost of asthma was determined for beneficiaries of a major employer by analyzing medical, pharmaceutical, and disability claims data. The incremental cost of asthma was determined by using a case-control method matching asthmatic patients to individuals with no record of asthma treatment. **RESULTS:** The use of health care services, as well as the rate of disability, was substantially higher among asthmatic patients than among control subjects. Annual per capita employer expenditures for asthmatic patients were approximately 2.5 times those for control subjects (\$5385 vs. \$2121, respectively). Among asthmatic employees with disability claims, total costs were approximately 3 times higher than those among disability claimants in the employee control sample (\$14,827 vs. \$5280). For asthmatic employees, wage-replacement costs for workdays lost as a result of disability and sporadic absenteeism (40%) accounted for almost as much as did medical care (43%). **CONCLUSION:** Failure to account fully for the broader consequences of asthma in terms of indirect and comorbid treatment costs would result in a significant underassessment of the cost of asthma to an employer.

Boot, C. R., van der Gulden, J. W., Orbon, K. H., et al. (2004). "Asthma and chronic obstructive pulmonary disease: differences between workers with and without sick leave." *Int Arch Occup Environ Health* **77**(5): 357-362.

<https://link.springer.com/article/10.1007/s00420-004-0515-4>

**OBJECTIVE:** Determinants of sick leave should be investigated before interventions to reduce sick leave can be designed. This cross-sectional study compares employees with asthma and chronic obstructive pulmonary disease (COPD) with and without sick leave. **METHODS:** One hundred and eighteen participants with asthma and 71 with COPD underwent a lung function test [one-second forced expiratory volume (FEV<sub>1</sub>), forced vital capacity (FVC)] and completed questionnaires on health complaints, work characteristics, demographic and psychosocial variables, and self-reported sick leave in the past 12 months. Backward multivariate logistic regression analyses, with sick leave (no/any) as dependent variable, were conducted for asthma, COPD, and the total group. **RESULTS:** Lung function measures were not significantly associated with sick leave in any group ( $P > 0.05$ ). For asthma, psychosocial variables (spending all energy at work, OR 0.7) and health complaints (frequency of dyspnoea, OR 0.4 and breathing problems such as coughing, wheezing, OR 1.1) were associated with sick leave. In the COPD group, age (OR 0.9) was the only significant variable to be maintained in the model. In the total group, work characteristics (adjustment in work pace, OR 3.3), age (OR 0.9) and spending all energy at work (OR 0.7) were maintained in the final model. **CONCLUSION:** Severity of the disease, as measured by lung function, is not a determinant of sick leave in asthma and COPD. Different processes play a role in asthma and COPD. Interventions for reducing sick leave should aim more at psychosocial factors than at treating the severity of the disease.

Boot, C. R., Vercoulen, J. H., van der Gulden, J. W., et al. (2005). "Predictors of changes in sick leave in workers with asthma: a follow-up study." *Int Arch Occup Environ Health* **78**(8): 633-640.

<https://link.springer.com/article/10.1007/s00420-005-0004-4>

**OBJECTIVE:** The aim of this prospective study was to investigate predictors of 1-year changes in sick leave in workers with asthma. **METHODS:** The initial cohort consisted of 111 workers with asthma. One-hundred and one participants completed the follow-up after 1 year. Self-reported sick leave over the past 12 months was reported at baseline and at follow-up. At the start of this study, all participants completed questionnaires on adaptation to functional limitations, psychosocial variables, working conditions, lung function characteristics, disease history characteristics, health complaints and functional limitations, and person characteristics ('potential predictors'). Three multivariate logistic regression models were calculated, with an increase in sick leave, a decrease in sick leave, and

stable high sick leave as dependent (outcome) variables, and the potential predictors as independent (explanatory) variables. RESULTS: An increase in sick leave was predicted by a lower level of education and perceiving more functional limitations in activities of daily life. A decrease in sick leave was predicted by spending all energy at work less often and perceiving fewer health complaints in social activities (adaptation criteria 4 and 5). Stable high sick leave was predicted by less job satisfaction, perceiving more support from the employer and perceiving more health complaints in social activities (adaptation criterion 5). Lung function characteristics, or disease history characteristics were not predictive for changes in sick leave in any of the groups. CONCLUSION: We conclude that adaptation to functional limitations played a major role in changes in sick leave in workers with asthma. Lung function characteristics hardly played a role.

Boot, C. R., Vercoulen, J. H., van der Gulden, J. W., et al. (2005). "Sick leave in workers with asthma and COPD: the role of attitudes, perceived social norms and self efficacy." *Patient Educ Couns* **58**(2): 192-198.

We investigated associations of sick leave in 165 workers with asthma and COPD with three components of the Model of Planned Behavior (MPB): attitudes, social norms towards sick leave, and perceived control over sick leave and over health complaints. All participants underwent lung-function tests and completed questionnaires on sick leave, and on the MPB-components. Differences were calculated between high and low sick leave (frequency and duration) for the total group of asthma and COPD and separately for asthma and COPD. The most relevant variable within each MPB-component was selected for multivariate analysis. In the total group and in the group with asthma, low sick leave was associated with more perceived control over fatigue. In COPD, the attitude 'finding the negative consequences of sick leave more unpleasant' was associated with high sick leave. It was concluded that similarities exist in a population of asthma and COPD patients, but that different MPB-components play a role in sick leave in asthma and COPD. Perceived control over health complaints is more important in asthma than in COPD. Attitudes towards sick leave appear to be more important in COPD patients.

Braido, F., Brusselle, G., Guastalla, D., et al. (2016). "Determinants and impact of suboptimal asthma control in Europe: The INTERNATIONAL CROSS-SECTIONAL AND LONGITUDINAL ASSESSMENT ON ASTHMA CONTROL (LIAISON) study." *Respir Res* **17**(1): 51.

<http://diposit.ub.edu/dspace/bitstream/2445/177974/1/663149.pdf>

BACKGROUND: According to the Global Initiative of Asthma, the aim of asthma treatment is to gain and maintain control. In the INTERNATIONAL CROSS-SECTIONAL AND LONGITUDINAL ASSESSMENT ON ASTHMA CONTROL (LIAISON) study, we evaluated the level of asthma control and quality of life (QoL), as well as their determinants and impact in a population consulting specialist settings. METHODS: LIAISON is a prospective, multicentre, observational study with a cross-sectional and a 12-month longitudinal phase. Adults with an asthma diagnosis since at least 6 months, receiving the same asthma treatment in the 4 weeks before enrolment were included. Asthma control was assessed with the 6-item Asthma Control Questionnaire (ACQ) and QoL with the MiniAsthma Quality of Life Questionnaire (MiniAQLQ). RESULTS: Overall, 8111 asthmatic patients were enrolled in 12 European countries. Asthma control was suboptimal in 56.5 % of patients and it was associated with poorer asthma-related QoL, higher risk of exacerbations and greater consumption of healthcare resources. Variables associated with suboptimal control were age, gender, obesity, smoking and comorbidities. Major determinants of poor asthma control were seasonal worsening and persisting exposure to allergens/irritants/triggers, followed by treatment-related issues. CONCLUSIONS: The cross-sectional phase results confirm that suboptimal control is frequent and has a high individual and economic impact. TRIAL REGISTRATION: The clinicaltrials.gov identifier is NCT01567280 .

Braido, F., Brusselle, G., Ingrassia, E., et al. (2013). "International cross-sectional and longitudinal assessment on asthma control in European adult patients - the LIAISON study protocol." *Bmc Pulmonary Medicine* **13**.

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<https://bmcpulmed.biomedcentral.com/track/pdf/10.1186/1471-2466-13-18.pdf>

**Background:** According to international guidelines, the goal of asthma management is to achieve and maintain control of the disease, which can be assessed using composite measures. Prospective studies are required to determine how these measures are associated with asthma outcomes and/or future risk. The 'International cross-sectional and longitudinal assessment on asthma control (LIAISON)' observational study has been designed to evaluate asthma control and its determinants, including components of asthma management. **Methods/design:** The LIAISON study will be conducted in 12 European countries and comprises a cross-sectional phase and a 12-month prospective phase. Both phases will aim at assessing asthma control (six-item Asthma Control Questionnaire, ACQ), asthma-related quality of life (Mini Asthma Quality of Life Questionnaire, Mini-AQLQ), risk of non-adherence to treatment (four-item Morisky Medication Adherence Scale, MMAS-4), potential reasons for poor control, treatment strategies and associated healthcare costs. The cross-sectional phase will recruit > 8,000 adult patients diagnosed with asthma for at least 6 months and receiving the same asthma treatment in the 4 weeks before enrolment. The prospective phase will include all patients with uncontrolled/poorly controlled asthma at the initial visit to assess the proportion reaching control during follow-up and to examine predictors of future risk. Visits will take place after 3, 6 and 12 months. **Discussion:** The LIAISON study will provide important information on the prevalence of asthma control and on the quality of life in a broad spectrum of real-life patient populations from different European countries and will also contribute to evaluate differences in management strategies and their impact on healthcare costs over 12 months of observation.

Bravo, A. J. B., Perez-Yarza, E. G., de Mercado, P. L. Y., et al. (2011). "Cost of childhood asthma in Spain: a cost evaluation model based on the prevalence." *Anales De Pediatría* **74**(3): 145-153.  
<https://www.sciencedirect.com/science/article/pii/S1695403310005114?via%3Dihub>

**Introduction:** Asthma is the most common chronic disease in childhood, reduces the quality of Life of children and their families, and produces high social and health care costs. In Spain, the cost of managing paediatric asthma is unknown. **Objective:** To estimate the cost of managing paediatric asthma in Spain and to examine its variability depending on asthma severity. **Patients and methods:** The cost of asthma in children under 16 years in 2008 was estimated by building a costs assessment model including the factors that influence the cost of asthma in children: prevalence, distribution of disease severity, age, frequency of resources use depending on severity, and the cost of each resource. A sensitivity analysis was conducted to evaluate the underlying uncertainty depending on the variability of the estimators of resource use, the unit cost of each resource, and the prevalence. **Results:** According to the model, the total cost of paediatric asthma in Spain is around 532 million euros, with a range of 392 to 693 million euros. Direct costs (health care costs) represent 60% of the total costs, and indirect costs (carer time), 40%. The mean annual cost per child with asthma is 1,149 euros, ranging from 403 euros for the mildest category of the disease to 5,380 euros for the most severe. **Conclusions:** The cost of paediatric asthma in Spain is very high and depends on disease severity. Although the most important costs are for the health care system, indirect costs are not negligible. (C) 2010 Asociacion Espanola de Pediatría. Published by Elsevier Espana, S.L. All rights reserved.

Buendía, J. A. et Patiño, D. G. (2021). "SMART therapy in adolescent and adults patients with moderate persistent asthma: a cost-utility analysis." *J Asthma*: 1-8.  
<https://www.tandfonline.com/doi/full/10.1080/02770903.2021.2019266>

**BACKGROUND:** Recent asthma guidelines, recommends for persistent asthma as first alternative low dose inhaled budesonide-formoterol maintenance and reliever over fixed combination of low doses inhaled corticosteroids - long-acting beta-agonist, or fixed-dose inhaled corticosteroids. Concerns arise as to which of the proposed alternatives has the best possible cost-effectiveness profile. This study aimed to assess the health and economic consequences of SMART, fixed combination, and fixed-dose inhaled corticosteroids in patients with moderate-severe persistent asthma. **METHODS:** A probabilistic Markov model was created to estimate the cost and quality-adjusted life-years (QALYs) of patients with persistent asthma. Total costs and QALYs of SMART, fixed combination, and fixed-dose inhaled corticosteroids were calculated over a lifetime horizon. Multiple sensitivity analyses were conducted.

Cost-effectiveness was evaluated at a willingness-to-pay value of \$19,000. RESULTS: The model suggests a potential gain of 1.27 and 1.34 QALYs per patient per year on SMART respect to fixed combination and fixed-dose ICS respectively. We observed a reduction of US\$4 in total discounted cost per person-year on SMART with respect to fixed combination and US\$0.1 respect to fixed-dose ICS. In the deterministic and probabilistic sensitivity analyses, our base-case results were robust to variations of all assumptions and parameters. CONCLUSION: SMART therapy was found to be cost-effective regarding fixed combination and fixed-dose inhaled corticosteroids. This evidence supports the use of SMART therapy in Colombia and must to be replicated in others middle-income countries.

Calamelli, E., Bottau, P. et Lanari, M. (2018). "Update on Interventions in Prevention and Treatment of Pediatric Asthma." *Pediatr Pulmonol* **25**(16): 1909-1919.

<http://www.eurekaselect.com/article/82117>

BACKGROUND: Asthma represents a worldwide health problem with a strong morbidity and a major impact on the health care system. Multiple efforts have been made towards the development of new strategies for the prevention and treatment of this disorder. In the light of this the present review of the literature aimed at summarizing the latest advances in prevention and treatment of pediatric asthma with a focus on the most effective options of interventions during the first stages of life. METHODS: References were identified by searches of PubMed. Search terms used in the search were "pediatric asthma", "treatment" and "prevention". We included only meta-analysis, randomized controlled trials, reviews and systematic review articles pertaining to humans and subjects aged 0-18 years. All the interventions have been classified as "non-pharmacological" and "pharmacological". RESULTS: Non-pharmacological interventions have been focused in identifying the genetic and environmental factors underlying the pathogenesis of this disease, including the individual genetic susceptibility, the early allergic sensitization, the role of the environmental microbiome and the exposure to infections and to pollutants. Moreover, the optimization of the existing pharmacological strategies and the development of new treatment options have improved markedly the management of this disease, thereby reducing the health care costs and ameliorating the quality of life of patients. CONCLUSION: Childhood asthma prevention and treatment still represents a worldwide challenge. Future efforts should be aimed at identifying high risk target populations, minimizing the costs of each policy of intervention and increasing adherence to treatment strategies.

Caraballo, L., Alvis-Guzmán, N., Zeiger, R. S., et al. (2018). "Drivers of health care costs for adults with persistent asthma." *World Allergy Organ J* **6**(1): 265-268.e264.

[https://www.jaci-inpractice.org/article/S2213-2198\(17\)30421-X/fulltext](https://www.jaci-inpractice.org/article/S2213-2198(17)30421-X/fulltext)

Chen, H., Blanc, P. D., Hayden, M. L., et al. (2008). "Assessing productivity loss and activity impairment in severe or difficult-to-treat asthma." *Value Health* **11**(2): 231-239.

OBJECTIVES: Asthma can be associated with substantial productivity loss and activity impairment, particularly among those with the most severe disease. We sought to assess the performance characteristics of an asthma-specific adaptation of the Work Productivity and Activity Impairment Questionnaire (WPAI:Asthma) in patients with either severe or difficult-to-treat asthma. METHODS: We analyzed 2529 subjects from The Epidemiology and Natural History of Asthma: Outcomes and Treatment Regimens (TENOR) study. The WPAI:Asthma was administered at baseline and at 12 months. Asthma control and quality-of-life were simultaneously assessed using the Asthma Therapy Assessment Questionnaire and Mini-Asthma Quality-of-Life Questionnaire, respectively. RESULTS: Severe versus mild-to-moderate asthma was associated with a greater percentage of impairment at work (28% vs. 14%), at school (32% vs. 18%), and in daily activities (41% vs. 21%). At baseline, greater asthma control problems correlated with higher levels of impairment as measured by the WPAI (work:  $r = 0.54$ , school:  $r = 0.37$ , activity:  $r = 0.55$ ). Over the 12-month follow-up period, improved quality-of-life correlated with decreased levels of impairment (work:  $r = -0.42$ , school:  $r = -0.36$ , activity:  $r = -0.48$ ). In multivariate analyses, greater than 10% overall work impairment at baseline predicted emergency visits (OR 2.6 [1.6, 4.0]) and hospitalization (OR 4.9 [1.8, 13.1]) at 12 months. CONCLUSIONS: The WPAI:Asthma correlates with other self-reported asthma outcomes in the

expected manner and predicts health-care utilization at 12 months when administered to patients with severe or difficult-to-treat asthma.

Chen, W., Lynd, L. D., FitzGerald, J. M., et al. (2016). "Excess medical costs in patients with asthma and the role of comorbidity." *Eur Respir J* **48**(6): 1584-1592.  
<https://erj.ersjournals.com/content/erj/48/6/1584.full.pdf>

Asthmatic patients frequently have comorbidities, but the role of comorbidities in the economic burden of asthma is unclear. We examined the excess direct medical costs, including asthma- and comorbidity-related costs, in patients with asthma. We created a propensity score-matched cohort of patients newly diagnosed with asthma and non-asthmatic comparison subjects, both aged 5-55 years, from health administrative data (1997-2012) in British Columbia, Canada. Health services use records were categorised into 16 major disease categories based on International Classification of Diseases codes. Excess costs (in 2013 Canadian dollars (\$)) were estimated as the adjusted difference in direct medical costs between the two groups. Average overall excess costs were estimated at \$1058/person-year (95% CI 1006-1110), of which \$134 (95% CI 132-136) was attributable to asthma and \$689 (95% CI 649-730) to major comorbidity classes. Psychiatric disorders were the largest component of excess comorbidity costs, followed by digestive disorders, diseases of the nervous system, and respiratory diseases other than asthma. Comorbidity-attributable excess costs greatly increased with age but did not increase over the time course of asthma. These findings suggest that both asthma and comorbidity-related outcomes should be considered in formulating evidence-based policies and guidelines for asthma management.

Chen, W., Lynd, L. D., FitzGerald, J. M., et al. (2016). "Influences of Socioeconomic Status on Costs of Asthma Under Universal Health Coverage." *Med Care* **54**(8): 789-795.  
<https://www.ingentaconnect.com/content/wk/mcar/2016/00000054/00000008/art00010>

**BACKGROUND:** Despite Canada's provision of universal health coverage, socioeconomic barriers to good-quality health care remain. Asthma provides an appropriate case study given its high prevalence, availability of effective controller therapies, and known variations in care. **OBJECTIVES:** The aim of this study is to examine the extent of differences in the economic burden of asthma and indicators of guideline-based care across socioeconomic status (SES) gradients. **RESEARCH DESIGN:** A total of 29,283 adults with moderate to severe asthma were identified from British Columbia's administrative health data for the year 1997-2013 and were matched to adults without asthma on the basis of sex and age. Direct medical costs (in 2013 Canadian dollars, \$) included all-cause inpatient, outpatient, and pharmacy costs. SES was measured at individual (receiving social assistance) and aggregate (median neighborhood household income) levels. We assessed the impact of SES on excess direct costs of asthma (the difference in all-cause direct medical costs between an asthma patient and the matched individual), and on use of asthma controller versus reliever medications. Associations were evaluated using generalized linear models. **RESULTS:** Asthmatics receiving social assistance incurred \$706 (95% confidence interval, \$302-\$1014) higher annual excess costs than the rest of the sample. Annual excess costs were \$120 (\$18-\$168) higher in low-SES versus high-SES neighborhoods. Low SES, at both individual and aggregate levels, was consistently associated with lower expenses on controller medications and higher expenses on reliever medications, indicators of suboptimal asthma care and control. **CONCLUSION:** Even under universal health care, individuals in lower SES groups did not receive guideline-based asthma care, potentially explaining their higher costs.

Chen, W., Safari, A., FitzGerald, J. M., et al. (2019). "Economic burden of multimorbidity in patients with severe asthma: a 20-year population-based study." *Thorax* **74**(12): 1113-1119.  
<https://thorax.bmj.com/content/74/12/1113.long>

**BACKGROUND:** The economic impact of multimorbidity in severe or difficult-to-treat asthma has not been comprehensively investigated. **AIMS:** To estimate the incremental healthcare costs of coexisting chronic conditions (comorbidities) in patients with severe asthma, compared with non-severe asthma and no asthma. **METHODS:** Using health administrative data in British Columbia, Canada (1996-2016),

we identified, based on the intensity of drug use and occurrence of exacerbations, individuals who experienced severe asthma in an incident year. We also constructed matched cohorts of individuals without an asthma diagnosis and those who had mild/dormant or moderate asthma (non-severe asthma) throughout their follow-up. Health service use records during follow-up were categorised into 16 major disease categories based on the International Classification of Diseases. Incremental costs (in 2016 Canadian Dollars, CAD\$1=US\$0.75=€0.56=€0.68) were estimated as the adjusted difference in healthcare costs between individuals with severe asthma compared with those with non-severe asthma and non-asthma. RESULTS: Relative to no asthma, incremental costs of severe asthma were \$2779 per person-year (95% CI 2514 to 3045), with 54% (\$1508) being attributed to comorbidities. Relative to non-severe asthma, severe asthma was associated with incremental costs of \$1922 per person-year (95% CI 1670 to 2174), with 52% (\$1003) being attributed to comorbidities. In both cases, the most costly comorbidity was respiratory conditions other than asthma (\$468 (17%) and \$451 (23%), respectively). CONCLUSIONS: Comorbidities accounted for more than half of the incremental medical costs in patients with severe asthma. This highlights the importance of considering the burden of multimorbidity in evidence-informed decision making for patients with severe asthma.

Chotirmall, S. H. (2017). "The cost of asthma control." *Appl Health Econ Health Policy* **22**(3): 414-415.  
<https://onlinelibrary.wiley.com/doi/pdfdirect/10.1111/resp.12991?download=true>

Crabtree-Ide, C., Lillvis, D. F., Nie, J., et al. (2021). "Evaluating the Financial Sustainability of the School-Based Telemedicine Asthma Management Program." *Popul Health Manag* **24**(6): 664-674.  
[https://www.liebertpub.com/doi/10.1089/pop.2020.0361?url\\_ver=Z39.88-2003&rfr\\_id=ori%3Arid%3Acrossref.org&rfr\\_dat=cr\\_pub%3Dpubmed](https://www.liebertpub.com/doi/10.1089/pop.2020.0361?url_ver=Z39.88-2003&rfr_id=ori%3Arid%3Acrossref.org&rfr_dat=cr_pub%3Dpubmed)

Using telemedicine to improve asthma management in underserved communities has been shown to be highly effective. However, program operating costs are perceived as the main barrier to dissemination and scaling up. This study evaluated whether a novel, evidence-based School-Based Telemedicine Enhanced Asthma Management (SB-TEAM) program, designed to overcome barriers to care for families of urban school-aged children, can be financially sustainable in real-world urban school settings. Eligible children (n = 400) had physician-diagnosed asthma with persistent or poorly controlled symptoms at baseline. Total costs included the cost of implementing and running the SB-TEAM program, asthma-related health care costs, cost of caregiver lost productivity in wages related to child illness, and school absenteeism fees. Using data from the SB-TEAM study and national data on wages and equipment costs, the authors modeled low, actual, and high-cost scenarios. The actual cost of administering the SB-TEAM program averaged \$344 per child. Expenses incurred by families for medical care (\$982), caregiver productivity cost (\$415), and school absenteeism costs (\$284) in SB-TEAM were not different from the costs in the control group (\$1594, \$492, and \$318 [P > 0.05]). The study findings remained robust under sensitivity analyses for various state- and school-specific regulations, staffing requirements, and wages. The authors concluded that the SB-TEAM program operating costs may be offset by the reduction in health care costs, caregiver lost wages, and school absenteeism associated with the program health benefit.

Dal Negro, R. W., Distante, C., Bonadiman, L., et al. (2016). "Cost of persistent asthma in Italy." *Multidiscip Respir Med* **11**: 44.  
[https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5162079/pdf/40248\\_2016\\_Article\\_80.pdf](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5162079/pdf/40248_2016_Article_80.pdf)

BACKGROUND: Asthma is a common disease of the airways with a significant burden for the society and for patients' quality of life. The Social Impact of Respiratory Integrated Outcomes (SIRIO) study estimated a mean cost of 1,177.40 € per patient/year in Italy, in 2007. The aim of the present study was to update the cost of persistent asthma patients in Italy. METHODS: An observational, retrospective, bottom-up analysis was carried out starting from the data base operating in the Lung Unit of the Specialist Medical Centre (CEMS), Verona (Italy), over the period June 2013-December 2015. Patients' data were recorded over the 12 ± 2 months before the enrollment and during 12 ± 2 months of follow-up. The prospective was the Italian National Health Service and the broad Italian society. Clinical data were measured in terms of forced expiratory volume in 1 s (FEV<sub>1</sub>(1%)) and

number of relapses. Healthcare resources (namely; number of hospitalizations and/or ER admissions; number of visits; drug use and duration, and indirect costs) were recorded. RESULTS: The cohort consisted of 817 patients with persistent asthma of different severity. They had a 42.96% male prevalence; a mean ( $\pm$ SE) age of 49.06 ( $\pm$ 0.64) years; a mean 87.47% ( $\pm$ 0.81) FEV(1)% pred. in baseline, and 69.16% of subjects had comorbidities. The mean ( $\pm$ SE) number of relapses was 0.91 ( $\pm$ 0.09) per patient/year before the enrolment. After 12 months, FEV(1)% significantly improved by +6.31% ( $\pm$ 0.45) from the corresponding baseline value ( $p < 0.001$ ). The number of relapses decreased of -0.46 ( $\pm$ 0.09) ( $p < 0.001$ ). The estimated total annual cost per asthmatic patient was 1,183.14 € ( $\pm$ 65.79 €) during the 12 months before the enrolment, and 1,290.89 € ( $\pm$ 68.74 €) throughout the follow-up. The increase was mostly due to the significantly increased duration of therapeutic strategies. The costs of hospitalization, general practitioner and rescue medications were significantly decreased. CONCLUSIONS: The periodic update of cost analysis is a key to monitor the trend of main asthma outcomes and related expenditure over time. It allows to plan the most convenient actions in terms of prevention strategies and effective interventions, with the aim of optimizing the healthcare resources consumption and maximizing the impact on clinical outcomes and patients' quality of life. The role of an appropriate pharmacological strategy still proves crucial in minimizing asthma morbidity and the corresponding socio-economic impact.

De Bortoli, M. M., Fell, A. K. M., Svendsen, M. V., et al. (2020). "Lifestyle, sick leave and work ability among Norwegian employees with asthma-A population-based cross-sectional survey conducted in Telemark County, Norway." *PLoS One* 15(4): e0231710.

<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7164599/pdf/pone.0231710.pdf>

OBJECTIVE: To investigate whether physician-diagnosed asthma modifies the associations between multiple lifestyle factors, sick leave and work ability in a general working population. METHODS: A cross-sectional study was conducted in Telemark County, Norway, in 2013. A sample of 16 099 respondents completed a self-administered questionnaire. We obtained complete data on lifestyle, work ability and sick leave for 10 355 employed persons aged 18-50 years. We modelled sick leave and work ability using multiple logistic regression, and introduced interaction terms to investigate whether associations with lifestyle factors were modified by asthma status. RESULTS: Several lifestyle risk factors and a multiple lifestyle risk index were associated with sick leave and reduced work ability score among persons both with and without physician-diagnosed asthma. A stronger association between lifestyle and sick leave among persons with asthma was confirmed by including interaction terms in the analysis: moderate lifestyle risk score \* asthma OR = 1.4 (95% CI 1.02-2.1); high lifestyle risk score \* asthma OR = 1.6 (95% CI 1.1-2.3); very high lifestyle risk score \* asthma OR = 1.6 (95% CI 0.97-2.7); obesity \* asthma OR = 1.5 (95% CI 1.02-2.1); past smoking \* asthma OR = 1.4 (95% CI 1.01-1.9); and current smoking \* asthma OR = 1.4 (95% CI 1.03-2.0). There was no significant difference in the association between lifestyle and work ability score among respondents with and without asthma. CONCLUSIONS: In the present study, we found that physician-diagnosed asthma modified the association between lifestyle risk factors and sick leave. Asthma status did not significantly modify these associations with reduced work ability score. The results indicate that lifestyle changes could be of particular importance for employees with asthma.

DeRigne, L., Stoddard-Dare, P. et Collins, C. (2020). "Differences Between U.S. Workers With Asthma by Paid Sick Leave Status: An Analysis of the 2018 National Health Interview Survey." *Policy, Politics, & Nursing Practice* 21(3): 164-173.

<https://journals.sagepub.com/doi/10.1177/1527154420937659>

Having asthma is a chronic condition that requires both acute and preventive care as a vital component of asthma action plans. This study looks at how having access to paid sick leave days may be important to adherence to asthma action plans. Does having paid sick days facilitate preventive care, help people avoid acute asthma incidents, reduce the number of lost work days, reduce the cost of care, and lessen financial worry among asthma sufferers? This research builds on a growing body of literature that has established a relationship between paid sick leave days and preventive and acute health care use and outcomes and yet is the first of its kind to examine the relationship specifically



between asthma and paid sick leave. This study used secondary data analysis to examine the relationship between six outcome variables categories and having paid sick leave in a nationally representative sample of N = 1,676 working U.S. adults in the National Health Interview Survey. Workers without paid sick leave benefits were significantly more likely to report they were worried about finances and struggle to afford their prescription medication compared to their counterparts who have paid sick leave benefits. Examined in light of past findings, workers with asthma who lack paid sick leave are in a precarious situation where they have increased worry likely due in part to reduced take-home pay due to unpaid sick days and increased medical expenses. There was no relationship between having paid sick leave and the receipt of preventive asthma care, measures of asthma control, receipt of patient education, and asthma medication use. Implications for policy and practice are put forth.

Dierick, B. J. H. et van der Molen, T. (2020). "Burden and socioeconomics of asthma, allergic rhinitis, atopic dermatitis and food allergy." *Expert Rev Pharmacoecon Outcomes Res* **20**(5): 437-453.  
<https://www.tandfonline.com/doi/full/10.1080/14737167.2020.1819793>

INTRODUCTION: Asthma, allergic rhinitis, atopic dermatitis, and food allergy affect approximately 20% of the global population. Few studies describe the burden of the totality of these diseases and only a handful studies provide a comprehensive overview of the socioeconomic impact of these diseases. AREAS COVERED: For this narrative review, we searched Pubmed using selected keywords and inspected relevant references using a snowballing process. We provide an overview of the socioeconomic burden of allergic diseases (in particular, asthma, allergic rhinitis, atopic dermatitis, and food allergy). The focus of this review is on their epidemiology (incidence, prevalence), burden (disability-adjusted life years, quality of life), and direct and indirect costs (absenteeism and presenteeism). We have put special emphasis on differences between countries. EXPERT COMMENTARY: Both the prevalence and the burden of allergic diseases are considerable with prevalence varying between 1% and 20%. We identified a plethora of studies on asthma, but studies were generally difficult to compare due to the heterogeneity in measures used. There were only few studies on the burden of food allergy; therefore, more studies on this allergy are required. For future studies, we recommend standardizing epidemiologic, socioeconomic impact, and quality of life measures of allergic diseases.

Ding, B. et Small, M. (2017). "Disease Burden of Mild Asthma: Findings from a Cross-Sectional Real-World Survey." *Adv Ther* **34**(5): 1109-1127.  
[https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5427102/pdf/12325\\_2017\\_Article\\_520.pdf](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5427102/pdf/12325_2017_Article_520.pdf)

INTRODUCTION: Most asthma patients have mild disease, although the burden of mild asthma is not well understood nor studied. Some evidence suggests that many patients with mild asthma experience suboptimal symptom control and exacerbations. This study characterizes the burden of illness and treatment patterns among patients with a confirmed diagnosis of mild asthma, defined as GINA Step 1 or Step 2, and residing in China, France, Germany, Italy, Japan, Spain, the United Kingdom, or the United States. METHODS: The Respiratory Disease-Specific Programme prospective cross-sectional survey was conducted with primary care and specialty physicians in each of the eight countries. Physician and patient surveys assessed demographic and clinical characteristics, frequency and timing of asthma symptoms, exacerbations, and rescue inhaler usage, the most recent FEV(1)% predicted, and healthcare utilization. GINA Step was determined by prescribed treatment regimen. GINA Step 1 patients were prescribed as-needed reliever medication and Step 2 required treatment with a low-dose inhaled corticosteroid, leukotriene receptor antagonist, or theophylline. Treatment adherence was assessed with the Morisky Medication Adherence scale, disease control with the Asthma Control Test, and work and activity impairments with the Work Productivity and Activity Impairment scale. RESULTS: The sample included 1115 GINA Step 1 and 2 patients, with 53% classified as Step 2. Overall asthma control was suboptimal, with reports of nocturnal symptoms (40.6%), symptom worsening (10.5%), and rescue inhaler usage in the last 4 weeks (33.6%). 25% of patients were uncontrolled. The overall mean number of exacerbations in the last 12 months was 0.4, with a higher frequency of exacerbations in Step 2 patients who also experienced more exacerbations requiring treatment

intensification, an emergency department visit, or hospitalization. CONCLUSION: Mild asthma imposes a substantial burden on patients, establishing the need for comprehensive management plans and ongoing support for treatment adherence. FUNDING: AstraZeneca.

Dor, A., Luo, Q., Gerstein, M. T., et al. (2018). "Cost-effectiveness of an Evidence-Based Childhood Asthma Intervention in Real-World Primary Care Settings." *J Ambul Care Manage* **41**(3): 213-224.

We present an incremental cost-effectiveness analysis of an evidence-based childhood asthma intervention (Community Healthcare for Asthma Management and Prevention of Symptoms [CHAMPS]) to usual management of childhood asthma in community health centers. Data used in the analysis include household surveys, Medicaid insurance claims, and community health center expenditure reports. We combined our incremental cost-effectiveness analysis with a difference-in-differences multivariate regression framework. We found that CHAMPS reduced symptom days by 29.75 days per child-year and was cost-effective (incremental cost-effectiveness ratio: \$28.76 per symptom-free days). Most of the benefits were due to reductions in direct medical costs. Indirect benefits from increased household productivity were relatively small.

Duenas-Meza, E. et Giraldo-Cadavid, L. F. (2020). "Cost-utility analysis of an integrated care program for children with asthma in a medium-income country." *Journal Of Global Health* **55**(11): 3110-3118.

OBJECTIVE: To evaluate the cost-utility of an integrated care program (ASMAIRE Infantil Program [PAI]) for children with asthma compared with standard of care. METHODS: A decision-analytic model was used to compare an integrated care program compared to the standard of care in children with asthma in Bogota, Colombia. Baseline characteristics of the patients were established according to the distribution of patients in the PAI database. Other inputs were obtained from published meta-analysis, local registries, medical bills, general mortality data, and expert opinion. Costs were presented in 2017 Colombian pesos. Outcomes included quality-adjusted life-years (QALYs). Costs and outcomes were discounted by 5% per year. Incremental cost-utility ratios were presented for PAI compared with standard of care. Univariate and multivariate probabilistic sensitivity analyses were conducted to assess model robustness to parameter uncertainty. RESULTS: The model predicted that patients that are part of the PAI would accrue more QALYs than patients on standard of care. The incremental results suggest that the PAI is a cost-effective treatment (incremental cost-utility ratio of Colombian pesos \$33 753 817/QALY) compared with standard of care. Sensitivity analyses suggest that results are most sensitive to cost of care (with and without PAI) and costs of severe exacerbation. However, the PAI is cost-effective irrespective of variation in any of the input parameters. CONCLUSION: Our model predicted that an integrated intervention for the management of asthma in pediatric patients improves QALYs, reduces number of disease related exacerbations compared to standard therapy and is cost-effective for the long-term control of the disease in Colombia.

Ehteshami-Afshar, S., FitzGerald, J. M., Carlsten, C., et al. (2016). "The impact of comorbidities on productivity loss in asthma patients." *Respir Res* **17**(1): 106.

[https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5002149/pdf/12931\\_2016\\_Article\\_421.pdf](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5002149/pdf/12931_2016_Article_421.pdf)

BACKGROUND: Health-related productivity loss is an important, yet overlooked, component of the economic burden of disease in asthma patients of a working age. We aimed at evaluating the effect of comorbidities on productivity loss among adult asthma patients. METHODS: In a random sample of employed adults with asthma, we measured comorbidities using a validated self-administered comorbidity questionnaire (SCQ), as well as productivity loss, including absenteeism and presenteeism, using validated instruments. Productivity loss was measured in 2010 Canadian dollars (\$). We used a two-part regression model to estimate the adjusted difference of productivity loss across levels of comorbidity, controlling for potential confounding variables. RESULTS: 284 adults with the mean age of 47.8 (SD 11.8) were included (68 % women). The mean SCQ score was 2.47 (SD 2.97, range 0-15) and the average productivity loss was \$317.5 per week (SD \$858.8). One-unit increase in the SCQ score was associated with 14 % (95 % CI 1.02-1.28) increase in the odds of reporting productivity loss, and 9.0 % (95 % CI 1.01-1.18) increase in productivity loss among those reported any

loss of productivity. A person with a SCQ score of 15 had almost \$1000 per week more productivity loss than a patient with a SCQ of zero. CONCLUSIONS: Our study deepens the evidence-base on the burden of asthma, by demonstrating that comorbidities substantially decrease productivity in working asthma patients. Asthma management strategies must be cognizant of the role of comorbidities to properly incorporate the effect of comorbidity and productivity loss in estimating the benefit of disease management strategies.

Enilari, O. et Sinha, S. (2019). "The Global Impact of Asthma in Adult Populations." *Ann Glob Health* **85**(1). <https://annalsglobalhealth.org/articles/10.5334/aogh.2412/>

Asthma is a disease characterized by chronic airway inflammation, leading to intermittent symptoms of wheeze, dyspnea, cough and chest tightness in combination with variable expiratory airway obstruction. Clinical diagnosis is usually established based on the presence of symptoms and documented variability in expiratory airflow limitation as measured by pulmonary function testing. Presently, asthma is a major chronic disease affecting approximately 334 million people worldwide. The epidemic spares no age group, race or ethnicity; however ethnicity and socioeconomic status do influence the prevalence, morbidity and mortality of asthma in the United States and various countries throughout the world. Moreover, asthma places a huge burden at the societal, financial and health-care levels of multiple nations.

Ferreira de Magalhães, M. et Amaral, R. (2017). "Cost of asthma in children: A nationwide, population-based, cost-of-illness study." *Pediatr Allergy Immunol* **28**(7): 683-691.

BACKGROUND: Childhood asthma is very prevalent and costs can be high, especially in severe disease. This study aimed to estimate the cost of asthma in Portuguese children and the variations by level of asthma control. METHODS: A nationwide, population- and prevalence-based cost-of-illness study with a societal perspective was conducted. We measured direct and indirect costs using a bottom-up approach and a human capital method, respectively, for 208 children (<18 years), from two national repositories. Generalized linear modelling for analysis of asthma costs' determinants and sensitivity analysis to assess uncertainty were performed. RESULTS: The mean annualized asthma cost per child was €929.35 (95% CI, 809.65-1061.11): €698.65 (95% CI, 600.88-798.27) for direct costs and €230.70 (95% CI, 197.36-263.81) for indirect costs. Extrapolations for the Portuguese children amounted to €161 410 007.61 (95% CI, 140 620 769.55-184 293 968.55) for total costs. Direct costs represent 75.2% with the costliest domain (51.1% of total costs) being the healthcare service use: 20.7% for scheduled medical visits and 30.4% for acute asthma care-non-scheduled medical visits (7.9%, €12 766 203.20), emergency department visits (11.7%, €18 932 464.80) and hospitalizations (10.8%, €17 406 946.00). Children with partly controlled and uncontrolled asthma had higher mean costs per year (adjusted coefficients: 1.46 [95% CI, 1.12-1.90] and 2.25 [95% CI, 1.56-3.24], respectively). CONCLUSIONS: Costs of childhood asthma are high (0.9% of the healthcare expenditures in Portugal). Direct costs represented three-fourth of total costs, mainly related to the use of healthcare services for acute asthma care. Policies and interventions to improve asthma control and reduce acute use of healthcare services have the potential to reduce asthma costs.

Finkelstein, E. A., Lau, E., Doble, B., et al. (2021). "Economic burden of asthma in Singapore." *BMJ Open Respir Res* **8**(1). <https://bmjopenrespres.bmj.com/content/bmjresp/8/1/e000654.full.pdf>

BACKGROUND AND OBJECTIVE: Up-to-date economic burden of asthma in Singapore is currently unknown. METHODS: We quantify the per capita and total annual costs of asthma for adults and children by level of symptom control (uncontrolled, partly controlled, and well controlled) via a cross-sectional online survey administered to a national web panel. Participants were asked about healthcare utilisation, days missed from work, and reduced productivity due to their symptoms. These values were then monetised and multiplied by prevalence estimates of adult and child asthmatics to generate total costs. RESULTS: A total of 300 adults and 221 parents of children with asthma were included in analysis. The total annual cost of adult asthma was estimated to be SGD 1.74 billion

(US\$1.25 billion) with 42% coming from the uncontrolled group, 45% from the partly controlled group, and 13% from the well-controlled group. For children, the total cost is SGD 0.35 billion (US\$0.25 billion), with 64%, 26% and 10% coming from each group respectively. Combined, the annual economic burden of asthma in Singapore is SGD 2.09 billion (US\$1.50 billion) with 79% due to productivity losses. CONCLUSION: Poorly controlled asthma imposes a significant economic burden. Therefore, better control of disease has the potential to generate not only health improvements, but also medical expenditure savings and productivity gains.

Flórez-Tanus, Á., Parra, D. et Zakzuk, J. (2018). "Health care costs and resource utilization for different asthma severity stages in Colombia: a claims data analysis." *World Allergy Organizational Journal* **11**(1): 26.  
[https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6231276/pdf/40413\\_2018\\_Article\\_205.pdf](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6231276/pdf/40413_2018_Article_205.pdf)

BACKGROUND: Asthma is one of the most common chronic respiratory conditions worldwide. Asthma-related economic burden has been reported in Latin America, but knowledge about its economic impact to the Colombian health care system and the influence of disease severity is lacking. This study estimated direct medical costs and health care resource utilization (HCRU) in patients with asthma according to severity in Colombia. METHODS: This study identified all-age patients who had at least one medical event linked to an asthma diagnosis (CIE-10: J45-J46) between 2004 and 2014. Patients were selected if they had a continuous enrollment and uninterrupted insurance coverage between January 1-2015 and December 31-2015 and were categorized into 4 different severity levels using a modified algorithm based on Leidy criteria. Healthcare utilization and costs were estimated in a 1-year period after the identification period. A Generalized Linear Model (GLM) with gamma distribution and log link was used to analyze costs adjusting for patient demographics. RESULTS: A total of 20,410 patients were included: 69.5% had mild intermittent, 18.0% mild persistent, 6.9% moderate persistent and 5.5% severe persistent asthma; with mean costs (SD) of \$67 (134), \$482 (1506), \$1061 (1983), \$2235 (3426) respectively ( $p < 0.001$ ). The mean total direct cost was estimated at \$331 (1278) per patient. Medication and hospitalization had the higher proportion in total costs (46% and 31% respectively). General physician visits was the most used service (57.2%) and short-acting  $\beta$ -2 agonists the most used medication (24%). CONCLUSIONS: Health services utilization and direct costs of asthma were highly related to disease severity. Nationwide health policies aimed at the effective control of asthma are necessary and would play an important role in reducing the associated economic impact.

Godard, P., Chanez, P., Siraudin, L., et al. (2002). "Costs of asthma are correlated with severity : a 1-yr prospective study." *European Respiratory Journal* **19**(1): 61-67.  
<http://erj.ersjournals.com/cgi/reprint/19/1/61>

Asthma prevalence is increasing and asthma-related costs are likely to increase, but few studies have analysed the relationship of asthma costs and severity. The impact of severity on costs was quantified in a cohort of 318 asthmatic patients followed up prospectively for 1 yr. Patients presenting with a broad range of severity of the disease (intermittent, mild persistent, moderate persistent, severe persistent) were recruited by chest physicians throughout France and treated for 1 yr according to customary clinical practice and following international guidelines. Severity, direct and indirect costs, and quality of life (QoL) were assessed. A multivariate analysis was conducted to relate factors contributing to the costs measured. Mean direct costs for goods and services excluding hospitalization, numbers of consultations, supplementary examinations, and the use and cost of bronchodilators and corticosteroids, indirect costs of days lost from work, and adverse QoL parameters all increased significantly with increasing severity. This also applied to mean age, body weight, asthma duration, depression of forced expiratory volume in one second, and inhaled corticosteroid posology in the 234 patients completing the study. There was a significant relationship ( $r=0.614$ ,  $pv0.001$ ) between direct costs (hospitalization and cures were excluded) and three domains of the QoL questionnaire (mobility, pain and energy). Overall costs of asthma (including individual direct costs, indirect costs, and intangible quality of life costs) are clearly related to severity. This is the first study in asthma to combine rigorous independent classification of grades of severity in statistically valid numbers of patients of grades receiving "real-world" treatment and followed-up

prospectively for 1 yr. It allowed severity to be accurately related to direct, indirect and intangible costs of asthma. Quality of life explained a significant part of these costs.

Gonzalez Barcala, F. J., La Fuente-Cid, R. D., Alvarez-Gil, R., et al. (2011). "Factors associated with a higher prevalence of work disability among asthmatic patients." *J Asthma* **48**(2): 194-199.  
<https://www.tandfonline.com/doi/full/10.3109/02770903.2010.539294>

**OBJECTIVE:** To study asthma-related absenteeism in the asthmatic population in Spain and to identify some risk factors for absenteeism. **METHODS:** A cross-sectional study was performed on patients who had been diagnosed with asthma in the primary care setting at least 1 year before the start of this study. A questionnaire was designed that included socio-demographic and clinical variables. The time absent from work in the previous year was self-reported by the patients. **RESULTS:** More than 25% of the asthmatic population in Spain took sick leave during the previous year. Visits to a general practitioner or to the emergency department are the factors associated with the greatest risk of absenteeism. **CONCLUSIONS:** Absenteeism is common within the asthmatic population in Spain. The authors of this study believe that some of the determining factors could be modified by the health-care system.

Gruffydd-Jones, K., Thomas, M., Roman-Rodriguez, M., et al. (2019). "Asthma impacts on workplace productivity in employed patients who are symptomatic despite background therapy: a multinational survey." *J Asthma Allergy* **12**: 183-193.  
<https://www.dovepress.com/getfile.php?fileID=51176>

**Background:** Asthma affects millions of people worldwide, with many patients experiencing symptoms that affect their daily lives despite receiving long-term controller medication. **Purpose:** Work is a large part of most people's lives, hence this study investigated the impact of uncontrolled asthma on work productivity in adults receiving asthma maintenance therapy. **Patients and methods:** An online survey was completed by employed adults in Brazil, Canada, Germany, Japan, Spain and the UK. Participants were confirmed as symptomatic using questions from the Royal College of Physicians' 3 Questions for Asthma tool. The survey contained the Work Productivity and Activity Impairment - Specific Health Problem questionnaire and an open-ended question on the effect of asthma at work. **Results:** Of the 2,055 patients on long-term maintenance therapy screened, 1,598 were symptomatic and completed the survey. The average percentage of work hours missed in a single week due to asthma symptoms was 9.3%, ranging from 3.5% (UK) to 17.4% (Brazil). Nearly three-quarters of patients reported an impact on their productivity at work caused by asthma. Overall work productivity loss (both time off and productivity whilst at work) due to asthma was 36%, ranging from 21% (UK) to 59% (Brazil). When asked how asthma made participants feel at work, many respondents highlighted how their respiratory symptoms affect them. Tiredness, weakness and mental strain were also identified as particular challenges, with respondents describing concerns about the perception of colleagues and feelings of inferiority. **Conclusions:** This study emphasizes the extent to which work time is adversely affected by asthma in patients despite the use of long-term maintenance medication, and provides unique personal insights. Strategies to improve patients' lives may include asthma education, optimizing asthma management plans and running workplace well-being programs. Clinicians, employers and occupational health teams should be more aware of the impact of asthma symptoms on employees, and work together to help overcome these challenges.

Haahtela, T., Herse, F., Karjalainen, J., et al. (2017). "The Finnish experience to save asthma costs by improving care in 1987-2013." *J Allergy Clin Immunol* **139**(2): 408-414.e402.  
[https://www.jacionline.org/article/S0091-6749\(16\)31448-8/pdf](https://www.jacionline.org/article/S0091-6749(16)31448-8/pdf)

The Finnish National Asthma Program 1994-2004 markedly improved asthma care in the 1990s. We evaluated the changes in costs during 26 years from 1987 to 2013. Direct and indirect costs were calculated by using data from national registries. Costs from both the societal and patient perspectives were included. The costs were based on patients with persistent, physician-diagnosed asthma verified by lung function measurements. We constructed minimum and maximum scenarios to assess the

effect of improved asthma care on total costs. The number of patients with persistent asthma in the national drug reimbursement register increased from 83,000 to 247,583. Improved asthma control reduced health care use and disability, resulting in major cost savings. Despite a 3-fold increase in patients, the total costs decreased by 14%, from €222 million to €191 million. Costs for medication and primary care visits increased, but overall annual costs per patient decreased by 72%, from €2656 to €749. The theoretical total cost savings for 2013, comparing actual with predicted costs, were between €120 and €475 million, depending on the scenario used. The Finnish Asthma Program resulted in significant cost savings at both the societal and patient levels during a 26-year period.

Hansen, C. L., Baelum, J., Skadhauge, L., et al. (2012). "Consequences of asthma on job absenteeism and job retention." *Scand J Public Health* **40**(4): 377-384.

[https://journals.sagepub.com/doi/10.1177/1403494812449079?url\\_ver=Z39.88-2003&rfr\\_id=ori:rid:crossref.org&rfr\\_dat=cr\\_pub%3dpubmed](https://journals.sagepub.com/doi/10.1177/1403494812449079?url_ver=Z39.88-2003&rfr_id=ori:rid:crossref.org&rfr_dat=cr_pub%3dpubmed)

**AIMS:** Various social and economic effects are associated with asthma. This quantitative study describes the effects of current asthma on work life evaluated from the number of weeks receiving transfer incomes. **METHODS:** The study population comprised 7,241 persons answering the ECRHS II screening questionnaire, which was sent to a random age and gender stratified sample of 10,000 persons aged 20 to 44 years. Participants with current asthma were identified by positive answers to a set of validated questions. Transfer incomes for a five-year period were registered from a study-independent national database, which collects all public administered transfer incomes in Denmark. The numbers of weeks receiving unemployment, welfare, sick-leave and disability benefits were identified for each participant and differences between asthmatics and non-asthmatics were analyzed. **RESULTS:** Asthmatics had significantly more annual weeks receiving welfare (36.6 vs. 20.7,  $p=0.00$ ), sick leave (9.2 vs. 6.6,  $p=0.00$ ) and disability (19.3 vs. 11.4,  $p=0.00$ ) benefits than non-asthmatics. Adult-onset asthmatics had increased prevalence rate ratios for disability of 2.40 (95% confidence interval 1.70-3.40). Blue collar work significantly increased the probability of all public transfer incomes. **CONCLUSIONS:** Current asthma makes it harder to keep a job. Adult-onset asthmatics and blue collar workers are particularly affected.

Haselkorn, T., Szeffler, S. J., Chipps, B. E., et al. (2020). "Disease Burden and Long-Term Risk of Persistent Very Poorly Controlled Asthma: TENOR II." *J Allergy Clin Immunol Pract* **8**(7): 2243-2253.

<https://www.tandfonline.com/doi/full/10.1080/02770903.2016.1194430>  
[https://www.jaci-inpractice.org/article/S2213-2198\(20\)30241-5/pdf](https://www.jaci-inpractice.org/article/S2213-2198(20)30241-5/pdf)

**BACKGROUND:** Severe/difficult-to-treat disease occurs in 5% to 10% of patients with asthma, but accounts for more than 50% of related economic costs. Understanding factors associated with persistent very poorly controlled (VPC) asthma may improve outcomes. **OBJECTIVE:** To characterize persistent VPC asthma after more than 10 years of standard of care. **METHODS:** The Epidemiology and Natural history of asthma: Outcomes and treatment Regimens (TENOR) II (N = 341) was a multicenter, observational study of patients with severe/difficult-to-treat asthma with a single, cross-sectional visit more than 10 years after TENOR I. Persistent VPC asthma was defined as VPC asthma at TENOR I and TENOR II enrollment; without VPC asthma was defined as well- or not well-controlled asthma at either or both visits. Multivariable logistic regression assessed long-term predictors of persistent VPC asthma using TENOR I baseline variables. **RESULTS:** Of 327 patients, nearly half (48.0%, n = 157) had persistent VPC asthma. Comorbidities and asthma triggers were more frequent in patients with persistent VPC asthma than in patients without VPC asthma. Total geometric mean IgE was higher in patients with persistent VPC asthma (89.3 IU/mL vs 55.7 IU/mL); there was no difference in eosinophil levels. Lung function was lower in patients with persistent VPC asthma (mean % predicted pre- and postbronchodilator FEV<sub>1</sub>, 63.0% vs 82.8% and 69.6% vs 87.2%, respectively). Exacerbations in the previous year were more likely in patients with persistent VPC asthma (29.7% vs 9.0%, respectively). Predictors of persistent VPC asthma were black versus white race/ethnicity, allergic trigger count (4 vs 0), systemic corticosteroid use, and postbronchodilator FEV<sub>1</sub> (per 10% decrease). **CONCLUSIONS:** The burden of persistent VPC asthma is high in severe/difficult-to-treat disease; management of modifiable risk factors, maximization of lung function, and trigger avoidance may improve outcomes.

Hsu, J., Qin, X. T., Beavers, S. F., et al. (2016). "Asthma-Related School Absenteeism, Morbidity, and Modifiable Factors." *Am J Prev Med* **51**(1): 23-32.

[https://www.ajpmonline.org/article/S0749-3797\(15\)00792-8/pdf](https://www.ajpmonline.org/article/S0749-3797(15)00792-8/pdf)

Introduction: Asthma is a leading cause of chronic disease-related school absenteeism. Few data exist on how information on absenteeism might be used to identify children for interventions to improve asthma control. This study investigated how asthma-related absenteeism was associated with asthma control, exacerbations, and associated modifiable risk factors using a sample of children from 35 states and the District of Columbia. Methods: The Behavioral Risk Factor Surveillance System Child Asthma Call-back Survey is a random-digit dial survey designed to assess the health and experiences of children aged 0-17 years with asthma. During 2014-2015, multivariate analyses were conducted using 2006-2010 data to compare children with and without asthma-related absenteeism with respect to clinical, environmental, and financial measures. These analyses controlled for sociodemographic and clinical characteristics. Results: Compared with children without asthma-related absenteeism, children who missed any school because of asthma were more likely to have not well controlled or very poorly controlled asthma (prevalence ratio = 1.50; 95% CI = 1.34, 1.69) and visit an emergency department or urgent care center for asthma (prevalence ratio = 3.27; 95% CI = 2.44, 4.38). Mold in the home and cost as a barrier to asthma-related health care were also significantly associated with asthma-related absenteeism. Conclusions: Missing any school because of asthma is associated with suboptimal asthma control, urgent or emergent asthma-related healthcare utilization, mold in the home, and financial barriers to asthma-related health care. Further understanding of asthma-related absenteeism could establish how to most effectively use absenteeism information as a health status indicator. Published by Elsevier Inc. on behalf of American Journal of Preventive Medicine

Huang, M. J., Zhang, J. B., Liu, J., et al. (2020). "[Analysis of direct economic burden of occupational asthma]." *Respirology* **38**(6): 437-440.

Objective: To analyze the direct economic burden of occupational asthma patients and provide economic basis for the government to rationally allocate health resources. Methods: In September 2019, collected the case data of 53 patients diagnosed with occupational asthma who were hospitalized in our hospital from December 2008 to December 2018, and analyze the impact of gender, age, diagnosis time, ducation level, allergen type to the length of stay, hospitalization cost, medical technology diagnosis and treatment costs, western medicine costs, average daily hospitalization costs and other indicators. Results: The average length of hospitalization for occupational asthma patients was (38.7±8.1) days, and the average hospitalization cost was 14743 yuan, of which medical technology diagnosis and treatment costs, western medicine costs, and comprehensive medical service costs accounted for the top three, 42.5% (331977/781369) , 32.0% (249942/781369) , 19.6% (153268/781369) respectively. Hospitalization days for occupational asthma patients has decreased significantly in 2014-2018 (P<0.05) . There were no significant differences in hospitalization costs, medical technology diagnosis and treatment costs, western medicine costs, and average daily hospitalization costs for occupational asthma patients caused by different allergens (isocyanates, persulfates and phthalic anhydrides) (P>0.05) . Hospitalization days, hospitalization costs, medical technology diagnosis and treatment costs, western medicine costs, and average daily hospitalization costs of patients with moderate occupational asthma were significantly higher than those of mild patients (P<0.05) . Conclusion: Early detection of occupational asthma patients and early intervention can reduce the economic burden on patients and society.

Huerta, A., Uría, E., Cuesta, M., et al. (2010). "Allergic rhinitis alone or with asthma is associated with an increased risk of sickness absences." *J Asthma* **104**(11): 1654-1658.

<https://www.tandfonline.com/doi/full/10.1080/02770903.2018.1499035>

[https://www.resmedjournal.com/article/S0954-6111\(10\)00220-9/pdf](https://www.resmedjournal.com/article/S0954-6111(10)00220-9/pdf)

The aim of the study is to examine the risk of sickness absence in public sector employees with allergic rhinitis or asthma or both conditions combined. This is a prospective cohort study of 48,296 Finnish

public sector employees. Data from self-reported rhinitis and asthma were obtained from survey responses given during either the 2000-2002 or 2004 periods. Follow-up data on sickness absences for the public sector employees surveyed were acquired from records kept by the employers. During the follow-up, mean sick leave days per year for respondents were 17.6 days for rhinitis alone, 23.8 days for asthma alone and 24.2 days for both conditions combined. Respondents with neither condition were absent for a mean of 14.5 days annually. The impact of asthma and rhinitis combined on the risk of sick leave days was marginal compared to asthma alone (RR 1.1; 95% CI 1.0-1.3). In the subgroup analysis (those with current asthma or allergy medication), the risk ratio for medically certified sickness absence (>3 days) was 2.0 (95% CI 1.9-2.2) for those with asthma and rhinitis combined. Rhinitis, asthma and both these conditions combined increased the risk of days off work.

Jacob, C., Bechtel, B., Engel, S., et al. (2016). "Healthcare costs and resource utilization of asthma in Germany: a claims data analysis." *Eur J Health Econ* **17**(2): 195-201.

[https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4757601/pdf/10198\\_2015\\_Article\\_671.pdf](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4757601/pdf/10198_2015_Article_671.pdf)

**INTRODUCTION:** Asthma is associated with a substantial economic burden on the German Statutory Health Insurance. **AIMS AND OBJECTIVES:** To determine costs and resource utilization associated with asthma and to analyze the impact of disease severity on subgroups based on age and gender. **METHODS:** A claims database analysis from the statutory health insurance perspective was conducted. Patients with an ICD-10-GM code of asthma were extracted from a 10% sample of a large German sickness fund. Five controls for each asthma patient matched by age and gender were randomly selected from the same database. Costs and resource utilization were calculated for each individual in the asthma and control group. Incremental asthma-related costs were calculated as the mean cost difference. Based on prescribed asthma medication, patients were classified as intermittent or persistent. In addition, age groups of  $\leq 5$ , 6-18, and  $>18$  years were analyzed separately and gender differences were investigated. **RESULTS:** Overall, 49,668 individuals were included in the asthma group. On average, total annual costs per patient were €753 higher ( $p = 0.000$ ) compared to the control group (€2,168 vs. €1,415). Asthma patients had significantly higher ( $p = 0.000$ ) outpatient (€217), inpatient (€176), and pharmacy costs (€259). Incremental asthma-related total costs were higher for patients with persistent asthma compared to patients with intermittent asthma (€1,091 vs. €408). Women aged  $>18$  years with persistent asthma had the highest difference in costs compared to their controls (€1,207;  $p < 0.0001$ ). Corresponding healthcare resource utilization was significantly higher in the asthma group ( $p = 0.000$ ). **CONCLUSIONS:** The treatment of asthma is associated with an increased level of healthcare resource utilization and significantly higher healthcare costs. Asthma imposes a substantial economic burden on sickness funds.

Jansson, S. A., Backman, H., Andersson, M., et al. (2020). "Severe asthma is related to high societal costs and decreased health related quality of life." *Respir Med* **162**: 105860.

[https://www.resmedjournal.com/article/S0954-6111\(19\)30374-9/pdf](https://www.resmedjournal.com/article/S0954-6111(19)30374-9/pdf)

**BACKGROUND:** The aim of the present study was to estimate the societal costs and the key cost drivers for patients with severe asthma in Sweden. In addition, health-related quality of life (HRQOL) and morbidity of patients with severe asthma is described. **METHODS:** The study population comprised adults with severe asthma recruited from a large asthma cohort within the Obstructive Lung Disease in Northern Sweden (OLIN) studies. During 2017, patients were interviewed quarterly over telephone regarding their resource utilization and productivity losses. **RESULTS:** Estimated mean annual asthma-related costs per patient with severe asthma amounted to €6,500, of which approximately €2400 and €4100 were direct and indirect costs, respectively. The main cost drivers for direct costs were hospitalizations followed by drugs: approximately €1000 and €800, respectively. Patients on treatment with regular oral corticosteroids (OCS) had greater direct costs compared with those without regular OCS treatment. Co-morbid conditions were common and the costs were substantial also for co-morbid conditions, with a total cost of approximately €4200. The OCS group had significantly lower HRQOL compared to the non-OCS group. **CONCLUSIONS:** The societal costs due to severe asthma were substantial. Costs for co-morbid conditions contributed substantially to both direct and indirect costs. The direct costs were significantly higher in the maintenance OCS-group



compared to the non-maintenance OCS-group. These results indicate a need for improved management and treatment regimens for patients with severe asthma.

Jutkowitz, E., Nyman, J. A., Michaud, T. L., et al. (2015). "For what illnesses is a disease management program most effective?" *J Occup Environ Med* **57**(2): 117-123.

[https://www.valueinhealthjournal.com/article/S1098-3015\(16\)30580-0/fulltext?\\_returnURL=https%3A%2F%2Flinkinghub.elsevier.com%2Fretrieve%2Fpii%2FS1098301516305800%3Fshowall%3Dtrue](https://www.valueinhealthjournal.com/article/S1098-3015(16)30580-0/fulltext?_returnURL=https%3A%2F%2Flinkinghub.elsevier.com%2Fretrieve%2Fpii%2FS1098301516305800%3Fshowall%3Dtrue)

**OBJECTIVE:** We examined the impact of a disease management (DM) program offered at the University of Minnesota for those with various chronic diseases. **METHODS:** Differences-in-differences regression equations were estimated to determine the effect of DM participation by chronic condition on expenditures, absenteeism, hospitalizations, and avoidable hospitalizations. **RESULTS:** Disease management reduced health care expenditures for individuals with asthma, cardiovascular disease, congestive heart failure, depression, musculoskeletal problems, low back pain, and migraines. Disease management reduced hospitalizations for those same conditions except for congestive heart failure and reduced avoidable hospitalizations for individuals with asthma, depression, and low back pain. Disease management did not have any effect for individuals with diabetes, arthritis, or osteoporosis, nor did DM have any effect on absenteeism. **CONCLUSIONS:** Employers should focus on those conditions that generate savings when purchasing DM programs. **CLINICAL SIGNIFICANCE:** This study suggests that the University of Minnesota's DM program reduces hospitalizations for individuals with asthma, cardiovascular disease, depression, musculoskeletal problems, low back pain, and migraines. The program also reduced avoidable hospitalizations for individuals with asthma, depression, and low back pain.

Kerkhof, M., Tran, T. N., Soriano, J. B., et al. (2018). "Healthcare resource use and costs of severe, uncontrolled eosinophilic asthma in the UK general population." *Thorax* **73**(2): 116-124.

<https://thorax.bmj.com/content/thoraxjnl/73/2/116.full.pdf>

**BACKGROUND:** Little is known about the prevalence of severe, uncontrolled eosinophilic asthma (SUEA) and associated costs. **AIMS:** We sought to determine the prevalence of SUEA and compare asthma-related healthcare resource use (HCRU) and associated costs with overall means for a general asthma population. **METHODS:** This cohort study evaluated anonymised medical record data (December 1989 through June 2015) from the Clinical Practice Research Datalink and the Optimum Patient Care Research Database to study UK patients with active asthma (diagnostic code and one or more drug prescriptions in the baseline year), aged 5 years and older, without concomitant COPD, and with recorded eosinophil count. SUEA was defined as two or more asthma attacks during 1 baseline year preceding a high blood eosinophil count ( $\geq 0.3 \times 10^9/L$ ) for patients prescribed long-acting  $\beta(2)$ -agonist (LABA) and high-dosage inhaled corticosteroids (ICS) during baseline plus 1 follow-up year. We compared asthma-related HCRU and associated direct costs (2015 pounds sterling, £) during the follow-up year for SUEA versus the general asthma population. **RESULTS:** Of 363 558 patients with active asthma and recorded eosinophil count, 64% were women, mean (SD) age was 49 (21) years; 43% had high eosinophil counts, 7% had two or more attacks in the baseline year and 10% were prescribed high-dosage ICS/LABA for 2 study years. Overall, 2940 (0.81%; 95% CI 0.78% to 0.84%) patients had SUEA. Total mean per-patient HCRU and associated costs were four times greater for SUEA versus all patients (HCRU and cost ratios 3.9; 95% CI 3.7 to 4.1). **CONCLUSIONS:** Less than 1% of patients in a general asthma population had SUEA. These patients accounted for substantially greater asthma-related HCRU and costs than average patients with asthma.

Kirsch, F., Teuner, C. M., Menn, P., et al. (2013). "[Costs of illness for asthma and COPD in adults in Germany]." *Gesundheitswesen* **75**(7): 413-423.

<https://www.thieme-connect.com/products/ejournals/abstract/10.1055/s-0033-1333742>

**BACKGROUND;** Asthma and COPD have a high and growing epidemiological impact worldwide, and it is often indicated that significant economic costs are linked to this. The aim of this review is to

estimate the cost-of-illness for both diseases for adults in Germany. METHODS: A systematic search of Pubmed, Embase, EconLit and Business Source Complete was performed for the years 1995-2012 to identify German cost-of-illness studies for asthma and COPD in German or English language. 6 studies for asthma, 7 studies for COPD and 1 for both diseases met the inclusion criteria. The results of the identified studies were extrapolated to 2010 prices and compared within the same disease. RESULTS: In spite of the heterogeneity in methodology and results, medication was identified as the most important component of direct costs and work loss as the most important component of indirect costs. All in all, the estimated costs per case of illness and year for asthma sum up to 445 to 2 543 € and for COPD to 1 212 to 3 492 €. CONCLUSION: The analysed cost-of-illness studies confirm that asthma and COPD are costly but results vary markedly. COPD due to its higher costs per case and its similar prevalence causes higher macroeconomic costs. Our results emphasise the economic relevance of prevention and disease management for these lung diseases.

Kleinman, N. L., Brook, R. A. et Ramachandran, S. (2009). "An employer perspective on annual employee and dependent costs for pediatric asthma." *Ann Allergy Asthma Immunol* **103**(2): 114-120.  
[https://www.annallergy.org/article/S1081-1206\(10\)60163-9/fulltext](https://www.annallergy.org/article/S1081-1206(10)60163-9/fulltext)

BACKGROUND: The burden of pediatric asthma on parents' health care costs is not well described. OBJECTIVE: To evaluate direct and indirect health care costs of employees with children with asthma (asthma cohort) compared with employees with children without asthma (control cohort). METHODS: Retrospective analysis of 2001-2007 employer data including employee medical and pharmacy claims, payroll, work absence, demographics, and dependent medical and pharmacy claims. Asthma diagnosis or pharmacy claims for asthma controller medications were used to identify employees with dependents younger than 12 years for the asthma cohort. Controls were identified based on dependent age and lack of an asthma diagnosis or pharmacy claim for a controller medication. All costs were calculated using 2-part regression models that controlled for demographics, job information, Charlson Comorbidity Index, and region. Costs were calculated for employee health care, prescriptions, sick leave, short- and long-term disability, and workers' compensation and dependent health care and prescriptions. Costs were compared for employees with children aged 0 through 3 years, 4 through 7 years, 8 through 11 years, and younger than 12 years. RESULTS: Data were available for 11,794 asthma cohort employees and 64,812 controls. Statistically significant annual cost differences were identified for employee health care (\$154,  $P < .001$ ), prescriptions (\$95,  $P < .001$ ), sick leave (-\$41,  $P < .001$ ), short-term disability (-\$41,  $P = .008$ ), dependent health care (\$862,  $P < .001$ ), and prescriptions (\$534,  $P < .001$ ). CONCLUSIONS: Pediatric asthma is associated with significant additional health care and prescription costs for both employees and dependents.

Kponee-Shovein, K., Marvel, J., Ishikawa, R., et al. (2022). "Carbon footprint and associated costs of asthma exacerbation care among UK adults." *J Med Econ* **25**(1): 524-531.  
<https://www.tandfonline.com/doi/full/10.1080/13696998.2022.2063603>

INTRODUCTION: Asthma exacerbations are a primary driver of costs and health impacts from asthma. Despite research suggesting that asthma care has a disproportionate carbon footprint, emissions costs are not considered when evaluating its societal burden. To advance the understanding of greenhouse gas (GHG) emissions associated with asthma, we estimated the carbon footprint and associated costs of asthma exacerbation care by severity level among UK adults. METHODS: Guidelines for asthma exacerbation treatment in UK adults were reviewed by severity level: mild, moderate, and severe/life-threatening. Components of care for each severity were evaluated for GHG emission potential and key drivers were identified. Carbon dioxide equivalent (CO<sub>2</sub>e) emissions of drivers were sourced from published literature and combined to estimate the carbon footprint per exacerbation, by severity level. Emissions were scaled up to the annual UK adult population based on the annual number of exacerbations at each severity. Costs associated with emissions were estimated using the UK government's 2020 nontraded price of carbon, at £71 per tonne CO<sub>2</sub>e (tCO<sub>2</sub>e). RESULTS: Overall, emissions drivers for exacerbations were medical services, including patient-travel, and quick-relief inhalers. The annual number of mild, moderate, and severe/life-threatening asthma exacerbations among UK adults were 118.9 M, 5.5 M, and 2.4 M. Associated annual carbon footprints were

estimated to be 83,455 tCO<sub>2</sub>e, 192,709 tCO<sub>2</sub>e, and 448,037 tCO<sub>2</sub>e for mild, moderate, and severe/life-threatening exacerbations, respectively, with a total of 724,201 tCO<sub>2</sub>e. Total annual emissions costs from exacerbation care were £51.3 M; £5.9 M, £13.6 M, and £31.7 M for mild, moderate, and severe/life-threatening exacerbations, respectively. CONCLUSION: GHG emissions from asthma exacerbation management were the highest for severe/life-threatening events, followed by moderate exacerbations. Treatment to reduce the severity and occurrence of exacerbations, such as effective, long-term control therapy via lower-emission dry powder inhalers (DPIs), can help mitigate asthma care emissions. For mild exacerbations, the use of DPIs can eliminate associated emissions.

Krahn, M. D., Berka, C., Langlois, P., et al. (1996). "Direct and indirect costs of asthma in Canada, 1990." *Canadian Medical Association Journal* **154**(6): 821-831, 823 tabl., 822 fig.

<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC1487808/pdf/cmaj00090-0079.pdf>

Lang, D. M. (2015). "Severe asthma: epidemiology, burden of illness, and heterogeneity." *Allergy Asthma Proc* **36**(6): 418-424.

<https://www.ingentaconnect.com/content/ocean/aap/2015/00000036/00000006/art00008;jsessionid=8i3hnh344kaht.x-ic-live-02>

BACKGROUND: Patients with severe persistent asthma comprise only 5-10 % of the total asthma population, but account for a large proportion of asthma morbidity and health care expenditures. Among patients with severe asthma, higher costs can be expected in association with not well or poorly controlled asthma. OBJECTIVE: To summarize the evidence concerning the epidemiology, burden, and heterogeneity of severe asthma. METHODS: A literature search was performed to identify citations using the terms "severe asthma" and "epidemiology", "asthma control", "asthma" and "heterogeneity". RESULTS: Successful management of patients with severe asthma continues to be a major unmet need. One of the barriers to successful management is the heterogeneity of asthma. Asthma is not one disease; it is a disorder that can be subdivided into a number of different phenotypes and endotypes. A revised paradigm for asthma management, that entails categorization of asthma patients via use of "biomarkers", and prescribing targeted therapy, will supplant what has been a "one size fits all" approach to asthma management. CONCLUSION: The novel approach to asthma management, in which therapy will be more mechanism-specific based on phenotype/endotype, offers the potential for improved asthma care outcomes - particularly for patients with severe persistent asthma who are not well or poorly controlled.

Lee, E. W., Kim, H. S. et Kim, W. (2020). "Socioeconomic Burden of Disease Due to Asthma in South Korea." *Asia Pacific Journal of Public Health* **32**(4): 188-193.

[https://journals.sagepub.com/doi/10.1177/1010539520920524?url\\_ver=Z39.88-2003&rfr\\_id=ori:rid:crossref.org&rfr\\_dat=cr\\_pub%3dpubmed](https://journals.sagepub.com/doi/10.1177/1010539520920524?url_ver=Z39.88-2003&rfr_id=ori:rid:crossref.org&rfr_dat=cr_pub%3dpubmed)

This study aimed to estimate the socioeconomic burden of asthma in South Korea. The data were obtained from the National Patient Sample of 2014. The direct costs included health care and non-health care costs, and the indirect costs included loss of productivity. To estimate the prevalence of asthma, this study used both primary diagnoses and treatment-based criteria. The prevalence of asthma was 3.7% using primary diagnosis-based criteria. The total costs of asthma were \$645.8 million. The direct and indirect costs were \$553.9 million and \$92.0 million, respectively. When the treatment-based criteria were applied, the prevalence decreased to 1.8% and the total costs decreased to \$465.1 million. The direct and indirect costs were \$394.9 million and \$70.2 million, respectively. In the future, the cost of asthma, derived from various perspectives, should be regularly estimated and used as a basis for lowering the burden of disease due to asthma.

Lee, L. K., Obi, E., Paknis, B., et al. (2018). "Asthma control and disease burden in patients with asthma and allergic comorbidities." *J Asthma* **55**(2): 208-219.

<https://www.tandfonline.com/doi/full/10.1080/02770903.2017.1316394>

**OBJECTIVE:** To assess asthma control and associations with health-related quality of life (HRQoL) and economic outcomes among patients with asthma and allergic comorbidities treated with inhaled corticosteroids (ICS) and long-acting beta-agonists (LABA) combination therapy. **METHODS:** Data from the 2011-2013 US National Health and Wellness Survey were used to identify patients with asthma currently treated with ICS and LABA combination therapy (N = 1923). Patients were included if they self-reported a physician diagnosis of asthma and at least one allergic/asthma-related comorbid condition (e.g., nasal allergies, atopic dermatitis). Asthma Control Test scores categorized patients as very poorly (scores  $\leq 15$ ; 29.3%), not well (16-19; 25.1%), or well controlled (20-25; 45.7%). Outcomes included HRQoL (SF-36v2; SF-12v2), work productivity and activity impairment, healthcare utilization (HRU), and annual indirect and direct costs. Generalized linear models, controlling for covariates, examined whether outcomes differed by asthma control. **RESULTS:** Over half of the patients had very poorly or not well-controlled asthma (54.4%). Patients with very poorly controlled versus well-controlled asthma reported significantly greater decreases in HRQoL, greater overall work impairment, and higher HRU (all,  $p < 0.05$ ). Very poorly controlled patients incurred over double the indirect costs and nearly one and a half times the direct and total costs of well-controlled patients. **CONCLUSIONS:** Increasing level of asthma control was related to improved HRQoL and lower costs. The considerably high prevalence of uncontrolled asthma among patients on ICS and LABA suggests poor treatment adherence or unmet needs in current treatment and may require step-up therapy in appropriate patients according to clinical guidelines.

Lee, L. K., Ramakrishnan, K., Safioti, G., et al. (2020). "Asthma control is associated with economic outcomes, work productivity and health-related quality of life in patients with asthma." *BMJ Open Respir Res* **7**(1).  
<https://bmjopenrespres.bmj.com/content/bmjresp/7/1/e000534.full.pdf>

**BACKGROUND:** The objective of this analysis was to examine the association between asthma control (based on Asthma Control Test (ACT) responses) and healthcare resource utilisation (HRU), work productivity and health-related quality of life (HRQoL) among a nationwide sample of US adults with a self-reported diagnosis of asthma and without comorbid chronic obstructive pulmonary disease. **METHODS:** Data were obtained from the 2015 and 2016 self-administered, internet-based National Health and Wellness Surveys. Patients were grouped by ACT score ( $\leq 15$ : poorly controlled; 16-19: partly controlled; 20-25: well-controlled asthma). Study outcomes included HRU (patient-reported healthcare provider visits, emergency department visits and hospitalisations during the previous 6 months); work productivity, measured using the Work Productivity and Activity Impairment-General Health Scale; HRU-associated costs and work productivity loss and HRQoL, measured using EuroQoL-5 Dimensions-5 Levels (EQ-5D-5L) and the Short Form Health Survey-36V.2 (SF-36V.2). Incremental differences in outcomes between groups were assessed using generalised linear models adjusted for covariates. **RESULTS:** Of 7820 eligible adults, 17.4% had poorly controlled, 20.1% partly controlled and 62.5% well-controlled asthma. Well-controlled asthma was associated with significantly lower HRU ( $p < 0.001$ ) and lower mean direct costs (\$6012 vs \$8554 and \$15 262, respectively;  $p < 0.001$ ); well-controlled asthma was also associated with significantly lower mean scores for work absenteeism, work presenteeism, overall work impairment and activity impairment (all  $p < 0.001$ ), and lower mean indirect costs (\$6353 vs \$10 448 and \$14 764, respectively;  $p < 0.001$ ). Clinically meaningful differences favouring well-controlled asthma were seen for all HRQoL measures, with statistically significantly higher adjusted mean EQ-5D-5L index and SF-6D Health Utilities Index scores (derived from SF-36V.2) for patients with well-controlled asthma compared with partly controlled or poorly controlled asthma ( $p < 0.001$ ). **CONCLUSIONS:** The study demonstrates a clear relationship between asthma control and its impact on HRU, costs, work productivity and HRQoL. This will allow for better identification and management of patients with poorly controlled asthma.

Leira, H. L., Berg, J. A., Bratt, U., et al. (2006). "[High incidence of work-related disease among asthmatics on sick-leave]." *Tidsskr Nor Laegeforen* **126**(18): 2367-2369.  
<https://tidsskriftet.no/sites/default/files/pdf2006--2367-9.pdf>

**BACKGROUND:** We have previously shown that work-related asthma is substantially underreported and usually not notified to the Labour Inspection Authority until it has become chronic and interferes

with future work. The aim of this study was to evaluate whether conditions relating to individuals are important for the susceptibility to work-related asthma and to assess whether there is a correspondence between patients' and physicians' perception of the importance of exposure to work in relation to the disease. MATERIAL AND METHODS: Questionnaires were sent to 824 workers (56% women) aged 18-55 years, who had been on sick leave > 16 days in the years 2000-2003. The disease was classified as work-related asthma if the following questions were answered positively: "Have you ever had respiratory symptoms in relation to your work?" and "Did the symptoms improve on absence from work?" RESULTS: The response rate was 72%, 58% of the responders were women. 416 (70%) had work-related asthma. There were fewer smokers in the group with work-related asthma than among those without, atopy was equally prevalent. Occupational titles reflected the gender differences of the Norwegian labour force. Indoor climate at the workplace was stated as the most frequent provoking factor. The physicians suspected a relationship to work for about half of the 416, notification was only sent for 21% of the male and 10% of the female employees. INTERPRETATION: The importance of occupational exposure seems to be underestimated, especially for women with asthma. Neither atopy nor smoking increased the risk for work-related symptoms. Indoors climate at the work place was most often given as the reason for work-related symptoms. A reduction of exposure led to a reduction of symptoms for most individuals.

Lewis, A., Torvinen, S., Dekhuijzen, P. N., et al. (2016). "The economic burden of asthma and chronic obstructive pulmonary disease and the impact of poor inhalation technique with commonly prescribed dry powder inhalers in three European countries." *Health Services Research* 16: 251.

[https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4942909/pdf/12913\\_2016\\_Article\\_1482.pdf](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4942909/pdf/12913_2016_Article_1482.pdf)

BACKGROUND: Asthma and chronic obstructive pulmonary disease (COPD) are common chronic inflammatory respiratory diseases, which impose a substantial burden on healthcare systems and society. Fixed-dose combinations (FDCs) of inhaled corticosteroids (ICS) and long-acting  $\beta_2$  agonists (LABA), often administered using dry powder inhalers (DPIs), are frequently prescribed to control persistent asthma and COPD. Use of DPIs has been associated with poor inhalation technique, which can lead to increased healthcare resource use and costs. METHODS: A model was developed to estimate the healthcare resource use and costs associated with asthma and COPD management in people using commonly prescribed DPIs (budesonide + formoterol Turbuhaler<sup>®</sup>) or fluticasone + salmeterol Accuhaler<sup>®</sup>) over 1 year in Spain, Sweden and the United Kingdom (UK). The model considered direct costs (inhaler acquisition costs and scheduled and unscheduled healthcare costs), indirect costs (productive days lost), and estimated the contribution of poor inhalation technique to the burden of illness. RESULTS: The direct cost burden of managing asthma and COPD for people using budesonide + formoterol Turbuhaler<sup>®</sup>) or fluticasone + salmeterol Accuhaler<sup>®</sup>) in 2015 was estimated at €813 million, €560 million, and €774 million for Spain, Sweden and the UK, respectively. Poor inhalation technique comprised 2.2-7.7 % of direct costs, totalling €105 million across the three countries. When lost productivity costs were included, total expenditure increased to €1.4 billion, €1.7 billion and €3.3 billion in Spain, Sweden and the UK, respectively, with €782 million attributable to poor inhalation technique across the three countries. Sensitivity analyses showed that the model results were most sensitive to changes in the proportion of patients prescribed ICS and LABA FDCs, and least sensitive to differences in the number of antimicrobials and oral corticosteroids prescribed. CONCLUSIONS: The cost of managing asthma and COPD using commonly prescribed DPIs is considerable. A substantial, and avoidable, contributor to this burden is poor inhalation technique. Measures that can improve inhalation technique with current DPIs, such as easier-to-use inhalers or better patient training, could offer benefits to patients and healthcare providers through improving disease outcomes and lowering costs.

Loftus, P. A. et Wise, S. K. (2015). "Epidemiology and economic burden of asthma." *Int Forum Allergy Rhinol* 5 **Suppl 1**: S7-10.

BACKGROUND: The "asthma epidemic" is on the rise, with the Center for Disease Control (CDC) epidemiological studies reporting a 3.0% asthma prevalence in the United States in 1970, 5.5% in 1996, and 7.8% in 2006 to 2008. This results in an immense economic burden, with asthma costing an

estimated \$56 billion in the United States in 2007, which is a 6% increase from the \$53 billion that was spent in 2002. METHODS: A review of the current literature and CDC reports were used to thoroughly examine and summarize the epidemiology and economic burden of asthma domestically and globally. RESULTS: Asthma shows a male predominance before puberty, and a female predominance in adulthood. Studies show Puerto Ricans to be the most commonly affected ethnicity, and a higher prevalence of asthma is found in lower income populations. Asthma is related to some of the more common otolaryngologic diseases such as allergy and obstructive sleep apnea. The condition results in significant morbidity, such as an increase in emergency department visits and a decrease in productivity due to missed school and works days. CONCLUSION: Epidemiological statistics report an undisputable increase of asthma both domestically and worldwide, which means the economic burden of this disease is also on the rise. Better access to healthcare, improved asthma education, and bridging the gap between ethnic and racial disparities in the treatment and management of asthma may help to control this epidemic, promote better outcomes, and prevent continued rising costs related to the management of this widespread disease.

McDonald, V. M., Hiles, S. A., Jones, K. A., et al. (2018). "Health-related quality of life burden in severe asthma." *Med J Aust* **209**(S2): S28-s33.

<https://www.tandfonline.com/doi/full/10.1080/02770903.2016.1201837>

It is largely unrecognised that the impacts of asthma are different in patients with severe disease compared with patients with mild to moderate disease. Severe asthma is associated with a significant health-related quality of life (HRQoL) burden due to excessive symptoms, frequent and life-threatening attacks, increased comorbidity burden, and high pharmacological treatment requirements. Interventions aimed at improving HRQoL need to be specifically tested in populations with severe asthma, including multicomponent interventions targeting the many clinical characteristics associated with the disease. It is necessary to have patient-reported outcome measures developed specifically for severe asthma. Public health messages recognising the significant burden of severe asthma on quality of life are needed.

Melero Moreno, C. et Quirce, S. (2019). "Economic impact of severe asthma in Spain: multicentre observational longitudinal study." *Curr Med Chem* **56**(8): 861-871.

<https://www.tandfonline.com/doi/full/10.1080/02770903.2018.1499035>

Objective: Estimate the economic impact of severe asthma from the Spanish social perspective through the estimation of the associated annual direct and indirect costs. Methods: Observational, longitudinal, retrospective study carried out in 20 Spanish secondary settings (Pulmonology and Allergy Services) among patients aged  $\geq 18$ , diagnosed with severe asthma according to European Respiratory Society/American Thoracic Society consensus and who have not experienced an exacerbation in the previous 2 months. Asthma-related healthcare resource utilization as well as asthma-related days off work were collected over a retrospective 12-month period from medical records review (inclusion period: June to November 2016). Total costs were calculated by multiplying the natural resource units used within 1 year by the corresponding unit cost. Costs were expressed in Euros for 2018. Results: A total of 303 patients were included, mean age was 54 years old and 67% were women. There were 5.7 physician visits per patient (3.3 in secondary care). The most common pharmacologic treatment was fixed dose combination of inhaled corticosteroids/long-acting  $\beta_2$ -adrenergic agonists (96.7%), followed by leukotriene receptor antagonists (57.1%). 134 patients (44.2%) had at least one severe asthma exacerbation (mean: 1.9 exacerbation/patient), of whom 22 patients required hospitalization, with a mean hospital stay of 10.9 days/patient. Mean sick leave due to severe asthma was 9.1 days per patient per year. Mean annual direct cost (confidence interval 95%) was €7472/patient (€6578-8612). The cost per exacerbation was €1410/patient. When indirect costs were added (€1082/patient [€564-1987]), the total annual mean cost rose to €8554/patient (€7411-10199). Conclusions: Taking the social perspective, the economic impact of severe asthma in Spain was estimated to be €8554/patient/year.

Meng, Y. Y., Babey, S. H., Hastert, T. A., et al. (2008). "Uncontrolled asthma means missed work and school, emergency department visits for many Californians." Policy Brief UCLA Cent Health Policy Res(Pb2008-2): 1-8.

In 2005, three million Californians reported that they had current asthma. Despite advances in therapy, asthma remains a disease that is not optimally controlled in many Californians. Inadequately controlled asthma can result in missed work and school and emergency department visits. Asthma was responsible for an estimated 1.9 million missed days of school and two million days of missed work in California in 2005. In addition, more than 475,000 children and adults in California went to the emergency department or urgent care center because of asthma. There are 659,000 children and adults who suffer from asthma symptoms every day or every week (22% of those with current asthma). These Californians suffering from frequent asthma symptoms have higher rates of missing school or work due to their asthma, visiting the emergency department or urgent care for their asthma, and rating their overall health as fair or poor. Improvements in access to health care, asthma management and avoidance of triggers can help these Californians reduce the severity of their asthma burden. Using data from the 2005 California Health Interview Survey (CHIS 2005), this policy brief examines the burden associated with frequent asthma symptoms among those with current asthma, and identifies key opportunities for reducing and controlling disease activity in these asthma sufferers. Asthma is a chronic disease that causes the airways of the lungs to become inflamed and more sensitive to constriction, making it harder to breathe. Current asthma refers to people who have been diagnosed with asthma and who report they still have asthma, or have had an episode or attack in the previous year. Frequent asthma symptoms are defined as experiencing asthma symptoms every day or every week.

Mullerova, H., Cockle, S. M., Gunsoy, N. B., et al. (2021). "Clinical characteristics and burden of illness among adolescent and adult patients with severe asthma by asthma control: the IDEAL study." Journal of Asthma **58**(4): 459-470.  
<https://www.tandfonline.com/doi/full/10.1080/02770903.2019.1708095>

Objectives: Severe asthma (SA) can be uncontrolled despite guideline-directed treatment. We described SA characteristics and identified factors associated with uncontrolled disease and frequent exacerbations. Methods: Post hoc analysis of the observational IDEAL study (201722/NCT02293265) included patients with SA aged  $\geq 12$  years receiving high-dose inhaled corticosteroids plus additional controller(s) for  $\geq 12$  months. Uncontrolled SA was defined by Asthma Control Questionnaire (ACQ)-5 scores  $\geq 1.5$  or  $\geq 1$  exacerbations (prior year), and further stratified by exacerbation frequency (no/infrequent [0-1] vs frequent [ $\geq 2$ ]; prior year); associated factors were determined using multivariate logistic regression. Results: Of 670 patients with SA, 540 (81%) were uncontrolled (ACQ-5 scores  $\geq 1.5$ : 80%;  $\geq 1$  exacerbations [prior year]: 71%). Uncontrolled patients had lower lung function and worse health-related quality of life (HRQoL) than controlled patients; 197/540 (37%) experienced frequent exacerbations (prior year). Worse St George's Respiratory Questionnaire (SGRQ) total score, comorbid sinusitis, or eczema were significantly associated with uncontrolled SA; younger age, never smoker status, exacerbation requiring hospitalization (previous year), worse SGRQ symptom score, comorbid nasal polyps, COPD, or osteoporosis were significantly associated with uncontrolled SA with frequent exacerbations. Conclusions: In IDEAL, one-fifth of patients with SA were controlled, based on symptoms. Uncontrolled, exacerbating SA was associated with specific comorbidities, frequent exacerbations, a lower lung function, and compromised HRQoL, although inference from this analysis is limited by the selective cross-sectional nature of the cohort. Nonetheless, these data highlight the need for more effective precision treatments in this population.

Nagase, H., Adachi, M., Matsunaga, K., et al. (2020). "Prevalence, disease burden, and treatment reality of patients with severe, uncontrolled asthma in Japan." Allergol Int **69**(1): 53-60.  
<https://www.sciencedirect.com/science/article/pii/S1323893019300772?via%3Dihub>

BACKGROUND: The severe asthma and severe, uncontrolled asthma (SUA) populations in Japan are not well-studied. We investigated the prevalence of continuously treated severe asthma and SUA patients, their disease burden, and the treatment reality via a Japanese health insurance claims

database. METHODS: Continuously treated asthma patients (patients prescribed inhaled corticosteroids for asthma  $\geq 4$  times in the past year) aged  $\geq 17$  years at the index date (latest visit between April 2014 and March 2015 for asthma treatment) were included in this analysis (KEIFU study, UMIN000027695). Asthma severity and control status at the index date were defined using modified criteria of ERS/ATS guidelines. Asthma hospitalization, oral corticosteroid (OCS) use, and total medical expenses were calculated using data up to 12 months post-index date. RESULTS: We identified 10,579 patients as continuously treated asthma patients. Of these, 823 (7.8%) had severe asthma; 267 (2.5%) and 556 (5.3%) patients had SUA and severe, controlled asthma (SCA), respectively. Compared with SCA and mild to moderate asthma patients, a greater percentage of SUA patients required hospitalization (13.7%, 6.2%, and 3.0%, respectively) and were prescribed OCSs (67.4%, 45.9%, and 16.2%, respectively). Yearly total medical expenses were also greater for SUA patients (mean [standard deviation]: 8346 [12,280], vs 5989 [10,483] and 3422 [8800] USD, respectively). CONCLUSIONS: The percentages of severe asthma and SUA patients continuously treated in Japan were obtained through this large-scale analysis using a health insurance claims database. SUA patients had greater medical and economic burdens, suggesting more appropriate treatment is required according to the treatment guidelines.

Narayan, T., Vellopoulou, K., Bakakos, P., et al. (2019). "The Economic Burden of Asthma in Greece: A Cross-Sectional Study." *Ann Am Thorac Soc* 17(5): 629-640.  
<https://link.springer.com/article/10.1007/s40258-019-00469-4>

BACKGROUND: The high prevalence rates of asthma worldwide and the chronic nature of the disease make asthma a major cause of morbidity, imposing a significant socio-economic burden in many countries. Specifically in Greece, the self-reported prevalence of asthma reached 9% in 2017. OBJECTIVES: The objective of this study was to estimate the total management cost of asthma in Greece and its potential determinants. METHODS: A population-based, random-digit-dialed telephone nationwide survey was conducted to recruit patients with asthma in Greece (n = 353). A structured questionnaire was used to collect data on demographic and lifestyle characteristics, exacerbations, asthma control, medical resource utilization, and productivity loss during the past 12 months. The total annual direct cost from the societal, payer, and patient perspective as well as the indirect cost was calculated. All costs refer to the year 2017 (€). The significance level was set to  $\alpha = 0.05$ . RESULTS: The mean (95% confidence interval) annual total cost per patient for asthma management from the societal, payer, and patient perspective was €895 (696-1105), €673 (497-861), and €151 (119-188), respectively. The direct medical cost accounted for almost 90% of the total cost, whereas only 4% was attributed to the indirect cost. The direct medical cost was mainly driven by the medication cost (48%). The total annual societal cost was statistically significantly higher in those with not well-controlled asthma ( $p = 0.014$ ) and those experiencing exacerbations during the past 12 months ( $p < 0.001$ ) than in their counterparts. The total annual economic burden of asthma in Greece was estimated at €727 million and €547 million from the societal and payer perspective, respectively. CONCLUSION: Our findings indicate that asthma imposes a high economic burden on society and the healthcare system in Greece. Therefore, greater investment in interventions aimed at asthma control and prevention of acute exacerbations may reduce the overall burden of asthma in Greece.

Nathel, L., Malmberg, P., Lundbäck, B., et al. (2000). "Is asthma underestimated as a cause of sick leave?" *Respir Med* 94(10): 977-982.

Public interest needs to be focused on the economic burden of asthma on society because of the increasing prevalence of the condition. Asthma is common in individuals of working age and sick leave is an important health-economic issue. In the present study we looked at the prevalence of asthma in a sick leave register. Individuals on sick leave due to asthma, individuals on sick leave due to any other respiratory disorder or symptom and individuals on sick leave due to non-respiratory conditions were included in a questionnaire based study. Individuals in the register diagnosed with asthma could be classified as current asthmatics or possible asthmatics in respectively 94% and 99% of the cases. They were also ex-smokers to a greater extent than the other groups, which was more pronounced in males. However, individuals on sick leave due to 'any other respiratory disorder' could be classified as



current asthmatics or possible asthmatics in respectively 19% and 30% of the cases. The corresponding figures in the group on sick leave due to 'other diagnoses' were 7% and 10%. Hence, there is evidence that asthma is an under-reported diagnosis and this must be taken into consideration when sick leave registers are used in health-economic studies.

Nathell, L. (2005). "Effects on sick leave of an inpatient rehabilitation programme for asthmatics in a randomized trial." *Scand J Public Health* **33**(1): 57-64.

[https://journals.sagepub.com/doi/10.1080/14034940410028343?url\\_ver=Z39.88-2003&rfr\\_id=ori:rid:crossref.org&rfr\\_dat=cr\\_pub%3dpubmed](https://journals.sagepub.com/doi/10.1080/14034940410028343?url_ver=Z39.88-2003&rfr_id=ori:rid:crossref.org&rfr_dat=cr_pub%3dpubmed)

**AIM:** Among adult asthmatics a major proportion of the cost of illness is attributed to productivity losses and societal costs in connection with sick leave compensation. The aim of the study was to evaluate an extensive structured four-week inpatient rehabilitation programme for asthmatics. **METHODS:** A diagnosis of asthma was made in a structured way among people on sick leave due to a respiratory disorder. In total, 197 persons were randomized to either a rehabilitation programme, or to usual care. The main components of the rehabilitation programme were education, pharmacological optimization, physical training, and coping skill acquisition. **RESULTS:** At the three-year follow-up, the median number of sick leave days in the rehabilitation group was 104, and in the usual care group 167 ( $p = 0.12$ ). An analysis of a subgroup consisting of persons not currently smoking with a previous diagnosis of asthma by a physician ( $n = 57$ ) showed a significant effect on sick leave at three years (median number of days 63 in the rehabilitation group vs 361 in the control group,  $p = 0.02$ ). All analyses were based on intention to treat. **CONCLUSIONS:** The long-term effects on sick leave of an extensive inpatient asthma rehabilitation programme are most evident for non-smokers and ex-smokers with a previous asthma diagnosis. It is therefore recommended that persons with asthma who are current smokers should be offered participation in smoking cessation programmes instead of asthma rehabilitation programmes.

Ng, B., Sadatsafavi, M., Safari, A., et al. (2019). "Direct costs of overdiagnosed asthma: a longitudinal, population-based cohort study in British Columbia, Canada." *Clin Exp Allergy* **9**(11): e031306.

<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6858138/pdf/bmjopen-2019-031306.pdf>

**OBJECTIVES:** A current diagnosis of asthma cannot be objectively confirmed in many patients with physician-diagnosed asthma. Estimates of resource use in overdiagnosed cases of asthma are necessary to measure the burden of overdiagnosis and to evaluate strategies to reduce this burden. We assessed differences in asthma-related healthcare resource use between patients with a confirmed asthma diagnosis and those with asthma ruled out. **DESIGN:** Population-based, prospective cohort study. **SETTING:** Participants were recruited through random-digit dialling of both landlines and mobile phones in the province of British Columbia, Canada. **PARTICIPANTS:** We included 345 individuals  $\geq 12$  years of age with a self-reported physician diagnosis of asthma. The diagnosis of asthma was reassessed at the end of 12 months of follow-up using a structured algorithm, which included a bronchodilator reversibility test, methacholine challenge test, and if necessary medication tapering and a second methacholine challenge test. **PRIMARY AND SECONDARY OUTCOME MEASURES:** Self-reported annual asthma-related direct healthcare costs (2017 Canadian dollars), outpatient physician visits and medication use from the perspective of the Canadian healthcare system. **RESULTS:** Asthma was ruled out in 86 (24.9%) participants. The average annual asthma-related direct healthcare costs for participants with confirmed asthma were \$C497.9 (SD \$C677.9) and for participants with asthma ruled out, \$C307.7 (SD \$C424.1). In the adjusted analyses, a confirmed diagnosis was associated with higher direct healthcare costs (relative ratio (RR)=1.60, 95% CI 1.14 to 2.22), increased rate of specialist visits (RR=2.41, 95% CI 1.05 to 5.40) and reliever medication use (RR=1.62, 95% CI 1.09 to 2.35), but not primary care physician visits ( $p=0.10$ ) or controller medication use ( $p=0.11$ ). **CONCLUSIONS:** A quarter of individuals with a physician diagnosis of asthma did not have asthma after objective re-evaluation. These participants still consumed a significant amount of asthma-related healthcare resources. The population-level economic burden of asthma overdiagnosis could be substantial.

Nguyen, H. V., Nadkarni, N. V., Sankari, U., et al. (2017). "Association between asthma control and asthma cost: Results from a longitudinal study in a primary care setting." *Respirology* **22**(3): 454-459.

**BACKGROUND AND OBJECTIVE:** Asthma control can be assessed with the Asthma Control Test (ACT) and a score of 20 or higher indicates good asthma control. Patients pay for their consultation and treatment in the fee-for-service primary healthcare system in Singapore. We hypothesized that achieving asthma control would result in lower asthma costs through reduced acute exacerbations, fewer physician consultations and lower lost productivity. The study compared the healthcare costs of patients who achieved asthma control and those with suboptimal asthma control based on ACT scores. Factors influencing asthma control and healthcare expenditure over time were also examined. **METHODS:** A total of 736 patients were enrolled into an asthma care programme in two polyclinics during 2008 and 2013. Direct costs of asthma management were derived from the frequency of polyclinic consultations, medication costs and hospitalization. Indirect costs were estimated from lost workdays due to exacerbations. The generalized estimating equation (GEE) approach was used to longitudinally model the factors associated with total healthcare expenditure. **RESULTS:** Patients with asthma control spent S\$48 (US\$36) more per doctor visit on asthma drugs ( $P < 0.01$ ) but incurred S\$65 (US\$48) less per doctor visit in total costs ( $P < 0.01$ ) than those with suboptimal asthma control. The savings from achieving asthma control for obese patients were greater than for normal-weight patients (S\$42 or the equivalent of US\$31;  $P < 0.05$ ). **CONCLUSION:** Optimal asthma control was associated with reduced healthcare costs. An effective treatment regimen should also consider other modifiable factors such as weight control to achieve asthma control and eventually reduce asthma costs.

Nunes, C., Pereira, A. M. et Morais-Almeida, M. (2017). "Asthma costs and social impact." *Asthma Res Pract* **3**: 1.

[https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5219738/pdf/40733\\_2016\\_Article\\_29.pdf](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5219738/pdf/40733_2016_Article_29.pdf)

In recent decades, both asthma prevalence and incidence have been increasing worldwide, not only due to the genetic background, but mainly because of the effect of a wide number of environmental and lifestyle risk factors. In many countries noncommunicable diseases, like asthma, are not yet considered a healthcare priority. This review will analyze and discuss disparities in asthma management in several countries and regions, such as access to healthcare human resources and medications, due to limited financial capacity to develop strategies to control and prevent this chronic disease. This review tries to explore the social and economic burden of asthma impact on society. Although asthma is generally accepted as a costly illness, the total costs to society (direct, indirect and intangible asthma costs) are difficult to estimate, mainly due to different disease definitions and characterizations but also to the use of different methodologies to assess the asthma socio-economic impact in different societies. The asthma costs are very variables from country to country, however we can estimate that a mean cost per patient per year, including all asthmatics (intermittent, mild, moderate and severe asthma) in Europe is \$USD 1,900, which seems lower than USA, estimated mean \$USD 3,100.

Nurmagambetov, T., Kuwahara, R. et Garbe, P. (2018). "The Economic Burden of Asthma in the United States, 2008-2013." *Ann Am Thorac Soc* **15**(3): 348-356.

**RATIONALE:** Asthma is a chronic disease that affects quality of life, productivity at work and school, and healthcare use; and it can result in death. Measuring the current economic burden of asthma provides important information on the impact of asthma on society. This information can be used to make informed decisions about allocation of limited public health resources. **OBJECTIVES:** In this paper, we provide a comprehensive approach to estimating the current prevalence, medical costs, cost of absenteeism (missed work and school days), and mortality attributable to asthma from a national perspective. In addition, we estimate the association of the incremental medical cost of asthma with several important factors, including race/ethnicity, education, poverty, and insurance status. **METHODS:** The primary source of data was the 2008-2013 household component of the Medical Expenditure Panel Survey. We defined treated asthma as the presence of at least one medical

or pharmaceutical encounter or claim associated with asthma. For the main analysis, we applied two-part regression models to estimate asthma-related annual per-person incremental medical costs and negative binomial models to estimate absenteeism associated with asthma. RESULTS: Of 213,994 people in the pooled sample, 10,237 persons had treated asthma (prevalence, 4.8%). The annual per-person incremental medical cost of asthma was \$3,266 (in 2015 U.S. dollars), of which \$1,830 was attributable to prescription medication, \$640 to office visits, \$529 to hospitalizations, \$176 to hospital-based outpatient visits, and \$105 to emergency room visits. For certain groups, the per-person incremental medical cost of asthma differed from that of the population average, namely \$2,145 for uninsured persons and \$3,581 for those living below the poverty line. During 2008-2013, asthma was responsible for \$3 billion in losses due to missed work and school days, \$29 billion due to asthma-related mortality, and \$50.3 billion in medical costs. All combined, the total cost of asthma in the United States based on the pooled sample amounted to \$81.9 billion in 2013. CONCLUSIONS: Asthma places a significant economic burden on the United States, with a total cost of asthma, including costs incurred by absenteeism and mortality, of \$81.9 billion in 2013.

Papaioannou, A. I., Kostikas, K., Zervas, E., et al. (2015). "Control of asthma in real life: still a valuable goal?" *Eur Respir Rev* **24**(136): 361-369.

<https://err.ersjournals.com/content/errev/24/136/361.full.pdf>

Although studies show that control of asthma can be achieved in the majority of patients, surveys repeatedly show that this is not the case in real life. Important measures to implement in order to achieve asthma control are trained healthcare professionals, a good patient-doctor relationship, patient education, avoidance of exposure to triggers, personalised management and adherence to treatment. These measures help the majority of asthma patients but have not yet been widely implemented and there should be a concerted action for their implementation. Moreover, further and focused research is needed in severe/refractory asthma.

Pate, C. A., Qin, X., Bailey, C. M., et al. (2020). "Cost barriers to asthma care by health insurance type among children with asthma." *J Asthma* **57**(10): 1103-1109.

<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7291943/pdf/nihms-1571591.pdf>

Objective: Children with asthma have ongoing health care needs and health insurance is a vital part of their health care access. Health care coverage may be associated with various cost barriers to asthma care. We examined cost barriers to receiving asthma care by health insurance type and coverage continuity among children with asthma using the 2012-2014 Child Asthma Call-back Survey (ACBS). Methods: The study sample included 3788 children under age 18 years with current asthma who had responses to the ACBS by adult proxy. Associations between cost barriers to asthma care and treatment were analyzed by demographic, health insurance coverage, and urban residence variables using multivariable logistic regression models. Results: Among insured children, more blacks reported a cost barrier to seeing a doctor (10.6% [5.9, 18.3]) compared with whites (2.9% [2.1, 4.0]) ( $p = 0.03$ ). Adjusting for demographic factors (sex, age, and race), uninsured and having partial year coverage were associated with cost barrier to seeing a doctor (adjusted prevalence ratio aPR = 8.07 [4.78, 13.61] and aPR = 6.58 [3.78, 11.45], respectively) and affording medication (aPR = 8.35 [5.23, 13.34] and aPR = 4.93 [2.96, 8.19], respectively), compared with children who had full year coverage. Public insurance was associated with cost barrier to seeing a doctor (aPR = 4.43 [2.57, 7.62]), compared with private insurance. Conclusions: Having no health insurance, partial year coverage, and public insurance were associated with cost barriers to asthma care. Improving health insurance coverage may help strengthen access to and reduce cost barriers to asthma care.

Piecoro, L. T., Potoski, M., Talbert, J. C., et al. (2001). "Asthma prevalence, cost, and adherence with expert guidelines on the utilization of health care services and costs in a state medicaid population." *Health Services Research* **36**(2): 358-371.

Pinnock, H., McKenzie, L., Price, D., et al. (2005). "Cost-effectiveness of telephone or surgery asthma reviews: economic analysis of a randomised controlled trial." *Br J Gen Pract* **55**(511): 119-124.

<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC1463186/pdf/bjgg55-119.pdf>

**BACKGROUND:** Only about a third of people with asthma attend an annual review. Clinicians need to identify cost-effective ways to improve access and ensure regular review. **AIM:** To compare the cost-effectiveness of nurse-led telephone with face-to-face asthma reviews. **DESIGN OF STUDY:** Cost-effectiveness analysis based on a 3-month randomised controlled trial. **SETTING:** Four general practices in England. **METHOD:** Adults due an asthma review were randomised to telephone or face-to-face consultations. Trial nurses recorded proportion reviewed, duration of consultation, and abortive calls/missed appointments. Data on use of healthcare resources were extracted from GP records. Cost-effectiveness was assessed from the health service perspective; sensitivity analyses were based on proportion reviewed and duration of consultation. **RESULTS:** A total of 278 people with asthma were randomised to surgery (n = 141) or telephone (n = 137) review. One hundred-and-one (74%) of those with asthma in the telephone group were reviewed versus 68 (48%) in the surgery group (P <0.001). Telephone consultations were significantly shorter (mean duration telephone = 11.19 minutes [standard deviation {SD} = 4.79] versus surgery = 21.87 minutes [SD = 6.85], P <0.001). Total respiratory healthcare costs per patient over 3 months were similar (telephone = pounds sterling 64.49 [SD = 73.33] versus surgery = pounds sterling 59.48 [SD = 66.02], P = 0.55). Total costs of providing 101 telephone versus 68 face-to-face asthma reviews were also similar (telephone = pounds sterling 725.84 versus surgery = pounds sterling 755.70), but mean cost per consultation achieved was lower in the telephone arm (telephone = pounds sterling 7.19 [SD = 2.49] versus surgery = pounds sterling 11.11 [SD = 3.50]; mean difference = - pounds sterling 3.92 [95% confidence interval = - pounds sterling 4.84 to pounds sterling 3.01], P <0.001). **CONCLUSIONS:** Telephone consultations enable a greater proportion of asthma patients to be reviewed at no additional cost to the health service. This mode of delivering care improves access and reduces cost per consultation achieved.

Quirce, S., Melero, C., Huerta, A., et al. (2021). "Economic impact of severe asthma exacerbations in Spain: multicentre observational study." *J Asthma* **58**(2): 207-212.

<https://www.tandfonline.com/doi/full/10.1080/02770903.2019.1674330>

**Objective:** To describe resource use and costs of severe exacerbations in patients with severe asthma. **Method:** Secondary analysis of an observational, longitudinal, retrospective study that estimated the economic impact of severe asthma. The study was carried out in severe asthma units of the pulmonology and allergy services of 20 public hospitals (inclusion period: June to November 2016). The study included adult patients diagnosed with severe asthma according to the European Respiratory Society/American Thoracic Society consensus in the stable phase (no exacerbation during the last 2 months), and with at least one severe exacerbation during the study period (12 months). Healthcare resource use due to severe exacerbations (emergency visits, hospitalizations and pharmacological treatment) was recorded. The direct health costs associated with severe exacerbations were calculated by multiplying the resources used by the corresponding unit cost (in 2018 euros). **Results:** 134 patients with  $\geq 1$  severe exacerbation were included: 63% were female and the mean age was 54 years. 249 severe exacerbations were registered. There were 1.5 physician visits at primary care, hospital care and/or emergency room per episode, 13% of episodes required hospitalization, with a mean hospital stay of 7.2 days. Systemic corticosteroids were prescribed in 92% of exacerbations. The mean direct cost was €758.7/exacerbation (95% confidence interval: 556.8-1,011.1), of which 82% was due to hospitalizations (€623.3/episode). Considering only episodes requiring hospital admission, the mean cost increased by €4,997/exacerbation. **Conclusions:** It was estimated that the economic impact of a severe exacerbation in Spanish patients with severe asthma was €758.7/exacerbation.

Reilly, M. J., Wang, L. et Rosenman, K. D. (2020). "The Burden of Work-related Asthma in Michigan, 1988-2018." *Ann Am Thorac Soc* **17**(3): 284-292.

<https://www.tandfonline.com/doi/full/10.1080/02770903.2018.1471704>

**Rationale:** Exposure to a variety of substances in the workplace can cause new-onset asthma or aggravate preexisting asthma, both of which are considered work-related asthma (WRA).

Understanding trends in the nature and causes of WRA can assist in the diagnosis and management of adult patients with asthma. Objective: To describe trends over 31 years of WRA surveillance in Michigan. Methods: Michigan law requires reporting of all known or suspected cases of occupational disease. WRA was confirmed by review of a standardized telephone interview and patient medical records. Enforcement inspections at the workplaces of the WRA cases included air monitoring and evaluation for asthma and asthma symptoms among coworkers. Results: The Michigan surveillance program identified 3,634 WRA cases from 1988 to 2018, including nine deaths. The cumulative incidence rate of WRA decreased from 3.5 to 2.0 cases per 100,000 workers. Cases most frequently worked in manufacturing (56%), health care (12%), and education (4%). The cumulative incidence rate of WRA decreased in each of those three industries, while increasing in retail trade and accommodations and food services. The most common exposures to known asthma inducers were to cleaning agents and isocyanates; the percentage exposed to cleaning agents increased from 5% to 20%, and the percentage exposed to isocyanates decreased from 20% to 7%. Fifty-one percent had not applied for workers' compensation benefits. Only 5% of the 571 workplaces where air sampling was performed were above the allowable exposure limit. Fifteen percent (1,622 of 10,493) of coworkers of the index cases reported onset of asthma since beginning to work at the facility or being bothered at work by daily or weekly chest tightness, shortness of breath, or wheezing. Conclusions: The industries and exposures where Michigan adults develop WRA have changed during the past 31 years. The identification of WRA cases, including WRA deaths, underscores the need for continued vigilance to monitor changes in where and how workers are exposed to asthma-causing agents, physician consideration of workplace exposures in new-onset or worsening adult asthma, and adoption of workplace standards that reduce exposure and require workplace medical monitoring to prevent and reduce the morbidity and mortality of WRA.

Rodriguez-Martinez, C. E., Sossa-Briceño, M. P. et Castro-Rodriguez, J. A. (2020). "Direct medical costs of pediatric asthma exacerbations requiring hospital attendance in a middle-income country." *Allergol Immunopathol (Madr)* **48**(2): 142-148.

[https://www.resmedjournal.com/article/S0954-6111\(18\)30082-9/pdf](https://www.resmedjournal.com/article/S0954-6111(18)30082-9/pdf)

**INTRODUCTION AND OBJECTIVES:** With the aim of making informed decisions on resource allocation, there is a critical need for studies that provide accurate information on hospital costs for treating pediatric asthma exacerbations, mainly in middle-income countries (MICs). The aim of the present study was to evaluate the direct medical costs associated with pediatric asthma exacerbations requiring hospital attendance in Bogota, Colombia. **PATIENTS AND METHODS:** We reviewed the available electronic medical records (EMRs) for all pediatric patients who were admitted to the Fundacion Hospital de La Misericordia with a discharge principal diagnosis pediatric asthma exacerbation over a 24-month period from January 2016 to December 2017. Direct medical costs of pediatric asthma exacerbations were retrospectively collected by dividing the patients into four groups: those admitted to the emergency department (ED) only; those admitted to the pediatric ward (PW); those admitted to the pediatric intermediate care unit (PIMC); and those admitted to the pediatric intensive care unit (PICU). **RESULTS:** A total of 252 patients with a median (IQR) age of 5.0 (3.0-7.0) years were analyzed, of whom 142 (56.3%) were males. Overall, the median (IQR) cost of patients treated in the ED, PW, PIMC, and PICU was US\$38.8 (21.1-64.1) vs. US\$260.5 (113.7-567.4) vs. 1212.4 (717.6-1609.6) vs. 2501.8 (1771.6-3405.0), respectively; this difference was statistically significant ( $p < 0.001$ ). **CONCLUSIONS:** The present study helps to further our understanding of the economic burden of pediatric asthma exacerbations requiring hospital attendance among pediatric patients in a MIC.

Sadatsafavi, M., Chen, W., Tavakoli, H., et al. (2016). "Saving in medical costs by achieving guideline-based asthma symptom control: a population-based study." *Allergy* **71**(3): 371-377.

<https://onlinelibrary.wiley.com/doi/10.1111/all.12803>

**BACKGROUND:** Asthma control is increasingly used as an outcome measure in asthma trials. Economic evaluations of asthma interventions require converting the impact of interventions on control to impact on resource use. The purpose of this study was to estimate the savings in direct costs by

achieving asthma symptom control as defined in the Global Initiative for Asthma (GINA) 2014 management strategy. METHODS: Adolescents and adults with asthma were recruited through random digit dialing. Asthma control per GINA and the use of healthcare resources were assessed at baseline and three-monthly visits up to 1 year. We used regression models to associate costs, measured in 2012 Canadian dollars (\$), with symptom control, adjusting for potential confounding variables. RESULTS: The final sample included 517 individuals (average age 48.9, 65.8% female) with mostly mild-moderate asthma contributing 2033 follow-up visits. In 598 (29.4%), 809 (39.8%), and 626 (30.8%) of visits, asthma was symptomatically controlled, partially controlled, or uncontrolled, respectively. The average 3-month costs of asthma were \$134.5. Of these, 20.5% were attributable to inpatient care, 47.8% to outpatient care, and 31.5% to medication. Compared to controlled asthma, partially controlled asthma was associated with a nonsignificant increase of \$9.5 (95% CI -\$13.6 - \$32.6) in adjusted 3-month costs and uncontrolled asthma with a statistically significant increase of \$81.7 (95% CI \$48.5 - \$114.9). CONCLUSION: A substantial fraction of this population-based sample of largely mild-moderate asthmatics was symptomatically uncontrolled. Achieving symptom control was associated with a reduction in direct costs. The adjusted values from this study can be used to inform cost-effectiveness analyses of asthma treatments.

Sculpher, M. (2001). "Using economic evaluations to reduce the burden of asthma and chronic obstructive pulmonary disease." *Pharmacoeconomics* **19**(suppl. 2): 21-25, 21 fig., 23 tabl.

Sculpher, M. J. et Price, M. (2003). "Measuring costs and consequences in economic evaluation in asthma." *Respir Med* **97**(5): 508-520.

Formal economic evaluation is playing an increasingly important role in health-care decision-making. This is shown by the requirement to present economic data to support applications for public reimbursement for new pharmaceuticals in Australia and the provinces of Canada, and by the appraisal process initiated by the National Institute for Clinical Excellence in the U.K. This growing role of economic analysis applies as much to the field of asthma as anywhere. This paper provides a detailed review of applied economic studies in asthma. The review is used to explore a range of methodological issues in the field including the choice of perspective and maximand, whether to use disease-specific or generic measures of outcome and whether decision-makers should receive disaggregated cost and consequence data or results that focus on an incremental cost-effectiveness ratio. It is concluded that, given the heterogeneity in decision-makers' objectives and constraints, economic studies should be planned and executed in such a way as to maximize flexibility in how results are presented.

Şekerel, B. E. et Türkteş, H. (2020). "Economic Burden of Pediatric Asthma in Turkey: A Cost of Illness Study from Payer Perspective." *J Asthma* **21**(4): 248-254.  
<https://www.tandfonline.com/doi/full/10.1080/02770903.2020.1802747>

OBJECTIVES: To estimate economic burden of pediatric asthma in Turkey from payer perspective. MATERIALS AND METHODS: This cost of illness study was based on identification of per patient annual direct medical costs for the management of pediatric asthma in Turkey from payer perspective. Average per patient direct medical cost was calculated based on cost items related to outpatient visits, laboratory and radiological tests, hospitalizations and interventions, drug treatment and equipment, and co-morbidities/complications. RESULTS: Based on total annual per patient costs calculated for outpatient admission (\$113.14), laboratory-radiological tests (\$35.94), hospitalizations (\$725.92), drug treatment/equipment (\$212.90) and co-morbidities/complications (\$144.62) cost items, total per patient annual direct medical cost related to management of pediatric asthma was calculated to be \$1,232.53 from payer perspective. Hospitalizations and interventions (58.9%) was the main cost driver. Direct cost for managing controlled and uncontrolled pediatric asthma were calculated to be \$530.17 [key cost driver: drugs/equipment (40.0%)] and \$1,023.16 [key cost driver: hospitalization/interventions (59.0%)], respectively. CONCLUSION: Our findings indicate that managing patients with pediatric asthma pose a considerable burden to health economics in Turkey, with

hospitalizations identified as the main cost driver and two-fold cost increment in case of uncontrolled disease.

Selroos, O., Kupczyk, M., Kuna, P., et al. (2015). "National and regional asthma programmes in Europe." *Eur Respir Rev* **24**(137): 474-483.  
[https://orbi.uliege.be/bitstream/2268/197099/1/SELROOS\\_national%20and%20regional%20asthma%20programmes\\_Eur%20Respir%20Rev\\_ppediteur.pdf](https://orbi.uliege.be/bitstream/2268/197099/1/SELROOS_national%20and%20regional%20asthma%20programmes_Eur%20Respir%20Rev_ppediteur.pdf)

This review presents seven national asthma programmes to support the European Asthma Research and Innovation Partnership in developing strategies to reduce asthma mortality and morbidity across Europe. From published data it appears that in order to influence asthma care, national/regional asthma programmes are more effective than conventional treatment guidelines. An asthma programme should start with the universal commitments of stakeholders at all levels and the programme has to be endorsed by political and governmental bodies. When the national problems have been identified, the goals of the programme have to be clearly defined with measures to evaluate progress. An action plan has to be developed, including defined re-allocation of patients and existing resources, if necessary, between primary care and specialised healthcare units or hospital centres. Patients should be involved in guided self-management education and structured follow-up in relation to disease severity. The three evaluated programmes show that, thanks to rigorous efforts, it is possible to improve patients' quality of life and reduce hospitalisation, asthma mortality, sick leave and disability pensions. The direct and indirect costs, both for the individual patient and for society, can be significantly reduced. The results can form the basis for development of further programme activities in Europe.

Serra-Batlles, J., Plaza, V., Morejon, E., et al. (1998). "Costs of asthma according to the degree of severity." *European Respiratory Journal* **12**: 1322-1326, 1324 tabl.  
<https://erj.ersjournals.com/content/erj/12/6/1322.full.pdf>

Settipane, R. A., Kreindler, J. L., Chung, Y., et al. (2019). "Evaluating direct costs and productivity losses of patients with asthma receiving GINA 4/5 therapy in the United States." *Ann Allergy Asthma Immunol* **123**(6): 564-572.e563.  
[https://www.annallergy.org/article/S1081-1206\(19\)31051-8/pdf](https://www.annallergy.org/article/S1081-1206(19)31051-8/pdf)

BACKGROUND: Despite the low prevalence for all patients with asthma, those with severe disease account for a disproportionately large economic burden. OBJECTIVE: To evaluate current direct health care and productivity loss costs associated with patients with asthma receiving Global Initiative for Asthma Step 4/5 therapy ("G4/5 asthma") in the United States. METHODS: Asthma patients aged 12 years or older were identified in the IBM MarketScan Research Databases between January 1, 2012 and December 31, 2015. Patients were indexed on their earliest medical claim for asthma and were required to have at least 2 years of continuous eligibility. The G4/5 asthma classification required 1 or more medium- or high-dosage inhaled corticosteroids (ICS)/long-acting beta-agonist (LABA) claims, 1 or more omalizumab claims, or systemic corticosteroids covering at least 50% of the 12-month baseline period. The European Respiratory Society/American Thoracic Society criteria for severe uncontrolled asthma were modified for claims data and used to identify patients with exacerbations or high rescue medication use ("Ex/R"). Direct health care costs and productivity loss costs attributable to workplace absence or short-term or long-term disability were measured during the 12-month post-index period. RESULTS: A total of 605,614 patients with asthma were identified. Annual health care costs were \$4,384 greater for G4/5 asthma vs non-G4/5 patients with asthma; asthma-related costs contributed \$2,183 of this difference ( $P < .001$ ). Differences were primarily driven by G4/5 patients with asthma with Ex/R, whose costs were \$5,019 greater than G4/5 patients without Ex/R ( $P < .001$ ). For patients with 1 or more absences or short-term disability claims, G4/5 patients missed 7.2 more work hours for absence and had 3.9 more days of work lost for short-term disability than non-G4/5 patients with asthma, respectively ( $P < .05$ ). CONCLUSION: G4/5 patients with asthma incurred significantly greater direct and indirect costs than non-G4/5 patients with asthma. Differences were largely driven by those with Ex/R.

Shenolikar, R., Song, X., Anderson, J. A., et al. (2011). "Costs of asthma among US working adults." *Am J Manag Care* **17**(6): 409-416.

**OBJECTIVES:** To evaluate the effect of asthma on direct and indirect costs among US working adults. **STUDY DESIGN:** A case-control retrospective analysis was conducted. Data between January 1, 2003, and December 31, 2006, among patients aged 18 to 64 years with vs without asthma were extracted from MarketScan Research Databases. Patients with chronic obstructive pulmonary disease or emphysema were excluded, and all patients were required to have 12-month continuous enrollment before and after the index date. Outcomes included direct medical costs, the number of absence days, the number of short-term disability days, and associated indirect costs. **METHODS:** Patients with asthma were propensity score-matched to patients without asthma using nearest neighbor 1:1 with caliper. Subsequent multivariate analysis was conducted on matched samples to examine the marginal effect of asthma on direct and indirect costs. **RESULTS:** A total of 13,379 patients with asthma were propensity score-matched to 13,379 patients without asthma; in each cohort, 3453 patients had absence eligibility, and 8497 patients had short-term disability eligibility. Direct costs for patients with asthma were \$3762, and indirect costs were \$4572. Compared with the matched cohort without asthma, patients with asthma had \$1785 higher direct medical expenditures ( $P < .001$ ). Incremental indirect costs were \$191 for absenteeism ( $P = .007$ ) and \$172 for short-term disability ( $P < .001$ ). **CONCLUSIONS:** Compared with patients without asthma, patients with asthma experience significantly higher direct medical costs and, although modest, significantly higher work loss. Treatments or interventions that prevent or reduce asthma symptoms may have a beneficial effect on medical costs and work absenteeism.

Sicras-Mainar, A., Capel, M., Navarro-Artieda, R., et al. (2020). "Real-life retrospective observational study to determine the prevalence and economic burden of severe asthma in Spain." *J Med Econ* **23**(5): 492-500. <https://www.tandfonline.com/doi/full/10.1080/13696998.2020.1719118>

**Objective:** We determined the percentage of patients with severe asthma and exacerbations and evaluated the costs of the disease based on blood eosinophil counts. **Methods:** A retrospective observational study based on the review of medical records in Spain was carried out. Patients  $\geq 18$  years of age requiring care during the years 2014-2015; diagnosed with asthma with at least 2 years of continuous records (at least one year prior to the index date defined as the first asthma medication prescription and at least one year after the index date) were included. **Study groups:** eosinophil counts  $< 300$  cells/ $\mu\text{l}$  and  $\geq 300$  cells/ $\mu\text{l}$ . **Main variables:** comorbidity, clinical parameters, exacerbations and annual asthma total costs. **Results:** A total of 268 severe asthmatic patients in Spain were included, representing 6.3% of the asthma population, with 58.6% having eosinophil count  $\geq 300$  cells/ $\mu\text{l}$  and 41.4% eosinophil count  $< 300$  cells/ $\mu\text{l}$ . The mean age was 56.1 years (63.4% women). Patients with eosinophilic inflammation ( $\geq 300$  cells/ $\mu\text{l}$ ) had lower FEV1 values (54.3% vs. 60.7%;  $p < .001$ ), poorer treatment adherence (65.6% vs. 77.3%;  $p < .001$ ), and a greater mean number of exacerbations (3.3 vs. 1.9;  $p < .001$ ). Exacerbations were correlated to FEV1 ( $\beta = -.606$ ), eosinophils ( $\beta = .255$ ), immunoglobulin E ( $\beta = .152$ ), and age ( $\beta = .128$ ),  $p < .001$ . The mean total asthma annual cost (ANCOVA) was 6222 vs. 4152 euros, respectively ( $p = .016$ ). Health costs were associated with age ( $\beta = .323$ ), FEV1 ( $\beta = .239$ ), eosinophils ( $\beta = .177$ ) and exacerbations ( $\beta = .158$ ),  $p < .01$ . **Limitations:** Those inherent to retrospective studies; the possible inaccuracy of diagnostic coding referring to severe asthma and other comorbidities and the external validity of the results. **Conclusions:** Health costs of patients with severe asthma were high. Total annual asthma costs and resource use were greater in patients with  $\geq 300$  cells/ $\mu\text{l}$ . Age, eosinophilia, exacerbations and FEV1 were associated with greater resource utilization and costs for the health system.

Song, H. J. et Blake, K. V. (2020). "Medical Costs and Productivity Loss Due to Mild, Moderate, and Severe Asthma in the United States." *J Allergy Clin Immunol Pract* **13**: 545-555. <https://www.dovepress.com/getfile.php?fileID=63121>



**BACKGROUND:** Little is known about economic and productivity loss by severity of asthma. We investigate health-care utilization, direct medical costs, and indirect costs due to productivity loss from asthma by severity. **METHODS:** We conducted a cross-sectional analysis of the Medical Expenditure Panel Survey database (2010-2017) of patients with asthma aged  $\geq 12$  years and categorized them into mild, moderate, and severe asthma groups based on symptom control medications. Study outcomes included health-care utilization, direct medical costs, and indirect costs of asthma-related absenteeism. We used zero-inflated Poisson regression models to estimate incremental health-care utilization and generalized linear models to estimate incremental annual direct medical costs compared to patients without asthma. **RESULTS:** An estimated 139 million persons had an asthma diagnosis. Of patients with asthma, 77.1%, 22.2%, and 0.7% had mild, moderate, and severe asthma, respectively. Compared to patients without asthma, patients with asthma had incremental mean differences of 4.16 outpatient visits, 0.18 emergency department visits, and 0.07 hospitalizations per year. Annual direct medical costs were significantly associated with asthma severity (\$3305 in mild, \$7250 in moderate, and \$9175 in severe asthma) ( $P < 0.05$ ). Patients with mild, moderate, and severe asthma reported 0.76, 2.31, and 7.19 missed work or school days, resulting in \$106, \$321, and \$1000 indirect costs per person per year, respectively. **CONCLUSION:** Asthma-related direct and indirect costs are significantly associated with asthma severity, with severe asthma medical costs being about three times higher than mild. Controlling asthma symptoms is important to reduce the economic and social burden of asthma.

Souliotis, K., Kousoulakou, H., Hillas, G., et al. (2017). "Direct and Indirect Costs of Asthma Management in Greece: An Expert Panel Approach." *Front Public Health* 5: 67.

<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5380663/pdf/fpubh-05-00067.pdf>

**OBJECTIVE:** Asthma is a major cause of morbidity and mortality and is associated with significant economic burden worldwide. The objectives of this study were to map current resource use associated with the disease management and to estimate the annual direct and indirect costs per adult patient with asthma. **METHODS:** A Delphi panel with seven leading pulmonologists was conducted. A semistructured questionnaire was developed to elicit data on resource use and treatment patterns. Unit costs from official, published sources were subsequently assigned to resource use to estimate direct medical costs. Indirect costs were estimated as number of work loss days. Cost base year was 2015, and the perspective adopted was that of the National Organization of Health Care Services Provision, as well as the societal. **RESULTS:** Patients with asthma are mainly managed by pulmonologists (71.4%) and secondarily by general practitioners and internists (28.6%). The annual cost of managing exacerbations was estimated at €273.1, while maintenance costs were estimated at €1,100.2 per year. Total costs of managing asthma per patient per year were estimated at €2,281.8, 64.4% of which represented direct medical costs. Of the direct costs, pharmaceutical treatment was the key driver, accounting for 63.9 and 41.2% of direct and total costs, respectively. Direct non-medical costs (patient travel and waiting time) were estimated at €152.3. Indirect costs accounted for 28.9% of total costs. **CONCLUSION:** Asthma is a chronic condition, the management of which constrains the already limited Greek health care resources. The increasing prevalence of the disease raises concerns as it could translate per patient costs into a significant burden for the Greek health care system. Thus, the prevention, self-management, and improved quality of care for asthma should find a place in the health policy agenda in Greece.

Stock, S., Redaelli, M., Luengen, M., et al. (2005). "Asthma: prevalence and cost of illness." *European Respiratory Journal* 25(1): 47-53.

<https://erj.ersjournals.com/content/erj/25/1/47.full.pdf>

The purpose of this study was to estimate the prevalence and cost of illness of asthma in Germany by retrospectively analysing routine health insurance data. This analysis investigated claims data from all insured persons of six large sickness funds. Insured persons with asthma were identified via the International Classification of Diseases (ninth revision) diagnosis and the Anatomical Therapeutic Chemical Classification System Code for regular medication prescriptions. Costs for hospital care, medication and sick benefit were taken from claims data. Costs for rehabilitation, premature death and early

retirement were estimated using the human capital approach and data from national statistics. Prevalence of asthma in the German statutory health insurance was 6.34%. Total costs for asthma, including direct and indirect costs, were calculated at 2.74 billion during 1999. The prevalence of asthma in the German statutory health insurance has previously been estimated to be 4–6%. The results of this large study show the prevalence of asthma in the German social insurance system to be ~6%. The study also indicates that there is room for substantial savings in the German social insurance system, with indirect costs amounting to 74.8% of total costs and payment of sick benefits through the sickness funds amounting to 58.3% of indirect costs. These costs may be reduced with better asthma control in patients.

Stróžek, J., Samoliński, B. K., Kłak, A., et al. (2019). "The indirect costs of allergic diseases." *Pediatr Allergy Immunol* **32**(3): 281-290.

It is estimated that every third person living in Europe suffers from allergic diseases. Allergies are a growing health problem in Poland where 40% of the population have allergy symptoms, including 12% afflicted with asthma. The actual cost of allergic diseases is difficult to estimate due to the lack or incompleteness of the relevant data. The aim of this review is to present estimates of the indirect costs of allergic diseases in Poland and globally, using asthma, allergic rhinitis and atopic dermatitis as examples. The analysis also includes the impact of allergic diseases on the costs to the social welfare system and employers. The literature review of the indirect costs of allergic diseases shows that the indirect costs of a disease, which substantially exceed the direct costs, increase with the disease activity and severity. Interestingly, some studies have found that the indirect costs of lost productivity due to hours missed from work to take care of a sick child could be threefold higher than those of absence due to a worker's own illness. The indirect costs of a disease can be significantly reduced by early diagnosis and appropriate treatment. *Int J Occup Med Environ Health*. 2019;32(3):281-90.

Suijkerbuijk, A. W., de Wit, G. A., Wijga, A. H., et al. (2013). "[Societal costs of asthma, COPD and respiratory allergy]." *Ned Tijdschr Geneeskd* **157**(46): A6562.

**OBJECTIVE:** To estimate the societal costs of asthma, COPD and respiratory allergy for the year 2007 and future healthcare costs for the period 2007-2032. **DESIGN:** Descriptive study. **METHODS:** Representative registries were used to estimate the healthcare costs of asthma, COPD and respiratory allergy for the year 2007. A simulation model for asthma and COPD and a demographic projection for respiratory allergy were used to determine future healthcare costs. Production losses due to sick leave and work incapacity were calculated using the friction-cost method. **RESULTS:** Total healthcare costs for asthma, COPD and respiratory allergy in 2007 were estimated at 287, 415 and 103 million euros respectively; on average 530, 1400 and 170 euros per patient with asthma, COPD and respiratory allergy. Average costs of sick leave for asthma were on average 1200 euros and for COPD 1900 euros per employee per year. The costs of work incapacity of an employee with COPD were 1200 euros. There is expected to be an increase in the number of patients from 443,000 in 2007 to 567,000 in 2032 for asthma and from 335,000 to 600,000 for COPD. The number of patients with a respiratory allergy are expected to remain approximately stable at 625,000 patients. The healthcare costs for respiratory allergy are expected to rise by 73%, those for asthma to double, and those for COPD to triple. **CONCLUSION:** Patients with asthma and COPD have high healthcare costs. Sick leave makes up a large part of the costs of asthma and COPD. In addition, the costs of work incapacity for employees with COPD are high. The number of patients with asthma and COPD will rise in the coming decades, as well as the healthcare costs for these diseases.

Sullivan, P. W., Ghushchyan, V., Navaratnam, P., et al. (2017). "The national cost of asthma among school-aged children in the United States." *J Asthma Allergy* **119**(3): 246-252.e241.

<https://www.dovepress.com/getfile.php?fileID=63121>

**BACKGROUND:** Recent research has quantified the national health care resource use (HCRU) and health care expenditure (HCE) burden associated with adult asthma; however, estimates specific to school-aged children are more than 2 decades old. **OBJECTIVE:** To estimate the national HCRU and

HCEs attributable to asthma among school-aged children in the United States. METHODS: This was a cross-sectional retrospective analysis of school-aged children (aged 6-17 years) in the nationally representative 2007-2013 Medical Expenditure Panel Survey. All-cause HCRU and HCEs of school-aged children with asthma were compared with school-aged children without asthma, controlling for sociodemographics and comorbidities. HCRU encounters included emergency department (ED) and outpatient visits, hospitalizations, and prescriptions. Expenditures included total, medical, ED, inpatient, outpatient, and pharmacy. Negative binomial regression analyses were used for HCRU and Heckman selection with logarithmic transformation, and smearing retransformation was used for HCEs. RESULTS: There were 44,320 school-aged children of whom 5,890 had asthma. Children with asthma incurred a higher rate of all-cause annual ED visits (incidence rate ratio [IRR], 1.5;  $P < .001$ ), hospitalizations (IRR, 1.4;  $P < .05$ ), outpatient visits (IRR, 1.4;  $P < .001$ ), and prescription drugs (IRR, 3.3;  $P < .001$ ) compared with school-aged children without asthma. They incurred US\$847 (2015 dollars) more annually in all-cause expenditures ( $P < .001$ ). Private insurance and Medicaid paid the largest share of expenditures. Pharmacy and outpatient costs represented the largest proportion of total expenditures. On the basis of the nationally representative Medical Expenditure Panel Survey sample weights from 2013, the total annual HCEs attributable to asthma for school-aged children in the United States was US\$5.92 billion (2015 dollars). CONCLUSION: Childhood asthma continues to represent a prevalent and significant clinical and economic burden in the United States. More aggressive treatment and asthma management programs are needed to address this national financial and resource burden.

Sullivan, P. W., Ghushchyan, V., Navaratnam, P., et al. (2018). "The national burden of poorly controlled asthma, school absence and parental work loss among school-aged children in the United States." *J Asthma* 55(6): 659-667.

<https://www.tandfonline.com/doi/full/10.1080/02770903.2017.1350972>

OBJECTIVE: The degree of poorly controlled asthma and its association with missed school days and parental missed work days is not well understood. METHODS: This was a retrospective analysis of missed school days and missed work days for school-aged children (SAC; aged 6-17) and their caregivers in the nationally representative 2007-2013 Medical Expenditure Panel Survey (MEPS). Indicators of poor asthma control included: exacerbation in previous 12 months; use of >3 canisters of short-acting beta agonist (SABA) in 3 months; and annual asthma-specific (AS) Emergency Department (ED) or inpatient (IP) visits. Negative binomial regression was used for missed school days, and a Heckman two-step selection model was used for missed work days. All analyses controlled for sociodemographics and other covariates. RESULTS: There were 44,320 SAC in MEPS, of whom 5,890 had asthma. SAC with asthma and an indicator of poor control missed more school days than SAC without asthma: exacerbation (1.8 times more;  $p < 0.001$ ); >3 canisters SABA (2.7 times more;  $p < 0.001$ ) and ED/IP visit (3.8 times more;  $p < 0.001$ ). The parents/caregivers of SAC with asthma and an exacerbation missed 1.2 times more work days ( $p < 0.05$ ), while those with SAC with asthma and an ED/IP visit missed 1.8 times more work days ( $p < 0.01$ ) than the parents of SAC without asthma. CONCLUSIONS: This study provides evidence of the significant national burden of poorly controlled asthma due to missed school and work days in the United States. More effective and creative asthma management strategies, with collaboration across clinical, community and school-based outreach, may help address this burden.

Sullivan, P. W., Ghushchyan, V. H., Campbell, J. D., et al. (2017). "Measuring the cost of poor asthma control and exacerbations." *J Asthma* 54(1): 24-31.

<https://www.tandfonline.com/doi/full/10.1080/02770903.2016.1194430>

BACKGROUND: Previous studies have shown an association between cost and poor asthma control. However, longitudinal studies of general populations are lacking. OBJECTIVE: To examine the cost of poor asthma control and exacerbations across a broad spectrum of asthma patients. METHODS: The Observational Study of Asthma Control and Outcomes (OSACO) was a prospective survey of persistent asthma patients in Kaiser Colorado in 2011-2012. Patients received a survey 3 times in one year, which included the Asthma Control Questionnaire (ACQ) and questions on exacerbations. Self-reported

exacerbations were compared to actual oral corticosteroid (OCS) use. Regression analyses examined the association of control (ACQ-5 scores) and exacerbations with healthcare expenditures, controlling for sociodemographics and smoking. Analyses of expenditures used Generalized Linear Models (GLM) with log-link. RESULTS: 2681 individuals completed at least one survey; 1799 completed all three. ACQ-5 scores were associated with higher all-cause and asthma-specific expenditures across all categories of costs (medical, outpatient, ER, pharmacy) except for inpatient expenditures. Each 1-point increase in the ACQ-5 score (i.e., worse control) was associated with a corresponding increase in all-cause annual healthcare and asthma-specific expenditures of \$1443 and \$927 (\$US 2013). Asthma exacerbations with documented OCS use were associated with an increase of \$3014 and \$1626 over 4 months, while self-reported exacerbations were \$713 and \$506. CONCLUSION: Results demonstrate that poor asthma control and exacerbations are strongly associated with higher healthcare expenditures. Results also confirm that collection of validated measures of control such as the ACQ-5 may provide valuable information toward improving clinical and economic outcomes.

Sullivan, P. W., Lanz, M. J., Ghushchyan, V. H., et al. (2020). "Healthcare resource utilization, expenditures, and productivity in patients with asthma with and without allergies." *J Asthma* **57**(9): 959-967.  
<https://www.tandfonline.com/doi/full/10.1080/02770903.2019.1628253>  
[https://www.jacionline.org/article/S0091-6749\(19\)31634-3/pdf](https://www.jacionline.org/article/S0091-6749(19)31634-3/pdf)

**Objective:** To compare healthcare resource utilization (HCRU), healthcare expenditures, and work productivity and activity impairment within a general asthma population with persistent asthma and evidence of allergy (PA-EA) and persistent asthma with no evidence of allergy (PA-NEA). **Methods:** We conducted a retrospective analysis of survey responses and claims from the Observational Study of Asthma Control and Outcomes (OSACO) study. Eligible patients with persistent asthma aged  $\geq 12$  years were sent four surveys over 15 months. Regression models were used to assess the association between: (1) PA-EA (defined as a positive response to a survey question about hay fever/seasonal allergies AND  $\geq 1$  diagnostic code for atopic conditions) and HCRU and expenditures; and (2) PA-EA and Work Productivity and Activity Impairment (WPAI)-Asthma questionnaire scores (vs. PA-NEA). **Results:** Adjusted data showed that, vs. PA-NEA (n = 312), patients with PA-EA (n = 971) incurred 1.34-times more all-cause prescriptions (95% confidence interval [CI], 1.20-1.48), \$132.79 higher prescription costs (95% CI, \$22.03-243.56), and \$926.11 higher all-cause total healthcare costs (95% CI, \$279.67-1572.54), per 4-month period. Patients with PA-EA were 4.1% less productive while working (95% CI, 3.75-4.48%) and experienced a 6.5% reduction in all activities (95% CI, 6.11-6.88%) vs. those with PA-NEA. **Conclusions:** Patients with PA-EA had greater HCRU, healthcare expenditures, and lower productivity compared with those patients with PA-NEA. These results highlight the burden of atopy in patients with persistent asthma and underscore the importance of allergic endotype identification for more vigilant disease management.

Swe, K. T., Rahman, M. M., Rahman, M. S., et al. (2018). "Cost and economic burden of illness over 15 years in Nepal: A comparative analysis." *PLoS One* **13**(4): e0194564.  
<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5884500/pdf/pone.0194564.pdf>

**BACKGROUND:** With an increasing burden of non-communicable disease in Nepal and limited progress towards universal health coverage, country- and disease-specific estimates of financial hardship related to healthcare costs need to be evaluated to protect the population effectively from healthcare-related financial burden. **OBJECTIVES:** To estimate the cost and economic burden of illness and to assess the inequality in the financial burden due to catastrophic health expenditure from 1995 to 2010 in Nepal. **METHODS:** This study used nationally representative Nepal Living Standards Surveys conducted in 1995 and 2010. A Bayesian two-stage hurdle model was used to estimate average cost of illness and Bayesian logistic regression models were used to estimate the disease-specific incidence of catastrophic health payment and impoverishment. The concentration curve and index were estimated by disease category to examine inequality in healthcare-related financial hardship. **FINDINGS:** Inflation-adjusted mean out-of-pocket (OOP) payments for chronic illness and injury increased by 4.6% and 7.3%, respectively, while the cost of recent acute illness declined by 1.5% between 1995 and 2010. Injury showed the highest incidence of catastrophic expenditure (30.7% in 1995 and 22.4% in

2010) followed by chronic illness (12.0% in 1995 and 9.6% in 2010) and recent acute illness (21.1% in 1995 and 7.8% in 2010). Asthma, diabetes, heart conditions, malaria, jaundice and parasitic illnesses showed increased catastrophic health expenditure over time. Impoverishment due to injury declined most (by 12% change in average annual rate) followed by recent acute illness (9.7%) and chronic illness (9.6%) in 15 years. Inequality analysis indicated that poorer populations with recent acute illness suffered more catastrophic health expenditure in both sample years, while wealthier households with injury and chronic illnesses suffered more catastrophic health expenditure in 2010. CONCLUSION: To minimize the economic burden of illness, several approaches need to be adopted, including social health insurance complemented with an upgraded community-based health insurance system, subsidy program expansion for diseases with high economic burden and third party liability motor insurance to reduce the economic burden of injury.

Szucs, T. D., Anderhub, H. et Rutishauser, M. (1999). "The economic burden of asthma : direct and indirect costs in Switzerland." *European Respiratory Journal* **13**: 281-286, 285 tabl., 282 fig.  
<https://erj.ersjournals.com/content/erj/13/2/281.full.pdf>

Szucs, T. D., Anderhub, H. P. et Rutishauser, M. (2000). "Determinants of health care costs and patterns of care of asthmatic patients in Switzerland." *Schweiz Med Wochenschr* **130**: 305-313.

Tan, N. C., Nguyen, H. V., Lye, W. K., et al. (2016). "Trends and predictors of asthma costs: results from a 10-year longitudinal study." *BMJ Open* **47**(3): 801-809.  
<https://erj.ersjournals.com/content/erj/47/3/801.full.pdf>

Research on asthma costs often focuses on estimating average asthma costs. Trends in asthma costs and patterns of medication use, especially for those who have been followed up and under treatment, have received much less attention. This study's objective was to document asthma costs over time for asthma patients who are enrolled in an asthma care programme in Singapore and to identify its predictors, using a 10-year longitudinal dataset. The study population comprised different cohorts of 939 asthma patients entering the programme at different times during 2004-2013. Average asthma costs were estimated and the trends over time examined graphically, within and across patient cohorts. Regression analyses were conducted to examine cost predictors, with a focus on the relationship between risk factors at programme enrolment and subsequent asthma costs. The results indicate that 10-year average annual asthma cost was GBP 341 per patient. The main drivers of costs were asthma medications and consultation fees. Use of combined inhaled corticosteroid/long-acting  $\beta$ -agonist medications increased over time, but this was accompanied by declines in controller drug use, doctor visits and total asthma drug costs. Obesity, smoking and asthma severity were the main predictors of subsequent asthma costs, especially for females.

Tavakoli, H., FitzGerald, J. M., Chen, W., et al. (2017). "Ten-year trends in direct costs of asthma: a population-based study." *Allergy* **72**(2): 291-299.  
<https://bmccmedicine.biomedcentral.com/track/pdf/10.1186/s12916-017-0823-7.pdf>

INTRODUCTION: There is little information on recent trends in the economic burden of asthma. Our objective was to estimate the excess costs of asthma and their trend in British Columbia, Canada, from 2002 to 2011. METHODS: A retrospective cohort of individuals aged 5-55 years was constructed from the provincial administrative health databases, consisting of patients with physician-diagnosed asthma and a propensity-score-matched comparison sample from the general population. Total direct medical costs were calculated as the sum of hospitalizations, outpatient visits and medication costs, adjusted to 2012 Canadian dollars (\$). Excess costs were defined as the difference in costs between the asthma and comparison groups. RESULTS: A total of 341 457 individuals (mean age at entry 27.3, 54.1% female) were equally divided into the asthma and comparison groups. Excess costs in patients with asthma were \$1028.0 (95% CI \$982.7-\$1073.4) per patient-year (PY). Medications contributed to the greatest share of excess costs (\$471.7/PY), whereas hospitalization and outpatient costs were, respectively, \$272.2/PY and \$284.1/PY. Only \$192.9/PY was attributable to asthma itself. There was a 2.9%/year increase in excess costs ( $P < 0.001$ ), a combination of asthma-attributable costs declining by

0.8%/year while nonasthma excess costs increasing by 3.8%/year. The most dramatic trend was observed in asthma-related outpatient costs, which decreased by %6.6/year. CONCLUSIONS: A significant share of excess costs in asthma is not attributable to the disease itself. The pattern of costs changed significantly during the study period. The burden of comorbid conditions should be considered in developing evidence-based policies for management of patients with asthma.

Viinanen, A., Lassenius, M. I., Toppila, I., et al. (2020). "The burden of adult asthma in Finland: impact of disease severity and eosinophil count on health care resource utilization." *J Asthma* **57**(10): 1092-1102.  
<https://www.tandfonline.com/doi/full/10.1080/02770903.2019.1633664>

**Objective:** To describe health care resource utilization (HCRU) and associated costs in adult patients referred for specialist asthma care in Southwest Finland, by disease severity and blood eosinophil count (BEC). **Methods:** This non-interventional, retrospective registry study (GSK ID: HO-17-17558) utilized data from patients >18 years of age on the hospital register of the Hospital District of Southwest Finland. Data extraction was from January 1, 2004 to December 31, 2015; the index date was the first hospital visit within this period with an International Classification of Diseases-10 diagnosis code for asthma or acute severe asthma. Patients were categorized by asthma severity (based on medication use) and BEC (<300 or ≥300 cells/μL). Total and asthma-related HCRU and estimated costs were recorded the year following index and for calendar years 2004-2015. **Results:** Overall, 14,398 patients were included; 388 had severe asthma at index. BEC was available for 3781 patients; 1434 had a BEC ≥300 cells/μL and 2347 had a BEC <300 cells/μL. A total of 1241 patients had severe asthma; 270 patients had severe eosinophilic asthma (severe asthma and a BEC ≥300 cells/μL). Patients with severe versus non-severe asthma had higher total- and asthma-related outpatient visits, inpatient days, emergency room visits and costs per patient year; those with BEC ≥300 cells/μL versus <300 cells/μL had more outpatient visits. All recorded HCRU and associated costs were highest in patients with severe eosinophilic asthma. **Conclusion:** This study demonstrated a substantial burden associated with severe and/or eosinophilic asthma for adults in Finland.

Watson, W. T., Gillespie, C., Thomas, N., et al. (2009). "Small-group, interactive education and the effect on asthma control by children and their families." *Cmaj* **181**(5): 257-263.  
<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2734203/pdf/1810257.pdf>

**BACKGROUND:** Effective approaches to education about asthma need to be identified. We evaluated the impact on asthma control by children and their caregivers of an intervention involving small-group, interactive education about asthma. **METHODS:** We randomly assigned children who visited an emergency department for an exacerbation of asthma (n = 398) to either of 2 groups. Children assigned to the control group followed the usual care recommended by their primary care physician. Those assigned to the intervention group participated in a small-group, interactive program of education about asthma. We examined changes in the number of visits to the emergency department during the year after the intervention. **RESULTS:** During the year after enrolment, children in the intervention group made significantly fewer visits to the emergency department (0.45 visits per child) compared with those in the control group (0.75 visits per child) (p = 0.004). The likelihood of a child in the intervention group requiring emergency care was reduced by 38% (relative risk [RR] 0.62, 95% confidence interval CI 0.48-0.81, p = 0.004). Fewer courses of oral corticosteroids (0.63 per child) were required by children in the intervention group than by those in the control group (0.85 per child) (p = 0.006). We observed significant improvements in the symptom domain of the questionnaire on pediatric asthma quality-of-life (p = 0.03) and the activity domain of the questionnaire on caregivers' quality of life (p = 0.05). Parents of children in the intervention group missed less work because of their child's asthma after participating in the educational program (p = 0.04). No impact on hospital admissions was observed. **INTERPRETATION:** Education about asthma, especially in a small-group, interactive format, improved clinically important outcomes and overall care of children with asthma.

Weiss, K. B. et Sullivan, S. D. (1993). "The economics costs of asthma. A review and conceptual model." *Pharmacoeconomics* **4**(1): 14-30, 12 tabl., 13 fig.

Wilke, T., Timmermann, H., Mueller, S., et al. (2022). "Association between asthma control and healthcare costs: Results from a German linked data study." *Health Serv Manage Res*: 9514848221100749.  
<https://journals.sagepub.com/doi/10.1177/09514848221100749>

**Background:** This study aimed to evaluate differences in healthcare resource utilization and cost among patients with controlled and uncontrolled asthma. **Methods:** Claims data from a German sickness fund was linked to patient survey data. Outpatient physicians enrolled patients and assessed asthma control using the ACT(TM) questionnaire. All-cause and asthma-specific healthcare resource use (HCRU)/costs were compared descriptively and based on multivariable models using a continuous ACT(TM) score. **Results:** Overall, 492 asthma patients were included (mean age: 53.8, 73.8% female). The mean/median ACT(TM) score was 19.9/20.7, with 183 patients (37.2%) classified as having uncontrolled asthma (mean ACT(TM) score < 20). Patients with uncontrolled asthma had significantly more hospitalizations ( $p = .035$ ) and medication prescriptions ( $p < .001$ ), which resulted in higher total healthcare costs for asthma-related (€1785 vs. €1615;  $p = .004$ ) and all-cause care (€4695 vs. €4117;  $p = .009$ ). While controlling for baseline characteristics, multivariable models confirmed a negative association between asthma control and total all-cause healthcare costs ( $p = .008$ ), total asthma-related costs ( $p = .008$ ), and costs of medication prescriptions ( $p = .001$ ). However, no significant association was found for all-cause ( $p = .062$ ) and asthma-related hospitalization costs ( $p = .576$ ). **Conclusion:** Considering continuous patient care, improving asthma control is not only desirable from a clinical perspective, but could also be an effective approach to reduce asthma-related HCRU and cost burden.

Wong, A., Tavakoli, H., Sadatsafavi, M., et al. (2017). "Asthma control and productivity loss in those with work-related asthma: A population-based study." *J Asthma* **54**(5): 537-542.  
<https://www.tandfonline.com/doi/full/10.1080/02770903.2016.1220011>

**OBJECTIVE:** In Canada, asthma is the third leading cause of work loss, yet little is known about the associated productivity loss. The goal of this study was to look at the relationship between asthma control and productivity loss, particularly contrasting those with work-related asthma (WRA) and non-work-related asthma (NWRA). **METHODS:** A population-based random sample of adults with asthma in British Columbia, Canada, was prospectively recruited. Asthma control was graded according to Global Initiative for Asthma classification, while productivity loss and presence of WRA was assessed using questionnaires. Ordinal regression models were then used to associate WRA with asthma control. Generalized linear models were applied to estimate the average productivity loss associated with different levels of asthma control among those with WRA and NWRA. **RESULTS:** The study included 300 employed adults. Sixty (20%) had WRA. The odds of being controlled were significantly lower in those with WRA (OR = 0.23, 95% CI: 0.09, 0.56;  $P < 0.01$ ). Those with WRA and uncontrolled asthma had a significant difference in productivity loss due to presenteeism (\$659.1 [95% CI: 12.9, 1581.5;  $P = 0.04$ ]), but not absenteeism (\$88.7 [95% CI: -86.5, 279.6;  $P = 0.35$ ]), when compared to those with NWRA and uncontrolled asthma. There was no significant difference when a similar comparison was made for those with controlled or partially controlled asthma. **CONCLUSIONS:** WRA is associated with worse asthma control and increased productivity loss. Presenteeism makes a significant contribution to productivity loss and should be considered when evaluating the overall economic burden of asthma, particularly WRA.

Yaghoubi, M., Adibi, A., Safari, A., et al. (2019). "The Projected Economic and Health Burden of Uncontrolled Asthma in the United States." *American Journal of Respiratory and Critical Care Medicine* **200**(9): 1102-1112.  
<Go to ISI>://WOS:000494384000012  
<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6888652/pdf/rccm.201901-0016OC.pdf>

**Rationale:** Despite effective treatments, a large proportion of patients with asthma do not achieve sustained asthma control. The "preventable" burden associated with lack of proper control is likely taking a high toll at the personal and population level. **Objectives:** We predicted the future excess health and economic burden associated with uncontrolled asthma among American adolescents and adults for the next 20 years. **Methods:** We built a probabilistic model that linked state-specific

estimates of population growth, aging, asthma prevalence, and asthma control levels. We conducted several meta-analyses to estimate the adjusted differences in healthcare resource use, quality-adjusted life years (QALYs), and productivity loss across control levels. We projected, nationally and at the state level, total direct and indirect (due to productivity loss) costs (in 2018 dollars) and QALYs lost because of uncontrolled asthma from 2019 to 2038. Measurements and Main Results: Total 20-year direct costs associated with uncontrolled asthma are estimated to be \$300.6 billion (95% confidence interval [CI], \$190.1 billion-411.1 billion). When indirect costs are added, total economic burden will be \$963.5 billion (95% CI, \$664.1 billion-1,262.9 billion). American adolescents and adults will lose an estimated 15.46 million (95% CI, 12.77 million-18.14 million) QALYs over this period because of uncontrolled asthma. Across states, the average 20-year per capita costs due to uncontrolled asthma ranged from \$2,209 (Arkansas) to \$6,132 (Connecticut). Conclusions: The burden of uncontrolled asthma is substantial and will continue to grow. Given that a substantial fraction of this burden is preventable, better adherence to evidence-informed asthma management strategies by care providers and patients has the potential to substantially reduce costs and improve quality of life.

Zafari, Z., Sadatsafavi, M., Chen, W., et al. (2018). "The projected economic and health burden of sub-optimal asthma control in Canada." *Respir Med* **138**: 7-12.  
[https://www.resmedjournal.com/article/S0954-6111\(18\)30082-9/pdf](https://www.resmedjournal.com/article/S0954-6111(18)30082-9/pdf)

**BACKGROUND:** Achieving optimal control is the primary objective of asthma management. However, despite the existence of effective treatments, many patients experience periods of sub-optimal asthma control. The objective of this study was to quantify and project the future economic and health burden of sub-optimal asthma control in Canada. **METHODS:** A probabilistic time-in-state model of asthma was created with inputs from published studies on the prevalence of asthma, levels of asthma control, and the impact of asthma control on costs and quality of life. In the primary analysis, we modeled the 20-year total direct costs (in 2014 Canadian dollars) and quality-adjusted life years (QALYs) from 2014 to 2033 in Canada. In the secondary analysis, we also incorporated indirect costs. **RESULTS:** The undiscounted projected 20-year direct costs and QALYs lost attributable to sub-optimal asthma control were \$24.40 billion and 1.82 million, respectively, from 2014 to 2033. The corresponding discounted values (at 3%) were \$18.54 billion and 1.38 million. When indirect costs were considered, the total undiscounted and discounted costs of sub-optimal control were projected to be \$280.49 billion, and \$213.10 billion, respectively. A 10% reduction in prevalence of sub-optimal control in asthma was associated with 18% reduction in the economic and health burden of asthma over this time period. **DISCUSSION:** Sub-optimal asthma control is associated with a substantial economic and health burden. Given that with evidence-based disease management asthma can be controlled in the majority of patients, strategies towards improving asthma management can be associated with a significant return on investment. **TRIAL REGISTRATION:** not applicable.

Zeiger, R. S., Schatz, M., Dalal, A. A., et al. (2016). "Utilization and Costs of Severe Uncontrolled Asthma in a Managed-Care Setting." *J Allergy Clin Immunol Pract* **4**(1): 120-129.e123.  
[https://www.jaci-inpractice.org/article/S2213-2198\(15\)00434-1/fulltext](https://www.jaci-inpractice.org/article/S2213-2198(15)00434-1/fulltext)

**BACKGROUND:** Clinical and economic burden of patients with severe uncontrolled asthma (SUA) in a real-world managed-care setting required further documentation. **OBJECTIVE:** The objective of this study was to determine the characteristics, clinical, and economic burden of SUA in a managed-care setting. **METHODS:** This observational study identified patients with persistent asthma aged 12 years or more (N = 25,935) using the International Classification of Diseases, 9th Revision asthma codes and Healthcare Effectiveness Data and Information Set administrative criteria. An SUA subgroup was identified when all of the following 3 criteria were met in 2012: (1) 2 or more asthma exacerbations; (2) 6 or more medium- or high-dose dispensed canisters of inhaled corticosteroid (ICS) as monotherapy or with long-acting  $\beta$ 2-agonist; and (3) 3 or more dispensed non-ICS controllers. Health care utilization and direct costs (all-cause and asthma-related) in 2013 were compared between SUA and non-SUA subgroups using multivariable regression. **RESULTS:** Compared with the non-SUA subgroup (N = 25,350, 97.7%), the SUA subgroup (N = 585, 2.3%) at baseline was significantly older and had more comorbidities, asthma specialist care, controller medication dispensed, and asthma



exacerbations. During follow-up, patients with SUA exhibited significantly more asthma exacerbations and short-acting  $\beta$ 2-agonist use, and higher all-cause and asthma-related costs than patients with non-SUA. The adjusted asthma-related average direct cost per patient at follow-up was significantly higher for SUA (mean  $\pm$  SE) (\$2325  $\pm$  \$75) than non-SUA (\$1261  $\pm$  \$9) with an incremental cost of \$1056 (95% CI, \$907-\$1205). Asthma drugs accounted for the major difference (incremental cost of \$848/patient; 95% CI, \$737-\$959). CONCLUSION: Increases and disparities in health care utilization and direct cost by SUA status suggest that patients with SUA require more intensive therapy, greater attention to adherence and comorbidities, more specialist care, and, possibly, personalized treatment approaches including novel biologic treatments.

## Interventions au domicile des patients

### REVUES DE LITTÉRATURE

Parekh, T. M., Copeland, C. R., Dransfield, M. T., et al. (2019). "Application of the community health worker model in adult asthma and COPD in the U.S.: a systematic review." *BMC Pulm Med* **19**(1): 116.  
[https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6593583/pdf/12890\\_2019\\_Article\\_878.pdf](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6593583/pdf/12890_2019_Article_878.pdf)

BACKGROUND: With rising medical costs, stakeholders and healthcare professionals are exploring community-based solutions to relieve the burden of chronic diseases and reduce health care spending. The community health worker (CHW) model is one example that has proven effective in improving patient outcomes globally. We sought to systematically describe the effectiveness of community health worker interventions in improving patient reported outcomes and reducing healthcare utilization in the adult asthma and chronic obstructive pulmonary disease (COPD) populations in the U.S. METHODS: Studies were included if they were a randomized control trial or involved a pre-post intervention comparison with clearly stated disease specific outcomes, targeted adult patients with asthma or COPD, and were performed in the United States. Risk of bias was assessed using the Cochrane Risk of Bias tool. The review adhered to the Preferred Reporting Items for Systematic Reviews and Meta-analysis (PRISMA) criteria and was registered with PROSPERO. RESULT: The search yielded 4013 potential articles, of which 47 were chosen for full-text review and 4 were chosen for inclusion; all focused on asthma and three had a comparison group. CHW interventions demonstrated improvement in asthma-related quality of life, asthma control, home trigger scores, and asthma symptom free days. There were no studies that reported COPD specific outcomes as a result of CHW interventions. CONCLUSION: Emerging evidence suggests CHW interventions may improve some aspects of asthma related disease burden in adults, however additional studies with consistent outcome measures are needed to confirm their effectiveness. Further research is also warranted to evaluate the use of community health workers in the COPD population.

Postma, J., Karr, C. et Kieckhefer, G. (2009). "Community health workers and environmental interventions for children with asthma: a systematic review." *J Asthma* **46**(6): 564-576.  
<https://www.tandfonline.com/doi/full/10.1080/02770900902912638>

Community health worker (CHW)-delivered, home-based environmental interventions for pediatric asthma were systematically reviewed. Seven PubMed/MEDLINE listed randomized controlled trials that encompassed the following intervention criteria were identified: (1) home-based; (2) delivered by a CHW; (3) delivered to families with children with asthma; and (4) addressed multiple environmental triggers for asthma. Details of research design, intervention type, and setting, interventionist, population served, and the evaluated outcomes were abstracted. Outcome assessment was broad and non-uniform. Categories included direct mediators of improved health outcomes, such as trigger-related knowledge, trigger reduction behaviors and allergen or exposure levels, and asthma-related health outcomes: change in lung function, medication use, asthma symptoms, activity limitations, and health care utilization. Indirect mediators of health outcomes, or psychosocial influences on health, were measured in few studies. Overall, the studies consistently identified positive outcomes associated with CHW-delivered interventions, including decreased asthma symptoms, daytime activity

limitations, and emergency and urgent care use. However, improvements in trigger reduction behaviors and allergen levels, hypothesized mediators of these outcomes, were inconsistent. Trigger reduction behaviors appeared to be tied to study-based resource provision. To better understand the mechanism through which CHW-led environmental interventions cause a change in asthma-related health outcomes, information on the theoretical concepts that mediate behavior change in trigger control (self-efficacy, social support) is needed. In addition, evaluating the influence of CHWs as clinic liaisons that enhance access to health professionals, complement clinic-based teaching, and improve appropriate use of asthma medications should be considered, alongside their effect on environmental management. A conceptual model identifying pathways for future investigation is presented.

## EN FRANCE

Bancher, F. (2017). Conseiller en environnement intérieur, un enjeu de santé publique : identification des freins et pistes d'action pour développer ce métier. Rennes : Ehesp. **MIP Santé oubliée**: 42p.

Entre 20 % et 25 % de la population française souffre d'affections respiratoires chroniques, notamment d'allergie respiratoire, de broncho-pneumopathie chronique obstructive (BPCO) et d'asthme. La prise en charge et la prévention de ces affections constituent un enjeu de santé publique à la fois en termes de morbi-mortalité mais aussi en terme économique. Plusieurs causes et facteurs de déclenchement ou d'aggravation des symptômes des pathologies respiratoires chroniques ont été identifiés parmi lesquels on retrouve des facteurs liés à la mauvaise qualité de l'air au domicile des patients : présence d'allergènes et/ou de polluants chimiques ou biologiques au domicile des patients. C'est la raison pour laquelle s'est développé, dans les années 1990, le métier de conseiller médical en environnement intérieur. L'intervention, sur prescription médicale, de ces conseillers au domicile des patients vise à réduire leur exposition aux risques en agissant sur la qualité de l'air intérieur de leur habitat et à proposer des mesures d'éviction des éléments polluants ou allergisants. Cette activité a pu bénéficier d'un soutien constant des pouvoirs publics, au travers de différents plans nationaux (plan « asthme », trois plans nationaux santé environnement, Grenelle de l'environnement, plan qualité de l'air intérieur) et un portage par la société de Pneumologie de Langue Française ou encore par la Haute Autorité de Santé. Pourtant, malgré l'intérêt de l'action des CEI sur la réduction de la symptomatologie de ces pathologies, ce métier semble avoir des difficultés à se développer. En effet, la reconnaissance de ce métier par certains acteurs, notamment de santé, n'est pas encore acquise, les modalités de financement de cette activité ne sont pas stabilisées et son cadre d'intervention mériterait d'être plus clairement défini. Une étude randomisée multicentrique "ECENVIR" actuellement en cours vise à confirmer l'intérêt de l'action des CEI et à emporter l'adhésion des pouvoirs politiques pour en garantir la pérennité. Dans le cadre de ce module inter-professionnel, la mission, après avoir identifié plusieurs freins au développement de cette activité, a émis plusieurs propositions pour promouvoir le métier de CEI, l'inscrire pleinement dans le champ de la promotion et de l'éducation à la santé et d'en assurer le financement. (R. A.)

Bex, V., Ramgolam, K., Barral, S., et al. (2021). "Évolution des interventions de conseillers médicaux en environnement intérieur à Paris : bilan sur 5 ans." *Environnement, Risques & Santé* 20(5): 433-445.

<https://www.cairn.info/revue-environnement-risques-et-sante-2021-5-page-433.htm>

<http://www.jle.com/fr/revues/ers/e->

[docs/evolution\\_des\\_interventions\\_de\\_conseillers\\_medicaux\\_en\\_environnement\\_interieur\\_a\\_paris\\_bilan\\_sur\\_5\\_ans\\_320933/article.phtml](http://www.jle.com/fr/revues/ers/e-docs/evolution_des_interventions_de_conseillers_medicaux_en_environnement_interieur_a_paris_bilan_sur_5_ans_320933/article.phtml)

Des audits environnementaux sont réalisés gratuitement depuis 20 ans par le Service parisien de santé environnementale (SPSE) de la Ville de Paris, sur prescription médicale, au domicile de Parisiens dont la pathologie est suspectée être liée à leur environnement intérieur. Ces audits, complétés par la mesure si nécessaire de polluants chimiques et microbiologiques, permettent de proposer des conseils aux patients pour qu'ils réduisent leur exposition aux polluants incriminés. Le SPSE a diversifié ses activités en mettant en place des consultations (sans déplacement à domicile) depuis 2017 : consultations avec un conseiller médical en environnement intérieur (CMEI) permettant aux

bénéficiaires de disposer d'une évaluation des facteurs de risque dans leur logement et de conseils pour leur permettre de réduire les expositions identifiées ; consultations bilan-environnement pour l'évaluation des expositions domestiques et professionnelles afin de déterminer si un audit est nécessaire. Cet article décrit l'évolution des 765 interventions (391 audits, 374 consultations) menées entre 2015 et 2019 et caractérise principalement les médecins prescripteurs. Un total de 391 audits a concerné 426 Parisiens, dont 39 % d'enfants, prescrits en grande partie par des pneumologues et des pédiatres pratiquant principalement à Paris, en secteurs hospitalier et libéral. Pour les médecins prescripteurs, ces audits permettent de connaître l'exposition de leurs patients à domicile et de leur apporter des conseils adaptés à leur situation. Depuis 2017, 58 consultations CMEI ont été délivrées au SPSE à 64 Parisiens, dont 30 % d'enfants, prescrites en majorité par des médecins généralistes libéraux et de centres de santé situés à Paris également. Depuis 2018, 202 consultations CMEI et 114 consultations bilan-environnement ont été délivrées à 248 patients adultes, parisiens ou franciliens, du service de pneumologie de l'hôpital Tenon (Paris, 20e). Les actions de prévention constituées par ces interventions, ciblées sur la réduction des expositions domestiques, pourraient être plus nombreuses si elles étaient mieux connues et si les moyens permettant leur mise en œuvre étaient augmentés.

Gangneux, J. P., Morel, H., Blanc, F. X., et al. (2022). "Évaluation multicentrique et randomisée de l'impact des conseillers en environnement intérieur sur le contrôle de l'asthme : l'étude ECENVIR." *Revue Française d'Allergologie* **62**(3): 330-331.

<https://www.sciencedirect.com/science/article/pii/S1877032022001488>

Introduction (contexte de la recherche) L'exposition répétée des patients asthmatiques aux allergènes intradomiciliaires contribue aux exacerbations de l'asthme. Plusieurs stratégies d'intervention sont proposées, parmi lesquelles, la visite domiciliaire de conseillers en environnement intérieur (CEI). Les CEI établissent un état des lieux au domicile du patient et proposent des mesures de remédiation afin d'améliorer les fonctions respiratoires. Plusieurs études monocentriques ont montré l'intérêt d'une telle démarche. Objectif L'étude ECENVIR est un essai clinique, multicentrique, prospectif et randomisé qui vise à évaluer l'impact des CEI sur le niveau de contrôle de l'asthme. Méthodes Au total, 104 patients ont été inclus dont 85 patients ont été suivis médicalement et randomisés dans 2 groupes : le Groupe Intervention (GI) a bénéficié d'une visite de CEI avec prélèvements pour mesures d'allergènes et conseils à l'inclusion et après 12 mois de suivi ; et le groupe témoin (GT) a bénéficié d'une même visite de contrôle uniquement à M12. Résultats Le critère de jugement principal a été analysé chez 71/85 patients : 34 dans le GI et 37 dans le GT. A M12, une amélioration du contrôle de l'asthme était notée dans le GI avec une diminution du nombre d'asthme sévère et une augmentation d'asthme intermittent ( $p=0,05$ ) comparativement au GT ( $p=0,24$ ). En comparaison intergroupe, 50 % (17/34) des patients du GI ont montré une amélioration clinique comparativement au GT ( $p=0,43$ ). Bien que non statistiquement significative probablement dû à un manque de puissance, les patients du GI avaient 1,5 fois plus de chance de s'améliorer cliniquement en analyse multivariée (OR 1,47 CI95 % [0,57–3,75]). Les analyses secondaires montrent que : (i) dans la population des asthmes sévères, 12/16 patients (75 %) du GI se sont améliorés contre 7/16 du GT (44 %) ( $p=0,06$ ) ; (ii) la consommation des corticoïdes oraux et le taux d'hospitalisation sont significativement diminués dans le groupe ayant bénéficié de conseils ( $p=0,029$  et  $p=0,042$ , respectivement). Conclusions L'intervention des CEI est bénéfique cliniquement sur le niveau de contrôle de l'asthme et permet sur le plan économique une diminution de la consommation de soins, en cours d'investigation via les données d'Assurance maladie.

Gangneux, J. P., Morel, B., Blanc, F. X., et al. (2022). Evaluation multicentrique et randomisée de l'impact des conseillers en environnement intérieur sur le contrôle de l'asthme: l'étude Ecenvir : poster. Rennes : CHU.

L'étude Ecenvir est un essai clinique, multicentrique, prospectif et randomisé qui vise à évaluer l'impact des conseillers en environnement intérieur (CEI) sur le niveau de contrôle de l'asthme.

Guilleux, C. (2011). "Entre expertise et contestation : la problématisation de l'air intérieur comme nouvelle menace environnementale et sanitaire." *Sciences sociales et santé* **29**(4): 5-28.

<https://www.cairn.info/revue-sciences-sociales-et-sante-2011-4-page-5.htm?ref=doi>

Cet article traite de la construction de la pollution de l'air intérieur comme nouvelle menace environnementale et sanitaire. Il s'appuie sur des observations et des entretiens réalisés avec des chercheurs et des professionnels de la « santé-environnement ». L'article montre que la problématisation savante décrit l'air intérieur comme relevant de l'espace domestique et de la responsabilité individuelle. Pour y répondre, les pouvoirs publics proposent un renforcement de la surveillance météorologique et un accompagnement des individus pour en faire des gestionnaires de leur air. Cette forme de prise en charge est questionnée par des décideurs locaux qui préfèrent intégrer la prévention dans les pratiques du secteur du bâtiment. De plus, de nouvelles catégories de malades dits « hypersensibles » bouleversent les cadres de pensée de la pollution domestique en l'élargissant à de nouveaux agents comme les ondes électromagnétiques. L'article discute en dernier point des conséquences de la généralisation de la norme de la responsabilité individuelle sur la formulation des enjeux de l'action collective.

Ott, M., Dellis, P., Dazy, A., et al. (2021). "Évaluation des visites à domicile par les Conseillers en environnement intérieur dans le dispositif Intair'Agir." *Revue Française d'Allergologie* **61**(4): 252-253.  
<https://www.sciencedirect.com/science/article/pii/S1877032021001226>

Introduction Dans le Grand Est le logiciel Intair'Agir a été créé en 2017 pour optimiser, centraliser et évaluer les visites des conseillers en environnement intérieur (CEI). Méthodes De 2017 à 2019, 1001 visites ont été analysées pour connaître : – le profil des patients, – les prescripteurs de visites, – la compliance des patients aux mesures d'éviction données. Résultats 1001 patients ont bénéficié d'une visite à domicile dans la région Grand Est par 8 CEI prescrites par 295 médecins. Un total de 127 des prescripteurs étaient médecins généralistes, 92 pneumologues, 40 pédiatres, 25 allergologues, 5 médecins du travail, 10 d'autres spécialités. L'âge moyen des patients étaient de 29,5 ans [0–88]. 52 % d'entre eux étaient asthmatiques, 47 % rhinitiques, 25 % avaient une conjonctivite. Les sensibilisations étaient : 65 % acariens, 38 % chat, 31 % chien, 25 % moisissures. 21,8 % des patients étaient monosensibilisés, 50,7 % étaient polysensibilisés et 27,5 % n'avaient pas de sensibilisation aux pneumallergènes. Lors de 19 visites sur 1001 des mesures de polluants chimiques ont été réalisées et 15 visites ont nécessité un signalement d'insalubrité à l'ARS. La typologie des logements visités était : 49,4 % propriétaire, 50,6 % locataire (dont 30,7 % de bailleur social). 75 % des logements avaient plus de 20 ans, 18 % moins de 20 ans et 7 % étaient neufs. Les logements étaient situés 27 % dans le centre urbain, 39 % en périphérie urbaine et 34 % en milieu rural. En 2019, 239 sur 369 visites ont été évaluées par téléphone soit 64,8 %. Le taux de suivi des conseils était de 70,4 %. Le taux de satisfaction : 61 % très satisfait, 31 % satisfait, moyennement satisfait 6 %, insatisfait 2 %. La visite a été jugée utile pour 90 % des patients, et inutile pour 7 %, NSP 3 %. Conclusion Le dispositif Intair'Agir permet d'avoir une vision plus exhaustive de l'intervention d'un CEI. Notre étude confirme son intérêt et souligne la compliance des patients aux conseils du CEI. Désormais, il convient d'étendre et pérenniser cette expérience à toute la France.

Potelon, A. (2017). Préfiguration d'un réseau de conseillers en environnement intérieur en Ile-de-France. Rennes : Ehesp. **Ingénieur d'études sanitaires**: 42p.  
<https://docplayer.fr/204538263-Prefiguration-d-un-reseau-de-conseillers-en-environnement-interieur-en-ile-de-france.html>

Nous passons environ 85% de notre temps dans des espaces clos, et en particulier dans nos logements. Or l'habitat est un déterminant de santé majeur qui est notamment corrélé à de nombreuses pathologies respiratoires (asthme, broncho-pneumopathie chronique obstructive, allergies respiratoires, etc.). Les médecins ne se déplaçant plus au domicile des patients, un corps de métier multidisciplinaire, compétent sur les domaines de l'habitat et de la santé, est donc devenu nécessaire. C'est le rôle des conseillers en environnement intérieur (CEI), dont l'objectif est d'établir des liens entre le logement et l'état de santé des patients, et de formuler des recommandations sur cette base. Ces professionnels interviennent sur prescription médicale, mais leurs audits ne sont pas pris en charge par les caisses primaires d'assurance maladie (CPAM). Sans source de financement

fiable, le métier peine à se développer. Dans le cadre du troisième plan régional santé-environnement (PRSE3), ce travail étudie la faisabilité de la mise en place d'un réseau de conseillers en environnement intérieur en Île-de-France. Il se base sur les projets de mise en réseau entrepris dans les autres régions, et sur les initiatives locales franciliennes. Des contacts ont été initiés avec des acteurs institutionnels ou associatifs susceptibles de prendre part au projet. L'étude formule des préconisations quant aux modalités de mise en œuvre d'un réseau de CEI en Île-de-France. (R. A.)

Quéruel, N. et Foisil, C. (2021). "Lyon : Nous contrôlons l'habitabilité des logements et jugeons si la santé de l'occupant est mise en danger [Interview]." *La Santé en action*(457): 39-40.

À Lyon, le service hygiène urbaine a formé un de ses techniciens au métier de conseiller en environnement intérieur. Ce dernier, à partir d'une prescription médicale, expertise les logements de personnes atteintes de pathologies afin de déterminer si leur habitat est un facteur causal associé de la maladie constatée. Plus largement, le service hygiène urbaine collabore avec la justice, l'agence régionale de santé (ARS) et la caisse d'allocations familiales (CAF) pour lutter contre l'habitat insalubre, contraindre les propriétaires à réaliser des travaux. L'un de ses objectifs majeurs est de soutenir les personnes en grande fragilité pour qu'elles puissent se maintenir dans leur logement ou être relogées si nécessaire.

## A L'ÉTRANGER

Apter, A. J., Bryant-Stephens, T., Han, X., et al. (2022). "Clinic navigation and home visits to improve asthma care in low income adults with poorly controlled asthma: Before and during the pandemic." *J Asthma* **118**: 106808.

<https://www.tandfonline.com/doi/full/10.1080/02770903.2020.1846746>

Asthma-related deaths, hospitalizations, and emergency visits are more numerous among low-income patients, yet management guidelines do not address this high-risk group's special needs. We recently demonstrated feasibility, acceptability, and preliminary evidence of effectiveness of two interventions to improve access to care, patient-provider communication, and asthma outcomes: 1) Clinic Intervention (CI): study staff facilitated patient preparations for office visits, attended visits, and afterwards confirmed patient understanding of physician recommendations, and 2) Home Visit (HV) by community health workers for care coordination and informing clinicians of home barriers to managing asthma. The current project, denominated "HAP3," combines these interventions for greater effectiveness, delivery of guideline-based asthma care, and asthma control for low-income patients recruited from 6 primary care and 3 asthma specialty practices. We assess whether patients of clinicians receiving guideline-relevant, real-time feedback on patient health and home status have better asthma outcomes. In a pragmatic factorial longitudinal trial, HAP3 enrolls 400 adults with uncontrolled asthma living in low-income urban neighborhoods. 100 participants will be randomized to each of four interventions: (1) CI, (2) CI with HVs, (3) CI and real-time feedback to asthma clinician of guideline-relevant elements of patients' current care, or (4) both (2) and (3). The outcomes are asthma control, quality of life, ED visits, hospitalizations, prednisone bursts, and intervention costs. The COVID-19 pandemic struck 6.5 months into recruitment. We describe study development, design, methodology, planned analysis, baseline findings and adaptations to achieve the original aims of improving patient-clinician communication and asthma outcomes despite the markedly changed pandemic environment.

Apter, A. J., Localio, A. R., Morales, K. H., et al. (2019). "Home visits for uncontrolled asthma among low-income adults with patient portal access." *J Allergy Clin Immunol* **144**(3): 846-853.e811.

<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6742549/pdf/nihms-1533345.pdf>

BACKGROUND: Asthma disproportionately affects low-income and minority adults. In an era of electronic records and Internet-based digital devices, it is unknown whether portals for patient-provider communication can improve asthma outcomes. OBJECTIVE: We sought to estimate the effect

on asthma outcomes of an intervention using home visits (HVs) by community health workers (CHWs) plus training in patient portals compared with usual care and portal training only. METHODS: Three hundred one predominantly African American and Hispanic/Latino adults with uncontrolled asthma were recruited from primary care and asthma specialty practices serving low-income urban neighborhoods, directed to Internet access, and given portal training. Half were randomized to HVs over 6 months by CHWs to facilitate competency in portal use and promote care coordination. RESULTS: One hundred seventy (56%) patients used the portal independently. Rates of portal activity did not differ between randomized groups. Asthma control and asthma-related quality of life improved in both groups over 1 year. Differences in improvements over time were greater for the HV group for all outcomes but reached conventional levels of statistical significance only for the yearly hospitalization rate (-0.53; 95% CI, -1.08 to -0.024). Poor neighborhoods and living conditions plus limited Internet access were barriers for patients to complete the protocol and for CHWs to make HVs. CONCLUSION: For low-income adults with uncontrolled asthma, portal access and CHWs produced small incremental benefits. HVs with emphasis on self-management education might be necessary to facilitate patient-clinician communication and to improve asthma outcomes.

Babineau-Therrien, J., Boulet, L. P. et Gagne, M. (2020). "Self-management support provided by trained asthma educators result in improved quality of life and asthma control compared to usual care: A systematic review and meta-analysis." *Patient Educ Couns* **103**(8): 1498-1506.

<Go to ISI>://WOS:000542942800006

Objectives: We sought to describe training activities on self-management support (SMS) for asthma educators and the effects of SMS provided by trained educators on asthma patient outcomes. Methods: We conducted a systematic review of six medical databases and sought for trials assessing SMS provided for adults with asthma by trained educators. Two reviewers independently selected and extracted data on asthma educators' training activities and patient outcomes. We performed meta-analyses for asthma-related quality of life (QoL) and asthma control. Results: We screened 3217 records and included 16 trials. Learning activities and assessments were reported in 8/16 and 4/16 trials, respectively. Compared to usual care, trained asthma educators provided SMS that resulted in clinically important improvements in QoL (pooled mean difference [MD] = 0.52; 95% confidence interval [95%CI]: 0.19 to 0.83) and asthma control (pooled MD = -0.68; 95% CI: -0.99 to -0.38). Conclusion: Although asthma-specific SMS provided by trained educators had a beneficial effect over the current care, our results highlight the need to better describe training activities for asthma educators. Practice implications: This systematic review provides key elements of efficient training activities for asthma educators and reaffirms the importance of training educators to provide SMS in order to improve asthma patients' QoL and asthma control.

Beckham, S., Kaahaaina, D., Voloch, K. A., et al. (2004). "A community-based asthma management program: effects on resource utilization and quality of life." *Hawaii Med J* **63**(4): 121-126.

OBJECTIVE: The Waianae Coast Comprehensive Health Center (WCCHC) developed an integrated community-based asthma management program in an effort to reduce inappropriate medical utilization and improve quality of life in their pediatric asthma population. METHODS: Over a period of three years, eighty-eight children with asthma participated in the community-based asthma management program. During this time, an automated asthma tracking system was developed, the WCCHC established a standard system of care based on the National Asthma Education and Prevention Program Expert Panel Report Guidelines for the Diagnosis and Management of Asthma (NAEPP Asthma Guidelines) adapted for cultural sensitivity, and a coordinated team care approach was implemented in the asthma management program. RESULTS: During the pilot study, forty children participated in the program. Among these forty individuals, there was a significant decrease in both per capita expenditures and asthma related visits after community health worker (CHW) intervention. Average per capita charges decreased from dollar 735 to dollar 181, Emergency Department (ED) visits decreased from 60 to 10, and the overall asthma related visits decreased from 1.5 to 0.25 per person after the initial CHW encounter. These results were replicated during the 2000-2001 intervention period where average per capita charges decreased from dollar 310 to dollar 129 and ED encounters

dropped from 32 to 10 after the first CHW encounter. In addition, the number of high utilizers-defined as those presenting to the ED two or more times for asthma-related diagnoses- sharply decreased from 176 in 1998 to only 16 in 2001. Quality of life improved, with 72% fewer nighttime and 96% fewer daytime symptoms reported after CHW intervention during the pilot study. During the year 2000, symptoms during exercise and asthma related doctor visits decreased 59% and 67% respectively after CHW intervention. CONCLUSION: The community-based asthma management program demonstrated success in improving utilization patterns and reducing asthma-related expense among program participants. Improvement was also noted in quality of life as expressed through frequency and time of asthma symptoms. Other health care institutions may also be positively impacted by developing multidisciplinary team implemented, culturally-adapted, and scientifically-based disease management programs.

Bellanti, J. A. (2006). "Literature review: the best new articles in the specialty of allergy, asthma, and immunology, 2004-2005." *Allergy Asthma Proc* **27**(3): 186-196.

<https://www.ingentaconnect.com/content/ocean/aap/2006/0000027/0000003/art00003;jsessionid=3lwdtg1ugt19h.x-ic-live-03>

A series of eight articles from the published literature for the period 2004-2005 was selected for review in this article. Small-airway obstruction in chronic obstructive pulmonary disease (COPD) and its management were the subjects of the first two articles reviewed in this commentary. Progression of COPD from the Global Initiative for Chronic Obstructive Lung Disease stages 0-4 was found to be most strongly associated with thickening of the airway wall and each of its compartments by a repair or remodeling process. Management of COPD, including the addition of pulmonary rehabilitation to treatment regimens, may reduce symptoms and improve exercise performance. The addition of theophylline or an inhaled corticosteroid (or both) to optimal inhaled bronchodilator therapy together with aggressive treatment of hypoxemia were suggested to provide additional benefits and lung-volume-reduction surgery and transplantation were recommended as other treatment options for a subgroup of patients with very severe disease. The next three articles addressed the impact of outdoor and indoor air pollution and the effects of childhood asthma as antecedents of asthma in the adult in later life. Current levels of air pollution are known to have chronic, adverse effects on lung development in children from age 10 to 18 years, leading to clinically significant deficits in attained forced expiratory volume in one second as children reach adulthood. Among inner-city children with atopic asthma, an individualized, home-based, comprehensive environmental intervention resulted in reduced asthma-associated morbidity and supported that a multifaceted, home-based, environmental intervention approach may be beneficial. The prognosis of childhood allergic asthma in adulthood was found to be determined largely early in life and the degree of atopy appeared to be a critical determinant of asthma persistence. The next article reviewed the controversial area of the treatment of chronic rhinosinusitis caused by fungi. Intranasal Amphotericin B was shown to reduce inflammatory mucosal thickening on both CT scan and nasal endoscopy and decreased the levels of intranasal markers for eosinophilic inflammation in patients with chronic rhinosinusitis. The last two articles reviewed two papers dealing with the role that gastrointestinal immune responses play in maintaining protective immunity in health and a critical role in the pathogenesis of a wide variety of clinical disorders associated with food allergy as well as the suspected pivotal role of oral tolerance to dietary proteins for the prevention of food allergy. The mode of antigen uptake in the gut and different regulatory immune cells appear to play critical roles in maintenance of oral tolerance as shown in many animal model systems.

Bellin, M. H., Newsome, A., Land, C., et al. (2017). "Asthma Home Management in the Inner-City: What can the Children Teach us?" *J Pediatr Health Care* **31**(3): 362-371.

<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6407130/pdf/nihms-1015638.pdf>

OBJECTIVE: Knowledge of asthma home management from the perspective of poor, minority children with asthma is limited. METHOD: Convenience sampling methods were used to recruit families of low-income children who are frequently in the emergency department for uncontrolled asthma. Thirteen youths participated in focus groups designed to elicit reflections on asthma home management. Data

were analyzed using grounded theory coding techniques. RESULTS: Participants (Mean age = 9.2 years) were African American (100%), enrolled in Medicaid (92.3%), averaged 1.4 (standard deviation = 0.7) emergency department visits over the prior 3 months, and resided in homes with at least 1 smoker (61.5%). Two themes reflecting multifaceted challenges to the development proper of self-management emerged in the analysis. DISCUSSION: Findings reinforce the need to provide a multipronged approach to improve asthma control in this high-risk population including ongoing child and family education and self-management support, environmental control and housing resources, linkages to smoking cessation programs, and psychosocial support.

Bhaumik, U., Norris, K., Charron, G., et al. (2013). "A Cost Analysis for a Community-Based Case Management Intervention Program for Pediatric Asthma." *Journal of Asthma* **50**(3): 310-317.

<https://www.tandfonline.com/doi/full/10.3109/02770903.2013.765447>

Objective. Evaluate the costs and benefits of the Boston Children's Hospital Community Asthma Initiative (CAI) program through reduction of Emergency Department (ED) visits and hospitalizations and quality of life (QOL) for patients and their families due to reduced missed school days and work days. Methods. Cost-benefit analysis was used to determine an adjusted Return on Investment (ROI) for all 102 patients enrolled in the CAI program in the calendar year 2006 after controlling for changes in a comparable population without CAI intervention. A societal ROI (SROI) was also computed by including additional indirect benefits due to reduced missed school days for patients and work days for caregivers. Results. Adjusted cost savings from fewer ED visits and hospitalizations resulted in an adjusted ROI of 1.33 (adjusted Net Present Value, (NPV) of savings = \$83,863) during the first 3 years after controlling for factors other than the CAI intervention. When benefits due to reduced missed school days and missed work days were added to adjusted cost savings, the SROI increased to 1.85 (Societal NPV of savings = \$215,100). Conclusions. Multidisciplinary, coordinated disease management programs offer the opportunity to prevent costly complications and hospitalizations for chronic diseases, while improving QOL for patients and families. This cost analysis supports the business case for the provision of proactive community-based asthma services that are traditionally not reimbursed by the fee-for-service health care system.

Bhaumik, U., Sommer, S. J., Giller-Leinwohl, J., et al. (2017). "Boston children's hospital community asthma initiative: Five-year cost analyses of a home visiting program." *J Asthma* **54**(2): 134-142.

<https://www.tandfonline.com/doi/full/10.1080/02770903.2016.1201837>

OBJECTIVE: To evaluate the costs and benefits of the Boston Children's Hospital Community Asthma Initiative (CAI) through reduction of Emergency Department (ED) visits and hospitalizations for the full pilot-phase program participants. METHODS: A cost-benefit analyses was conducted using hospital administrative data to determine an adjusted Return on Investment (ROI): on all 268 patients enrolled in the CAI program during the 33-month pilot program phase of CAI intervention between October 1, 2005 and June 30, 2008 using a comparison group of 818 patients from a similar cohort in neighboring ZIP codes without CAI intervention. Cost data through June 30, 2013 were used to examine cost changes and calculate an adjusted ROI over a 5-year post-intervention period. RESULTS: CAI patients had a cost reduction greater than the comparison group of \$1,216 in Year 1 (P = 0.001), \$1,320 in Year 2 (P < 0.001), \$1,132 (P = 0.002) in Year 3, \$1,123 (P = 0.004) in Year 4, and \$997 (P = 0.022) in Year 5. Adjusting for the cost savings for the comparison group, the cost savings from the intervention resulted in an adjusted ROI of 1.91 over 5 years. CONCLUSIONS: Community-based, multidisciplinary, coordinated disease management programs can decrease the incidence of costly hospitalizations and ED visits from asthma. An ROI of greater than one, as found in this cost analysis, supports the business case for the provision of community-based asthma services as part of patient-centered medical homes and Accountable Care Organizations.

Bhaumik, U., Sommer, S. J., Lockridge, R., et al. (2020). "Community Asthma Initiative: Cost Analyses using Claims Data from a Medicaid Managed Care Organization." *J Asthma* **57**(3): 286-294.

<https://www.tandfonline.com/doi/full/10.1080/02770903.2019.1565825>



**Objective:** Use claims data to examine the cost benefit of the Community Asthma Initiative (CAI), a Boston area nurse-supervised community health worker (CHW) asthma home-visiting program. **Methods:** The reduction in asthma treatment costs was assessed using Massachusetts claims data from one Medicaid Managed Care Organization (MCO) in the north east that included all costs between January 1, 2011 and December 31, 2016. The data was used to determine asthma-related utilization cost reductions between 1 year pre- and 1, 2 and 3 years post-intervention. The cost reductions for 45 CAI patients and 45 cost-matched comparison patients were measured. Return on investment (ROI) was computed as the difference in cost reduction for CAI patients and a cost-matched comparison population divided by CAI program cost. **Results:** The excess reduction in per patient asthma-related utilization costs among CAI patients compared to the comparison population was \$806 ( $p = 0.047$ ), \$1,253 ( $p = 0.01$ ) and \$1,549 ( $p = 0.005$ ) between 1 year pre- and 1, 2 and 3 years post-intervention. These yielded adjusted ROI's of 0.31, 0.78 and 1.37 after 1, 2 and 3 years post-CAI intervention. **Conclusions:** The reduction in asthma utilization costs of a home visit program by nurse-supervised CHWs exceeds program costs. The findings support the business case for the provision of secondary prevention of home-based asthma services through reimbursement from payers or integration into Accountable Care Organizations (ACOs).

Breyse, J., Dixon, S., Gregory, J., et al. (2014). "Effect of weatherization combined with community health worker in-home education on asthma control." *American journal of public health* **104**(1): e57-64.  
<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3910032/pdf/AJPH.2013.301402.pdf>

**OBJECTIVES:** We assessed the benefits of adding weatherization-plus-health interventions to an in-home, community health worker (CHW) education program on asthma control. **METHODS:** We used a quasi-experimental design to compare study group homes ( $n = 34$ ) receiving CHW education and weatherization-plus-health structural interventions with historical comparison group homes ( $n = 68$ ) receiving only education. Data were collected in King County, Washington, from October 2009 to September 2010. **RESULTS:** Over the 1-year study period, the percentage of study group children with not-well-controlled or very poorly controlled asthma decreased more than the comparison group percentage (100% to 28.8% vs 100% to 51.6%;  $P = .04$ ). Study group caregiver quality-of-life improvements exceeded comparison group improvements ( $P = .002$ ) by 0.7 units, a clinically important difference. The decrease in study home asthma triggers (evidence of mold, water damage, pests, smoking) was marginally greater than the comparison group decrease ( $P = .089$ ). Except for mouse allergen, the percentage of study group allergen floor dust samples at or above the detection limit decreased, although most reductions were not statistically significant. **CONCLUSIONS:** Combining weatherization and healthy home interventions (e.g., improved ventilation, moisture and mold reduction, carpet replacement, and plumbing repairs) with CHW asthma education significantly improves childhood asthma control.

Broquet Ducret, C., Verga, M. E., Stoky-Hess, A., et al. (2013). "[Impact of a small-group educational intervention for 4- to 12-year-old asthmatic children and their parents on the number of healthcare visits and quality of life]." *Arch Pediatr* **20**(11): 1201-1205.

**INTRODUCTION:** Asthma is the most frequent chronic disease in children. Many educational approaches to asthma exist, but there is no evidence of their effectiveness because of the heterogeneity of practices. Several studies show that good knowledge of the disease associated with personal skills and optimal medication improve treatment compliance and decrease school absenteeism and asthma exacerbations. The "Asthma School" conducted in the Children's Hospital of Lausanne, Switzerland is in keeping with these recommendations. The aim of the study was to evaluate the impact of Asthma School (therapeutic education) on the number of medical visits in asthmatic children. We also assessed the quality of life of children and their caregivers. **METHODS:** We included in a prospective longitudinal study every child aged 4 to 12 years and their parents attending Asthma School over 1 year and followed them at 6 months. The number of emergency visits, medical appointments, and hospitalizations during the year before and after Asthma School was assessed with a questionnaire administered to the family physicians (GPs, pediatricians). Quality of life was evaluated with the Paediatric Asthma Quality of Life Questionnaire (PAQLQ) at inclusion and 6 months

after. RESULTS: Twenty-seven children and their parents were included. The mean age was 7.02 years. Pediatric visits, emergency visits, and hospitalizations decreased significantly between the year before and the year after Asthma School. Emergency visits were 41, 1 year before Asthma School and 21, 1 year after it, medical appointments were 62 vs 30, and hospitalizations were 17 vs 2, respectively. The Wilcoxon sign-rank test demonstrates a significant difference with  $P=0.010$  for medical appointments,  $P=0.021$  for emergency visits, and  $P=0.002$  for hospitalizations. Quality of life in children improved in all domains but one evaluated by the PAQLQ(S) (score of 5.90 vs 6.52). Parental quality of life (PACQLQ) improved in all domains (overall score of 5.21 vs 6.15). CONCLUSION: Interactive education on asthma improves clinically important outcomes and quality of life in children and their families. The skills acquired allow them to manage daily life.

Bryant-Stephens, T., Kenyon, C., Apter, A. J., et al. (2020). "Creating a community-based comprehensive intervention to improve asthma control in a low-income, low-resourced community." *J Asthma* **57**(8): 820-828. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6930970/pdf/nihms-1540016.pdf>

Introduction: Asthma evidence-based interventions (EBI) are implemented in the home, school, community or primary care setting. Although families are engaged in one setting, they often have to navigate challenges in another setting. Objective: Our objective is to design and implement a comprehensive plan which integrates EBI's and connects the four sectors in underserved communities such as Philadelphia. Methods: September 2015-April 2016 we implemented a three-pronged strategy to understand needs and resources of the community including 1) focus groups and key informant interviews, 2) secondary data analysis and 3) pilot testing for implementation to determine gaps in care, and opportunities to overcome those gaps. Results: Analysis of the focus group and key informant responses showed themes: diagnosis fear, clinician time, home and school asthma trigger exposures, school personnel training and communication gaps across all four sectors. EBI's were evaluated and selected to address identified themes. Pilot testing of a community health worker (CHW) intervention to connect home, primary care and school resulted in an efficient transfer of asthma medications and medication administration forms to the school nurse office for students with uncontrolled asthma addressing a common delay leading to poor asthma management in school. Conclusion: Thus far there has been limited success in reducing asthma disparities for low-income minority children. This study offers hope that strategically positioning CHWs may work synergistically to close gaps in care and result in improved asthma control and reduced asthma disparities.

Bryant-Stephens, T. et Li, Y. (2008). "Outcomes of a Home-Based Environmental Remediation for Urban Children with Asthma." *Journal of the National Medical Association* **100**(3): 306-316. <https://www.sciencedirect.com/science/article/pii/S0027968415312438>

Context Increasing urban asthma prevalence and severity is found among minority, underserved populations. Improving asthma self-management includes home management of complex medical protocols as well as environmental trigger removal. Objective: To study the effectiveness of a low-cost approach to improve control of asthma symptoms in an urban population through lay educators who promote a generalized approach to asthma trigger avoidance in the bedrooms of children with asthma. Design and Patients Prospective, randomized controlled trial with two arms: historical controls and matched controls for each subject. Subjects Two-hundred-eighty-one patients living in an urban environment, randomized to receive home visits only ( $n=128$ ) or home visits with environmental remediation ( $n=153$ ). One-hundred-fifteen controls matched according to age, gender and ethnicity did not receive any intervention. Interventions In-home education visits covered asthma physiology, asthma trigger avoidance and asthma management. Environmental remediation was conducted together with the caregiver. Outcomes Primary outcomes include length of hospital stay, number of emergency visits and number of sick visits. Secondary outcomes are symptom frequency, medication management and trigger reduction. Results Both intervention groups experienced reduction of hospitalizations, emergency room visits, sick visits and asthma symptoms. Both groups showed outcomes significantly superior to the matched control group. Intervention effectively reduced the presence of rodents and carpet in home and increased the use of mattress and pillow

covers. Conclusions This study shows that low-cost in-home education and environmental remediation improve outcomes for children with asthma. Lay educators can deliver effective asthma-specific education that results in improved asthma control.

Bryant-Stephens, T., Reed-Wells, S., Canales, M., et al. (2016). "Home visits are needed to address asthma health disparities in adults." *J Allergy Clin Immunol* **138**(6): 1526-1530.

Research on asthma frequently recruits patients from clinics because the ready pool of patients leads to easy access to patients in office waiting areas, emergency departments, or hospital wards. Patients with other chronic conditions, and with mobility problems, face exposures at home that are not easily identified at the clinic. In this article, we describe the perspective of the community health workers and the challenges they encountered when making home visits while implementing a research intervention in a cohort of low-income, minority patients. From their observations, poor housing, often the result of poverty and lack of social resources, is the real elephant in the chronic asthma room. To achieve a goal of reduced asthma morbidity and mortality will require a first-hand understanding of the real-world social and economic barriers to optimal asthma management and the solutions to those barriers.

Caekelbergh, K., Lamotte, M. et Annemans, L. (2002). "Epidémiologie et coût de l'asthme et de la bronchopneumopathie chronique obstructive en Belgique." *Ibes Briefing*(38): 5 , tabl.

Dans ce premier article d'une série thématique, l'accent est mis sur les aspects généraux de l'asthme et de la bronchopneumopathie chronique obstructive (BPCO), comme la prévalence et le coût de ces deux affections. Des articles ultérieurs évalueront certains traitements, et dans la mesure où très peu de données belges sont disponibles sur ce sujet, ces articles se réfèrent à des données tirées d'autres pays, qui permettent une extrapolation pour la Belgique.

Campbell, J. D., Brooks, M., Hosokawa, P., et al. (2015). "Community Health Worker Home Visits for Medicaid-Enrolled Children With Asthma: Effects on Asthma Outcomes and Costs." *American journal of public health* **105**(11): 2366-2372.

<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4605150/pdf/AJPH.2015.302685.pdf>

Objectives. We sought to estimate the return on investment of a streamlined version of an evidence-based community health worker (CHW) asthma home visit program. Methods. We used a randomized parallel group trial of home visits by CHWs to Medicaid-enrolled children with uncontrolled asthma versus usual care. Results. A total of 373 participants enrolled in the study (182 in the intervention group and 191 in the control group, of whom 154 and 179, respectively, completed the study). The intervention group had greater improvements in asthma symptom-free days (2.10 days more over 2 weeks; 95% CI = 1.17, 3.05;  $P < .001$ ) and caretakers' quality of life (0.43 units more; 95% CI = 0.20, 0.66;  $P < .001$ ) and a larger reduction in urgent health care utilization events (1.31 events fewer over 12 months; 95% CI = -2.10, -0.52;  $P = .001$ ). The intervention arm compared with the control arm saved \$1340.92 for the \$707.04 additional costs invested for the average participant. The return on investment was 1.90. Conclusions. A streamlined CHW asthma home visit program for children with uncontrolled asthma improved health outcomes and yielded a return on investment of 1.90.

Cataletto, M., Abramson, S., Meyerson, K., et al. (2011). "The Certified Asthma Educator: The United States Experience." *Pediatric Allergy Immunology and Pulmonology* **24**(3): 159-163.

<https://www.liebertpub.com/doi/10.1089/ped.2011.0083>

Asthma is responsible for significant healthcare costs in the United States. Although advances in pharmacology and environmental science have provided many opportunities to improve asthma control, asthma remains a major cause of missed school days, acute care visits, and hospitalizations. Patient education is a key component of asthma care. The National Asthma Educator Certification Board was established in February 2000 and charged with the mission of "promoting optimal asthma management and quality of life for individuals with asthma, their families and communities by

advancing excellence in asthma education through the certified asthma educator process." This study was performed to describe the workforce of certified asthma educators (AE-Cs (R)) by surveying a sample of educators who completed the recertification process. AE-Cs (R) who had completed the recertification process were invited to participate in an anonymous online survey. Sixty five of 135 (48%) recertificants completed the survey. The primary training of respondents was in respiratory therapy (51.6%) and nursing (42.2%). Respondents were primarily female (92.3%) and Caucasian (95.4%). The majority worked in specialty care outpatient (59.3%) or hospital inpatient (40.7%) settings. Twenty percent reported an increase in job responsibilities as a result of achieving their initial certification as an AE-C (R). Most AE-Cs (R) have their basic training in either respiratory therapy or nursing. The workforce of AE-Cs (R) does not reflect the racial or ethnic percentages seen in the asthma population in the United States. More educators are needed to serve the growing numbers of individuals with asthma. Achievement of certification as an AE-C (R) resulted in additional job responsibilities in 20% of survey respondents.

Coutinho, M. T., Subzwari, S. S., McQuaid, E. L., et al. (2020). "Community Health Workers' Role in Supporting Pediatric Asthma Management: A Review." *Clin Pract Pediatr Psychol* **8**(2): 195-210.  
<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC9053383/pdf/nihms-1713299.pdf>

**OBJECTIVE:** Community Health Workers (CHWs) have been effective in improving health outcomes in vulnerable communities by providing health education and management services. We review CHW-led asthma education and management interventions for children and their families. Next, we describe the selection and training of CHWs in pediatric asthma management in the Rhode Island Integrated Response Asthma Care Implementation Program (RI-AIR). **METHODS:** We queried the MEDLine, Cochrane, PubMed, and EMBASE databases with keywords ("community health worker", "asthma", "health worker", "lay worker", "pediatric", "child", and "childhood") from inception until September 2019. Criteria for study inclusion included: published in English, conducted in the United States, approved with an ethics notification, published in peer-reviewed journal, and involved CHWs as the interventionists. The initial search identified 216 manuscripts. Fifteen studies met criteria for inclusion. **RESULTS:** CHWs provide asthma management and education services, including home environmental trigger assessments, strategies to reduce environmental trigger exposure, resource linkage, and community referrals. We describe RI-AIR, and its CHW-led asthma education and management interventions. **CONCLUSIONS:** CHWs are effective and vital supports for positive asthma outcomes. More research is needed to guide models of intervention using CHWs, specifically addressing integration in interdisciplinary teams, training, and reimbursement for CHW services. **IMPLICATIONS FOR IMPACT STATEMENT:** CHWs are effective in helping children with asthma and their families learn to manage asthma. It is important to develop programs that prepare CHWs to work with other medical professionals and health care models to pay for their services.

Crabtree-Ide, C., Lillvis, D. F., Nie, J., et al. (2021). "Evaluating the Financial Sustainability of the School-Based Telemedicine Asthma Management Program." *Popul Health Manag* **24**(6): 664-674.  
[https://www.liebertpub.com/doi/10.1089/pop.2020.0361?url\\_ver=Z39.88-2003&rft\\_id=ori%3Arid%3Acrossref.org&rft\\_dat=cr\\_pub%3Dpubmed](https://www.liebertpub.com/doi/10.1089/pop.2020.0361?url_ver=Z39.88-2003&rft_id=ori%3Arid%3Acrossref.org&rft_dat=cr_pub%3Dpubmed)  
[https://www.liebertpub.com/doi/10.1089/pop.2020.0361?url\\_ver=Z39.88-2003&rft\\_id=ori:rid:crossref.org&rft\\_dat=cr\\_pub%3Dpubmed](https://www.liebertpub.com/doi/10.1089/pop.2020.0361?url_ver=Z39.88-2003&rft_id=ori:rid:crossref.org&rft_dat=cr_pub%3Dpubmed)

Using telemedicine to improve asthma management in underserved communities has been shown to be highly effective. However, program operating costs are perceived as the main barrier to dissemination and scaling up. This study evaluated whether a novel, evidence-based School-Based Telemedicine Enhanced Asthma Management (SB-TEAM) program, designed to overcome barriers to care for families of urban school-aged children, can be financially sustainable in real-world urban school settings. Eligible children (n = 400) had physician-diagnosed asthma with persistent or poorly controlled symptoms at baseline. Total costs included the cost of implementing and running the SB-TEAM program, asthma-related health care costs, cost of caregiver lost productivity in wages related to child illness, and school absenteeism fees. Using data from the SB-TEAM study and national data on wages and equipment costs, the authors modeled low, actual, and high-cost scenarios. The actual cost

of administering the SB-TEAM program averaged \$344 per child. Expenses incurred by families for medical care (\$982), caregiver productivity cost (\$415), and school absenteeism costs (\$284) in SB-TEAM were not different from the costs in the control group (\$1594, \$492, and \$318 [P > 0.05]). The study findings remained robust under sensitivity analyses for various state- and school-specific regulations, staffing requirements, and wages. The authors concluded that the SB-TEAM program operating costs may be offset by the reduction in health care costs, caregiver lost wages, and school absenteeism associated with the program health benefit.

Crocker, D. D., Kinyota, S., Dumitru, G. G., et al. (2011). "Effectiveness of Home-Based, Multi-Trigger, Multicomponent Interventions with an Environmental Focus for Reducing Asthma Morbidity: A Community Guide Systematic Review." *Am J Prev Med* **41**(2, Supplement 1): S5-S32.  
<https://www.sciencedirect.com/science/article/pii/S0749379711003217>

Context Asthma exacerbations are commonly triggered by exposure to allergens and irritants within the home. The purpose of this review was to evaluate evidence that interventions that target reducing these triggers through home visits may be beneficial in improving asthma outcomes. The interventions involve home visits by trained personnel to conduct two or more components that address asthma triggers in the home. Intervention components focus on reducing exposures to a range of asthma triggers (allergens and irritants) through environmental assessment, education, and remediation. Evidence acquisition Using methods previously developed for the Guide to Community Preventive Services, a systematic review was conducted to evaluate the evidence on effectiveness of home-based, multi-trigger, multicomponent interventions with an environmental focus to improve asthma-related morbidity outcomes. The literature search identified over 10,800 citations. Of these, 23 studies met intervention and quality criteria for inclusion in the final analysis. Evidence synthesis In the 20 studies targeting children and adolescents, the number of days with asthma symptoms (symptom-days) was reduced by 0.8 days per 2 weeks, which is equivalent to 21.0 symptom-days per year (range of values: reduction of 0.6 to 2.3 days per year); school days missed were reduced by 12.3 days per year (range of values: reduction of 3.4 to 31.2 days per year); and the number of asthma acute care visits were reduced by 0.57 visits per year (interquartile interval: reduction of 0.33 to 1.71 visits per year). Only three studies reported outcomes among adults with asthma, finding inconsistent results. Conclusions Home-based, multi-trigger, multicomponent interventions with an environmental focus are effective in improving overall quality of life and productivity in children and adolescents with asthma. The effectiveness of these interventions in adults is inconclusive due to the small number of studies and inconsistent results. Additional studies are needed to (1) evaluate the effectiveness of these interventions in adults and (2) determine the individual contributions of the various intervention components.

Eggleston, P. A., Butz, A., Rand, C., et al. (2005). "Home environmental intervention in inner-city asthma: a randomized controlled clinical trial." *Ann Allergy Asthma Immunol* **95**(6): 518-524.

BACKGROUND: Airborne pollutants and indoor allergens increase asthma morbidity in inner-city children; therefore, reducing exposure, if feasible, should improve asthma morbidity. OBJECTIVE: To conduct a randomized controlled trial of methods to reduce environmental pollutant and allergen exposure in the homes of asthmatic children living in the inner city. METHODS: After the completion of questionnaires, spirometry and allergen skin tests, home inspection, and measurement of home air pollutant and allergen levels, 100 asthmatic children aged 6 to 12 years were randomized to the treatment group (home-based education, cockroach and rodent extermination, mattress and pillow encasings, and high-efficiency particulate air cleaner) or to the control group (treated at the end of the 1-year trial). Outcomes were evaluated by home evaluations at 6 and 12 months, clinic evaluation at 12 months, and multiple telephone interviews. RESULTS: In the treatment group, 84% received cockroach extermination and 75% used the air cleaner. Levels of particulate matter 10 microm or smaller declined by up to 39% in the treatment group but increased in the control group (P < .001). Cockroach allergen levels decreased by 51% in the treatment group. Daytime symptoms increased in the control group and decreased in the treatment group (P = .04). Other measures of morbidity, such as spirometry findings, nighttime symptoms, and emergency department use, were not significantly

changed. CONCLUSIONS: A tailored, multifaceted environmental treatment reduced airborne particulate matter and indoor allergen levels in inner-city homes, which, in turn, had a modest effect on morbidity.

Elkugia, N., Crocker, M. E., Stout, J. W., et al. (2021). "Development of an Asthma Home-Visit Training Program for Community Health Workers and Their Supervisors in Washington State." *Front Public Health* 9: 674843. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8267368/pdf/fpubh-09-674843.pdf>

The community health worker (CHW) asthma home-visiting model developed by Public Health-Seattle & King County (PHSKC) is an evidence-based approach proven to improve health outcomes and quality of life. In addition, it has been shown to be an effective and culturally appropriate approach to helping people with asthma understand the environmental and behavioral causes of uncontrolled asthma, while acquiring the skills they need to control their asthma. This paper describes the development and implementation of training curricula for CHWs and supervisors in the asthma home visiting program. To facilitate dissemination, this program took advantage of the current healthcare landscape in Washington State resulting from Centers for Medicare & Medicaid Services (CMS) approval of the 1115 Medicaid Waiver project. Key aspects of the training program development included: (1) Engagement: forming a Community Advisory Board with multiple stakeholders to help prioritize training content; (2) Curriculum Development: building the training on evidence-based home-visit protocols previously developed at PHSKC; (3) Implementation of the training program; (4) Evaluation of the training; and (5) Adaptation of the training based on lessons learned. We describe key factors in the training program's improvement including the use of a community-based participatory approach to engage stakeholders at multiple phases of the project and ensure regional adaptation; combining in-person and online modules for delivery; and holding learning collaboratives for post-training and technical support. We also outline our training program evaluation plan and the planned evaluation of the home visit program which the trainees will deliver, both of which follow the RE-AIM framework. However, because the COVID-19 pandemic has curtailed training activities and prohibited the trainees from implementation of these CHW home visit practices, our evaluation is currently incomplete. Therefore, this case study provides insight into the adaptation of the training program, but not the delivery of the home visit program, the outcomes of which remain to be seen.

Fakih, I., Swartz, N., Schatzki, T., et al. (2020). "Creating a community-based comprehensive intervention to improve asthma control in a low-income, low-resourced community." *J Med Econ* 57(8): 820-828. <https://www.tandfonline.com/doi/full/10.1080/13696998.2022.2088196>

Introduction: Asthma evidence-based interventions (EBI) are implemented in the home, school, community or primary care setting. Although families are engaged in one setting, they often have to navigate challenges in another setting. Objective: Our objective is to design and implement a comprehensive plan which integrates EBI's and connects the four sectors in underserved communities such as Philadelphia. Methods: September 2015-April 2016 we implemented a three-pronged strategy to understand needs and resources of the community including 1) focus groups and key informant interviews, 2) secondary data analysis and 3) pilot testing for implementation to determine gaps in care, and opportunities to overcome those gaps. Results: Analysis of the focus group and key informant responses showed themes: diagnosis fear, clinician time, home and school asthma trigger exposures, school personnel training and communication gaps across all four sectors. EBI's were evaluated and selected to address identified themes. Pilot testing of a community health worker (CHW) intervention to connect home, primary care and school resulted in an efficient transfer of asthma medications and medication administration forms to the school nurse office for students with uncontrolled asthma addressing a common delay leading to poor asthma management in school. Conclusion: Thus far there has been limited success in reducing asthma disparities for low-income minority children. This study offers hope that strategically positioning CHWs may work synergistically to close gaps in care and result in improved asthma control and reduced asthma disparities.

Giese, J. K. (2019). "Evidence-based pediatric asthma interventions and outcome measures in a healthy homes program: An integrative review." *Journal of Asthma* **56**(6): 662-673.  
<https://doi.org/10.1080/02770903.2018.1472279>  
<https://www.tandfonline.com/doi/full/10.1080/02770903.2018.1472279>

Gomez, M., Reddy, A. L., Dixon, S. L., et al. (2017). "A Cost-Benefit Analysis of a State-Funded Healthy Homes Program for Residents With Asthma: Findings From the New York State Healthy Neighborhoods Program." *Public Health Manag Pract* **23**(2): 229-238.  
<https://www.ingentaconnect.com/content/wk/phh/2017/00000023/00000002/art00029>

CONTEXT: Despite considerable evidence that the economic and other benefits of asthma home visits far exceed their cost, few health care payers reimburse or provide coverage for these services. OBJECTIVE: To evaluate the cost and savings of the asthma intervention of a state-funded healthy homes program. DESIGN: Pre- versus postintervention comparisons of asthma outcomes for visits conducted during 2008-2012. SETTING: The New York State Healthy Neighborhoods Program operates in select communities with a higher burden of housing-related illness and associated risk factors. PARTICIPANTS: One thousand households with 550 children and 731 adults with active asthma; 791 households with 448 children and 551 adults with asthma events in the previous year. INTERVENTION: The program provides home environmental assessments and low-cost interventions to address asthma trigger-promoting conditions and asthma self-management. Conditions are reassessed 3 to 6 months after the initial visit. MAIN OUTCOME MEASURES: Program costs and estimated benefits from changes in asthma medication use, visits to the doctor for asthma, emergency department visits, and hospitalizations over a 12-month follow-up period. RESULTS: For the asthma event group, the per person savings for all medical encounters and medications filled was \$1083 per in-home asthma visit, and the average cost of the visit was \$302, for a benefit to program cost ratio of 3.58 and net benefit of \$781 per asthma visit. For the active asthma group, per person savings was \$613 per asthma visit, with a benefit to program cost ratio of 2.03 and net benefit of \$311. CONCLUSION: Low-intensity, home-based, environmental interventions for people with asthma decrease the cost of health care utilization. Greater reductions are realized when services are targeted toward people with more poorly controlled asthma. While low-intensity approaches may produce more modest benefits, they may also be more feasible to implement on a large scale. Health care payers, and public payers in particular, should consider expanding coverage, at least for patients with poorly controlled asthma or who may be at risk for poor asthma control, to include services that address triggers in the home environment.

Gruber, K. J., McKee-Huger, B., Richard, A., et al. (2016). "Removing asthma triggers and improving children's health: The Asthma Partnership Demonstration project." *Ann Allergy Asthma Immunol* **116**(5): 408-414.  
[https://www.annallergy.org/article/S1081-1206\(16\)30086-2/fulltext](https://www.annallergy.org/article/S1081-1206(16)30086-2/fulltext)

BACKGROUND: Studies have revealed the efficacy of home-based environmental interventions on reduction of asthma symptoms as a strategy for managing asthma in children. A focus on education and behavior change alone is generally too limited to reduce exposure to asthma triggers that exist because of adverse housing conditions. OBJECTIVE: To demonstrate that housing conditions as a focus of a health intervention should be considered more widely as an effective means of addressing serious health problems such as asthma. METHODS: Residences of 41 families of children identified with some of the highest rates of asthma-related hospital visits were assessed for the presence of asthma triggers. RESULTS: The intervention had a positive effect on lessening the effect of the child's asthma on the family's lives and activities. Reductions in frequency of negative effects of children's asthma on sleeping, job or work around the house, and family activity plans, fewer worries or concerns about children getting enough sleep and performing normal daily activities, and fewer adverse effects of children's asthma medications were reported. Reduced use of asthma medication, medication applications, and health visits were noted. Households with return visits had 50% lower hospital bills for childhood asthma treatment. CONCLUSION: Home environment conditions that lead to or exacerbate asthma may be reduced or eliminated by making minor repairs and introducing reasonable cleaning regimens that address sources of asthma triggers. This can produce greater awareness on the

part of families about the presence of asthma triggers and motivate future action to address the conditions associated with these triggers.

Higgins, J. C., Kiser, W. R., McClenathan, S., et al. (1998). "Influence of an interventional program on resource use and cost in pediatric asthma." *American Journal of Managed Care* **4**(10): 1465-1469, 1463 tabl.

Holley, S. et Walker, D. (2018). "Barriers and facilitators to self-management of asthma in adolescents: An interview study to inform development of a novel intervention." *Clinical & Experimental Allergy* **48**(8): 944-956. <https://onlinelibrary.wiley.com/doi/10.1111/cea.13141>

**BACKGROUND AND OBJECTIVE:** Despite literature that spans twenty years describing the barriers to asthma self-management in adolescents, successful, clinically based interventions to address this important issue are lacking. Given the limitations of some of the previous studies, we conducted a study that aimed to gain a broader insight into barriers and facilitators to self-management of asthma by adolescents, not just adherence to treatment, and triangulated their views with those of their parents and healthcare professionals. **METHODS:** Focus groups and interviews were conducted separately for 28 adolescents with asthma aged 12-18 years, 14 healthcare professionals and 12 parents. Focus groups and interviews were audio-recorded, and transcripts from each participant group were analysed separately using inductive thematic analysis. We triangulated the three perspectives by comparing themes that had emerged from each analysis. **RESULTS:** Adolescents', parents' and healthcare professionals' views were summarized into ten related themes that included forgetting and routines, knowledge, embarrassment and confidence, communication with healthcare professionals, triggers, support at school, apathy and taking responsibility. We found that adolescents, parents and healthcare professionals raised similar barriers and facilitators to self-management and our results provide further validation for previous studies. **CONCLUSION AND CLINICAL RELEVANCE:** Our study highlights that healthcare professionals may need to consider a range of psychological and contextual issues influencing adolescents' ability to effectively self-manage their asthma, in particular, how they implement treatment routines and the understanding that adolescents have of their condition and treatments. Crucially, healthcare professionals need to consider how this information is communicated and ensure they facilitate open, inclusive, two-way consultations. From this more comprehensive understanding, we have developed interventional strategies that healthcare professionals can utilize to empower adolescents to improve their asthma self-management.

Hsu, J., Wilhelm, N., Lewis, L., et al. (2016). "Economic Evidence for US Asthma Self-Management Education and Home-Based Interventions." *The Journal of Allergy and Clinical Immunology: In Practice* **4**(6): 1123-1134.e1127. <https://www.sciencedirect.com/science/article/pii/S2213219816301519>  
<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5117439/pdf/nihms789098.pdf>

The health and economic burden of asthma in the United States is substantial. Asthma self-management education (AS-ME) and home-based interventions for asthma can improve asthma control and prevent asthma exacerbations, and interest in health care-public health collaboration regarding asthma is increasing. However, outpatient AS-ME and home-based asthma intervention programs are not widely available; economic sustainability is a common concern. Thus, we conducted a narrative review of existing literature regarding economic outcomes of outpatient AS-ME and home-based intervention programs for asthma in the United States. We identified 9 outpatient AS-ME programs and 17 home-based intervention programs with return on investment (ROI) data. Most programs were associated with a positive ROI; a few programs observed positive ROIs only among selected populations (eg, higher health care utilization). Interpretation of existing data is limited by heterogeneous ROI calculations. Nevertheless, the literature suggests promise for sustainable opportunities to expand access to outpatient AS-ME and home-based asthma intervention programs in the United States. More definitive knowledge about how to maximize program benefit and sustainability could be gained through more controlled studies of specific populations and increased uniformity in economic assessments.



Huffaker, M. et Phipatanakul, W. (2014). "Introducing an environmental assessment and intervention program in inner-city schools." *J Allergy Clin Immunol* **134**(6): 1232-1237.  
[https://www.jacionline.org/article/S0091-6749\(14\)01320-7/pdf](https://www.jacionline.org/article/S0091-6749(14)01320-7/pdf)

Home-based environmental interventions have demonstrated clinical benefit for children with asthma. Although much is known about school-based exposures, few studies have comprehensively examined the role the school environment plays in asthma and how effectively changing the environment might reduce morbidity when adjusting for exposures in the home. This review summarizes the importance and common challenges of school-based environmental assessment and intervention studies linked to health effects. We focus on the key components of study development and the challenges and benefits to implementation.

Jonas, J. A., Leu, C. S. et Reznik, M. (2022). "A randomized controlled trial of a community health worker delivered home-based asthma intervention to improve pediatric asthma outcomes." *Journal of Asthma* **59**(2): 395-406.  
<https://www.tandfonline.com/doi/full/10.1080/02770903.2020.1846746>

**OBJECTIVE:** The objective of this study was to evaluate the effects of using Community Health Workers (CHWs) to deliver the home-based Wee Wheezers asthma education program on asthma symptoms among children with persistent asthma. **METHODS:** In this randomized controlled trial of 151 children aged 2-9 years with persistent asthma, we assigned 75 to the intervention and 76 to the control. The primary outcome was caregiver-reported asthma symptom days. Secondary outcomes included asthma-related healthcare utilization, caregivers' asthma knowledge, illness perception and management behaviors, MDI-spacer administration technique, and home environmental triggers. Outcomes were collected at baseline, 3, 6, 9 and 12 months. A repeated measurements analytic approach with generalized estimating equations was used. To account for missing data, multiple imputation methods were employed. **RESULTS:** At 3 and 6 months, improvement in symptom days was not significantly different between groups. However, at 9 and 12 months, the reduction in asthma symptom days was 2.15 and 2.31 days more respectively for those in the intervention group compared to the control. Improvements in MDI-spacer technique, knowledge and attitudes were significant throughout follow-up. Improvement in habits regarding MDI use was significant at 3 and 6 months, and asthma routines were improved at 3 months. However, there was no change in asthma-related healthcare utilization or home environmental triggers. **CONCLUSION:** Using CHWs to deliver a home-based asthma education program to caregivers of children with persistent asthma led to improvements in symptom days and several secondary outcomes. Expanding the use of CHWs to provide home-based interventions can help reduce disparities in children's health outcomes.

Kattan, M., Stearns, S. C., Crain, E. F., et al. (2005). "Cost-effectiveness of a home-based environmental intervention for inner-city children with asthma." *J Allergy Clin Immunol* **116**(5): 1058-1063.  
[https://www.jacionline.org/article/S0091-6749\(05\)01790-2/pdf](https://www.jacionline.org/article/S0091-6749(05)01790-2/pdf)

**BACKGROUND:** Exposure to indoor allergens contributes to increased asthma morbidity. The Inner-City Asthma Study, a randomized trial involving home environmental allergen and irritant remediation among children aged 6 through 11 years with moderate-to-severe asthma, successfully reduced asthma symptoms. A cost-effectiveness analysis can help stakeholders to evaluate the potential costs and benefits of adopting such a program. **OBJECTIVE:** We sought to assess the cost-effectiveness of the environmental intervention of the Inner-City Asthma Study. **METHODS:** Incremental cost-effectiveness ratios for a 2-year study period were calculated. Health outcome was measured as symptom-free days. Resource use measures included ambulatory visits, hospitalizations, and pharmaceutical use. CIs were obtained by using bootstrapping. **RESULTS:** The intervention, which cost \$1469 per family, led to statistically significant reductions in symptom days, unscheduled clinic visits, and use of beta-agonist inhalers. Over the year of the intervention and a year of follow-up, the intervention cost was \$27.57 per additional symptom-free day (95% CI, \$7.46-\$67.42). Subgroup analysis showed that targeting the intervention to selected high-risk subgroups did not reduce the incremental cost-effectiveness ratio. **CONCLUSIONS:** A targeted home-based environmental

intervention improved health and reduced service use in inner-city children with moderate-to-severe asthma. The intervention is cost-effective when the aim is to reduce asthma symptom days and the associated costs.

Kearney, G. D., Johnson, L. C., Xu, X., et al. (2014). "Eastern Carolina Asthma Prevention Program (ECAPP): An Environmental Intervention Study Among Rural and Underserved Children with Asthma in Eastern North Carolina." *Environ Health Insights* **8**: 27-37.

<https://journals.sagepub.com/doi/pdf/10.4137/EHI.S16430>

**OBJECTIVE:** Asthma is the most common chronic childhood condition affecting 6.3 million (US) children aged less than 18 years. Home-based, multi-component, environmental intervention studies among children with asthma have demonstrated to be effective in reducing asthma symptoms. In this study, a local hospital and university developed an environmental intervention research pilot project, Eastern Carolina Asthma Prevention Program (ECAPP), to evaluate self-reported asthma symptoms, breathing measurements, and number of asthma-related emergency department (ED) visits among low-income, minority children with asthma living in rural, eastern North Carolina. Our goal was to develop a conceptual model and demonstrate any asthma respiratory improvements in children associated with our home-based, environmental intervention. **METHODS:** This project used a single cohort, intervention design approach to compare self-reported asthma-related symptoms, breathing tests, and ED visits over a 6 month period between children with asthma in an intervention study group (n = 12) and children with asthma in a control study group (n = 7). The intervention study group received intense asthma education, three home visits, 2 week follow-up telephone calls, and environmental intervention products for reducing asthma triggers in the home. The control group received education at baseline and 2 week calls, but no intervention products. **RESULTS:** At the end of the study period, significant improvements were observed in the intervention group compared with the control group. Overall, the intervention group experienced a 58% (46 ± SD 26.9) reduction in self-reported asthma symptoms; 76% (34 ± SD 29.7) decrease in rescue medicine; 12% (145 ± SD 11.3) increase in controller medicine; 37% decrease in mean exhaled nitric oxide levels and 33% fewer ED asthma-related visits. **CONCLUSION:** As demonstrated, a combination of efforts appeared effective for improving asthma respiratory symptoms among children in the intervention group. ECAPP is a low cost pilot project that could readily be adapted and expanded into other communities throughout eastern North Carolina. Future efforts could include enhanced partnerships between environmental health professionals at local health departments and pediatric asthma programs at hospitals to carry out ECAPP.

Kelly, C. Z., Morrow, A. L., Shults, J., et al. (2000). "Outcomes evaluation of a comprehensive intervention program for asthmatic children enrolled in medicaid." *Pediatrics* **105**(5): 1029-1035, 1024 tabl., 1021 fig.

<https://publications.aap.org/pediatrics/article-abstract/105/5/1029/66018/Outcomes-Evaluation-of-a-Comprehensive?redirectedFrom=fulltext>

Krieger, J., Song, L. et Philby, M. (2015). "Community health worker home visits for adults with uncontrolled asthma: the HomeBASE Trial randomized clinical trial." *JAMA Intern Med* **175**(1): 109-117.

<https://jamanetwork.com/journals/jamainternalmedicine/articlepdf/1939375/loi140121.pdf>

**IMPORTANCE:** Asthma is often poorly controlled. Home visitation by community health workers (CHWs) to improve control among adults has not been adequately evaluated. **OBJECTIVE:** To test the hypothesis that CHW home visits for adults with uncontrolled asthma improve outcomes relative to usual care. **DESIGN, SETTING, AND PARTICIPANTS:** Randomized parallel group study with 1-year follow-up, conducted 2008 through 2011 at homes of low-income adults aged 18 to 65 years with uncontrolled asthma living in King County, Washington. **INTERVENTIONS:** The CHWs provided a mean of 4.9 home visits during a 1-year period to assess asthma control, self-management, and home environment and to support asthma self-management practices. **MAIN OUTCOMES AND MEASURES:** Primary prespecified outcomes were symptom-free days (number of 24-hour periods in prior 2 weeks without asthma symptoms), asthma-related quality of life (Mini Asthma Quality of Life Questionnaire), and asthma-related unscheduled health care use. **RESULTS:** Of 463 individuals who completed

eligibility screening, 443 were eligible, 366 participated (177 in intervention and 189 in control groups), and 333 completed the study (91%). The intervention group had significantly greater increases in mean symptom-free days per 2 weeks (2.02 [95% CI, 0.94-3.09];  $P < .001$ ) and quality of life (0.50 [95% CI, 0.28-0.71] points;  $P < .001$ ) relative to the control group, adjusted for age, sex, race/ethnicity, and education level. The number needed to treat to increase symptom-free days by 2 days per 2 weeks was 7.4 and to improve quality of life by 0.5 points was 2.6. Mean urgent health care use episodes in the past 12 months decreased significantly and similarly in both groups, from a mean of 3.46 to 1.99 episodes in the intervention group (mean change, -1.47 [95% CI, -2.28 to -0.67];  $P < .001$ ) and from a mean of 3.30 to 1.96 episodes in the control group (mean change, -1.34 [95% CI, -2.00 to -0.72];  $P < .001$ ) ( $P = .83$  comparing groups). **CONCLUSIONS AND RELEVANCE:** The provision of in-home asthma self-management support by CHWs to low-income adults with uncontrolled asthma improves asthma control and quality of life but not unscheduled health care use. Additional studies are needed to confirm these findings and determine the value of wider implementation of this approach. **TRIAL REGISTRATION:** [clinicaltrials.gov](https://clinicaltrials.gov) Identifier: NCT01783028.

Krieger, J. W., Takaro, T. K., Song, L., et al. (2005). "The Seattle-King County Healthy Homes Project: A Randomized, Controlled Trial of a Community Health Worker Intervention to Decrease Exposure to Indoor Asthma Triggers." *American journal of public health* **95**(4): 652-659.

<https://doi.org/10.2105/AJPH.2004.042994>

<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC1449237/pdf/0950652.pdf>

**Objectives.** We assessed the effectiveness of a community health worker intervention focused on reducing exposure to indoor asthma triggers. **Methods.** We conducted a randomized controlled trial with 1-year follow-up among 274 low-income households containing a child aged 4-12 years who had asthma. Community health workers provided in-home environmental assessments, education, support for behavior change, and resources. Participants were assigned to either a high-intensity group receiving 7 visits and a full set of resources or a low-intensity group receiving a single visit and limited resources. **Results.** The high-intensity group improved significantly more than the low-intensity group in its pediatric asthma caregiver quality-of-life score ( $P = .005$ ) and asthma-related urgent health services use ( $P = .026$ ). Asthma symptom days declined more in the high-intensity group, although the across-group difference did not reach statistical significance ( $P = .138$ ). Participant actions to reduce triggers generally increased in the high-intensity group. The projected 4-year net savings per participant among the high-intensity group relative to the low-intensity group were \$189-\$721. **Conclusions.** Community health workers reduced asthma symptom days and urgent health services use while improving caregiver quality-of-life score. Improvement was greater with a higher-intensity intervention.

Lantz, P. M., Miller, G., Rhyan, C. N., et al. (2018). ""Pay for Success" Financing and Home-Based Multicomponent Childhood Asthma Interventions: Modeling Results From the Detroit Medicaid Population." *Milbank Q* **96**(2): 272-299.

[https://deepblue.lib.umich.edu/bitstream/handle/2027.42/144303/milq12325\\_am.pdf?sequence=1](https://deepblue.lib.umich.edu/bitstream/handle/2027.42/144303/milq12325_am.pdf?sequence=1)

**Policy Points:** The Pay for Success (PFS) financing approach has potential for scaling the implementation of evidence-based prevention interventions in Medicaid populations, including a range of multicomponent interventions for childhood asthma that combine home environment risk mitigation with medical case management. Even though this type of intervention is efficacious and cost-saving among high-risk children with asthma, the main challenges for implementation in a PFS context include legal and regulatory barriers to capturing federal Medicaid savings and using them as a source of private investor repayment. Federal-level policy change and guidance are needed to support PFS financing of evidence-based interventions that would reduce expensive acute care among Medicaid enrollees. **CONTEXT:** Pay for Success has emerged as a potential financing mechanism for innovative and cost-effective prevention programs. In the PFS model, interventions that provide value to the public sector are implemented with financing from private investors who receive a payout from the government only if the metrics identified in a performance-based contract are met. In this nascent field, little has been written about the potential for and challenges of PFS initiatives that produce

savings and/or value for Medicaid. METHODS: In order to elucidate the basic economics of a PFS intervention in a Medicaid population, we modeled the potential impact of an evidence-based multicomponent childhood asthma intervention among low-income children enrolled in Medicaid in Detroit. We modeled outcomes and a comparative benefit-cost analysis in 3 risk-based target groups: (1) all children with an asthma diagnosis; (2) children with an asthma-related emergency department visit in the past year; and (3) children with an asthma-related hospitalization in the past year. Modeling scenarios for each group produced estimates of potential state and federal Medicaid savings for different types or levels of investment, the time frames for savings, and some overarching challenges. FINDINGS: The PFS economics of a home-based asthma intervention are most viable if it targets children who have already experienced an expensive episode of asthma-related care. In a 7-year demonstration, the overall (undiscounted) modeled potential savings for Group 2 were \$1.4 million for the federal Medicaid and \$634,000 for the state Medicaid programs, respectively. Targeting children with at least 1 hospitalization in the past year (Group 3) produced estimated potential savings of \$2.8 million to federal Medicaid and \$1.3 million to state Medicaid. However, current Medicaid rules and regulations pose significant challenges for capturing federal Medicaid savings for PFS payouts. CONCLUSIONS: A multicomponent intervention that provides home remediation and medical case management to high-risk children with asthma has significant potential for PFS financing in urban Medicaid populations. However, there are significant administrative and payment challenges, including the limited ability to capture federal Medicaid savings and to use them as a source of investor repayment. Without some policy reform and clear guidance from the federal government, the financing burden of PFS outcome payments will be on the state Medicaid program or some other state-level funding source.

Largo, T. W., Borgianni, M., Wisinski, C. L., et al. (2011). "Healthy Homes University: a home-based environmental intervention and education program for families with pediatric asthma in Michigan." *Public Health Rep* **126 Suppl 1**(Suppl 1): 14-26.  
<https://journals.sagepub.com/doi/pdf/10.1177/00333549111260S104>

Environmental conditions within the home can exacerbate asthmatic children's symptoms. To improve health outcomes among this group, we implemented an in-home environmental public health program-Healthy Homes University--for low-income families in Lansing, Michigan, from 2005 to 2008. Families received four visits during a six-month intervention. Program staff assessed homes for asthma triggers and subsequently provided products and services to reduce exposures to cockroaches, dust mites, mold, tobacco smoke, and other triggers. We also provided asthma education that included identification of asthma triggers and instructions on specific behaviors to reduce exposures. Based on self-reported data collected from 243 caregivers at baseline and six months, the impact of asthma on these children was substantially reduced, and the proportion who sought acute unscheduled health care for their asthma decreased by more than 47%.

Margellos-Anast, H., Gutierrez, M. A. et Whitman, S. (2012). "Improving asthma management among African-American children via a community health worker model: findings from a Chicago-based pilot intervention." *J Asthma* **49**(4): 380-389.  
<https://www.tandfonline.com/doi/full/10.3109/02770903.2012.660295>

OBJECTIVES: Asthma affects 25-30% of children living in certain disadvantaged Chicago neighborhoods, a rate twice the national prevalence (13%). Children living in poor, minority communities tend to rely heavily on the emergency department (ED) for asthma care and are unlikely to be properly medicated or educated on asthma self-management. A pilot project implemented and evaluated a community health worker (CHW) model for its effectiveness in reducing asthma morbidity and improving the quality of life among African-American children living in disadvantaged Chicago neighborhoods. METHODS: Trained CHWs from targeted communities provided individualized asthma education during three to four home visits over 6 months. The CHWs also served as liaisons between families and the medical system. Seventy children were enrolled into the pilot phase between 15 November 2004 and 15 July 2005, of which 96% were insured by Medicaid and 54% lived with a smoker. Prior to starting, the study was approved by an institutional review board. Data on 50 children

(71.4%) who completed the entire 12-month evaluation phase were analyzed using a before and after study design. RESULTS: Findings indicate improved asthma control. Specifically, symptom frequency was reduced by 35% and urgent health resource utilization by 75% between the pre- and post-intervention periods. Parental quality of life also improved by a level that was both clinically and statistically significant. Other important outcomes included improved asthma-related knowledge, decreased exposure to asthma triggers, and improved medical management. The intervention was also shown to be cost-effective, resulting in an estimated \$5.58 saved per dollar spent on the intervention. CONCLUSIONS: Findings suggest that individualized asthma education provided by a trained, culturally competent CHW is effective in improving asthma management among poorly controlled, inner-city children. Further studies are needed to affirm the findings and assess the model's generalizability.

Marshall, E. T., Guo, J., Flood, E., et al. (2020). "Home Visits for Children With Asthma Reduce Medicaid Costs." *Prev Chronic Dis* **17**: E11.

<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7021461/pdf/PCD-17-E11.pdf>

We conducted a multicomponent, low-cost, home intervention for children with uncontrolled asthma, the Reducing Ethnic/Racial Asthma Disparities in Youth (READY) study, to evaluate its effect on health outcomes and its return on investment. From 2009 through 2014 the study enrolled 289 children aged 2 to 13 years with uncontrolled asthma and their adult caregivers in Boston and Springfield, Massachusetts. Community health workers (CHWs) led in-home asthma management and environmental trigger remediation education over 5 visits spanning 6 months. Asthma health outcomes and indoor environment data were collected via survey, and health use costs were accessed through Massachusetts Medicaid (MassHealth). Results showed significant improvements in asthma control, health care use, and environmental trigger reduction and a positive return on investment (1.34) for participants who had 2 or more emergency department visits 1 year prior to the first home visit. The CHW asthma home visiting intervention improved trigger management, clinical outcomes, and Medicaid cost savings, demonstrating that asthma home visits improve health quality and reduce costs.

Martin, M. A., Hernández, O., Naureckas, E., et al. (2006). "Reducing home triggers for asthma: the Latino community health worker approach." *J Asthma* **43**(5): 369-374.

<https://www.tandfonline.com/doi/full/10.1080/02770900600709781>

This study assessed the ability of a community health worker asthma intervention to change home asthma triggers. A total of 56 children and 47 adults with asthma were enrolled. Home trigger scores for the children averaged 2.8 at the initial home visit and then 2.3, 2.1, and 2.0 at 3, 6, and 12 months. Home trigger scores for the adults showed a similar trend. Every home visit was associated with a 0.32 reduction in home trigger score ( $p < 0.01$ ) for children and a 0.41 reduction ( $p < 0.01$ ) for adults. This intervention shows promise as a way to reduce asthma triggers in urban low-income Latino communities.

Martin, M. A., Mosnaim, G. S., Olson, D., et al. (2015). "Results from a community-based trial testing a community health worker asthma intervention in Puerto Rican youth in Chicago." *J Asthma* **52**(1): 59-70.

<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8341398/pdf/nihms-1726604.pdf>

Abstract Objective: Puerto Rican children suffer disproportionately from asthma. Project CURA tested the efficacy of a community health worker (CHW) intervention to improve use of inhaled corticosteroids (ICS) and reduce home asthma triggers in Puerto Rican youth in Chicago. METHODS: This study employed a behavioral randomized controlled trial design with a community-based participatory research approach. Medications and technique were visually assessed; adherence was determined using dose counters. Home triggers were assessed via self-report, visual inspection and salivary cotinine. All participants received education on core asthma topics and self-management skills. Participants in the CHW arm were offered home education by the CHW in four visits over four months. The attention control arm received four newsletters covering the same topics. RESULTS:

While most of the participants had uncontrolled persistent asthma, <50% had ICS at baseline. In the CHW arms, 67% of participants received the full four-visit intervention. In the Elementary school cohort (n=51), the CHW arm had lower odds of having an ICS (OR=0.2; p=0.02) at 12-months; no differences were seen in other outcomes between arms at any time point. The only significant treatment arm difference in the high school cohort (n=50) was in inhaler technique where the CHW arm performed 18.0% more steps correct at five months (p<0.01) and 14.2% more steps correct at 12 months (p<0.01). CONCLUSIONS: While this CHW intervention did not increase the number of participants with ICS or reduce home asthma triggers, important lessons were learned including challenges to CHW intervention fidelity and the need for CHWs to partner with clinical providers.

Martin, M. A., Pugach, O., Mosnaim, G., et al. (2021). "Community Health Worker Asthma Interventions for Children: Results From a Clinically Integrated Randomized Comparative Effectiveness Trial (2016–2019)." *Pediatr Pulmonol* **111**(7): 1328-1337.

<https://onlinelibrary.wiley.com/doi/10.1002/ppul.25187>

**Objectives.** To compare asthma control for children receiving either community health worker (CHW) or certified asthma educator (AE-C) services. **Methods.** The Asthma Action at Erie Trial is a comparative effectiveness trial that ran from 2016 to 2019 in Cook County, Illinois. Participants (aged 5–16 years with uncontrolled asthma) were randomized to 10 home visits from clinically integrated asthma CHWs or 2 in-clinic sessions from an AE-C. **Results.** Participants (n = 223) were mainly Hispanic (85%) and low-income. Both intervention groups showed significant improvement in asthma control scores over time. Asthma control was maintained after interventions ended. The CHW group experienced a greater improvement in asthma control scores. One year after intervention cessation, the CHW group had a 42% reduction in days of activity limitation relative to the AE-C group (b = 0.58; 95% confidence interval = 0.35, 0.96). **Conclusions.** Both interventions were associated with meaningful improvements in asthma control. Improvements continued for 1 year after intervention cessation and were stronger with the CHW intervention. **Public Health Implications.** Clinically integrated asthma CHW and AE-C services that do not provide home environmental remediation equipment may improve and sustain asthma control.

Meghea, C. I., Li, B., Zhu, Q., et al. (2013). "Infant health effects of a nurse-community health worker home visitation programme: a randomized controlled trial." *Child Care Health Dev* **39**(1): 27-35.

<https://onlinelibrary.wiley.com/doi/10.1111/j.1365-2214.2012.01370.x>

**BACKGROUND:** Home visiting is supported as a way to improve child health and development. Home visiting has been usually provided by nurses or community health workers (CHWs). Few studies compared the child health advantages of a nurse-CHW team approach over nurse prenatal and postnatal home visiting. **METHODS:** A randomized trial was conducted with Medicaid-insured pregnant women in Kent County, Michigan. Pregnant women were assigned to a team intervention including nurse-CHW home visitation, or standard community care (CC) including nurse home visitation. Morbidity was assessed in 530 infants over their first 12 months of life from medical claims and reported by the mother. **RESULTS:** There were no differences in overall child health between the nurse-CHW intervention and the CC arm over the first year of life. There were fewer mother-reported asthma/wheezing/croup diagnostics in the team intervention group among infants whose mothers have low psychosocial resources (13% vs. 27%, P = 0.01; adjusted OR = 0.4, P = 0.01). There were no differences in diagnosed asthma/wheezing/croup documented by medical claims. There were no differences in immunizations, hospitalizations and ear infections. **CONCLUSIONS:** There was no strong evidence that infant health was improved by the addition of CHWs to a programme of CC that included nurse home visitation. Targeting such interventions at common health problems of infancy and childhood or at diagnosed chronic conditions may prove more successful.

Montaudié-Dumas, I., Giovannini-Chami, L., Debai, C., et al. (2013). "[Impact on the indoor environment of allergic children of the medical counselor on indoor environment, after two successive visits at 6 months interval]." *Arch Pediatr* **20**(12): 1288-1295.

**BACKGROUND:** The aim of this retrospective study was to assess the impact of a medical indoor environment counselor (MIEC) on the allergic child's indoor home environment, as well as the real-life experience of patients' families. **METHODS:** We enrolled 50 children (age, 4-18 years) with allergic respiratory illness (96 % asthmatics) from March 2011 to January 2012. During the first visit, the CMEI gave advice according to the results of the assessment. Home environmental exposures were assessed 6 months later. A satisfaction questionnaire was completed by the parents. **RESULTS:** We found a significant decrease in the presence of house dust mites ( $P = 0.0047$ ), humidity, and molds ( $P = 0.0047$ ) as well as volatile organic compounds ( $P = 0.0047$ ). Smoking habits were not significantly changed ( $P = 0.083$ ), nor was the presence of domestic pets ( $P = 0.3173$ ). Over 74 % of the families were very satisfied with the CMEI's intervention. **DISCUSSION:** According to de Blay's study, a home visit by the MEIC increased compliance with mite reduction. The intervention to advise parents of asthmatic children on the risks of passive smoking was ineffective in reducing their children's exposure to environmental tobacco smoke. The advice given by the MEIC was better understood by the patients than that expressed by the medical teams. **CONCLUSION:** A targeted home-based environmental intervention increased the compliance to mite, humidity, and mold reduction. The role of the CMEI will undoubtedly develop: follow-up studies are necessary to justify their activity (cost-efficacy ratio of their intervention).

Morgan, W. J., Crain, E. F., Gruchalla, R. S., et al. (2004). "Results of a home-based environmental intervention among urban children with asthma." *N Engl J Med* **351**(11): 1068-1080.

<https://www.nejm.org/doi/pdf/10.1056/NEJMoa032097?articleTools=true>

**BACKGROUND:** Children with asthma who live in the inner city are exposed to multiple indoor allergens and environmental tobacco smoke in their homes. Reductions in these triggers of asthma have been difficult to achieve and have seldom been associated with decreased morbidity from asthma. The objective of this study was to determine whether an environmental intervention tailored to each child's allergic sensitization and environmental risk factors could improve asthma-related outcomes. **METHODS:** We enrolled 937 children with atopic asthma (age, 5 to 11 years) in seven major U.S. cities in a randomized, controlled trial of an environmental intervention that lasted one year (intervention year) and included education and remediation for exposure to both allergens and environmental tobacco smoke. Home environmental exposures were assessed every six months, and asthma-related complications were assessed every two months during the intervention and for one year after the intervention. **RESULTS:** For every 2-week period, the intervention group had fewer days with symptoms than did the control group both during the intervention year (3.39 vs. 4.20 days,  $P < 0.001$ ) and the year afterward (2.62 vs. 3.21 days,  $P < 0.001$ ), as well as greater declines in the levels of allergens at home, such as *Dermatophagoides farinae* (Der f1) allergen in the bed ( $P < 0.001$ ) and on the bedroom floor ( $P = 0.004$ ), *D. pteronyssinus* in the bed ( $P = 0.007$ ), and cockroach allergen on the bedroom floor ( $P < 0.001$ ). Reductions in the levels of cockroach allergen and dust-mite allergen (Der f1) on the bedroom floor were significantly correlated with reduced complications of asthma ( $P < 0.001$ ). **CONCLUSIONS:** Among inner-city children with atopic asthma, an individualized, home-based, comprehensive environmental intervention decreases exposure to indoor allergens, including cockroach and dust-mite allergens, resulting in reduced asthma-associated morbidity.

Nam, J. Y., Park, J. H., Hsu, J., et al. (2016). "Economic Evidence for US Asthma Self-Management Education and Home-Based Interventions." *Asia Pac J Public Health* **4**(6): 1123-1134.e1127.

<https://journals.sagepub.com/doi/10.1177/1010539520920524>

The health and economic burden of asthma in the United States is substantial. Asthma self-management education (AS-ME) and home-based interventions for asthma can improve asthma control and prevent asthma exacerbations, and interest in health care-public health collaboration regarding asthma is increasing. However, outpatient AS-ME and home-based asthma intervention programs are not widely available; economic sustainability is a common concern. Thus, we conducted a narrative review of existing literature regarding economic outcomes of outpatient AS-ME and home-based intervention programs for asthma in the United States. We identified 9 outpatient AS-ME

programs and 17 home-based intervention programs with return on investment (ROI) data. Most programs were associated with a positive ROI; a few programs observed positive ROIs only among selected populations (eg, higher health care utilization). Interpretation of existing data is limited by heterogeneous ROI calculations. Nevertheless, the literature suggests promise for sustainable opportunities to expand access to outpatient AS-ME and home-based asthma intervention programs in the United States. More definitive knowledge about how to maximize program benefit and sustainability could be gained through more controlled studies of specific populations and increased uniformity in economic assessments.

Naufal, G. et Naiser, E. (2022). "A Cost-Effectiveness Analysis of a Community Health Worker Led Asthma Education Program in South Texas." *J Asthma Allergy* **15**: 547-556.

<https://www.dovepress.com/getfile.php?fileID=80527>

**PURPOSE:** This paper examines the cost-effectiveness of an asthma-related education program. **MATERIALS AND METHODS:** Using a pre and post approach, the paper calculates first changes in cost due to variations in outcome (from baseline to follow-up). We also estimate cost-effectiveness ratios for each of the eight outcomes (numbers of asthma attacks, hospital, and ER visits, and physical and emotional health, and activity levels of both children and family members). **RESULTS:** The intervention saved the household around \$36 per day. Cost-effectiveness ratios ranged between less than \$2.2 for children and family members' physical and emotional health, and activity levels to between \$4.1 and \$82.8 for asthma attacks and hospital visits. Cost-benefit results showed minimal benefit due to conservative estimates. We could not quantify the economic value of physical and emotional health improvement seen based on the measures. **CONCLUSION:** Cost savings and ratios suggest that such a program could reduce health disparities due to improved knowledge, decreasing exposure to asthma triggers, enhancing health outcomes, and improving the quality of life of the children with asthma and their whole family.

Nguyen, K. H., Boulay, E. et Peng, J. (2011). "Quality-of-Life and Cost-Benefit Analysis of a Home Environmental Assessment Program in Connecticut." *Journal of Asthma* **48**(2): 147-155.

<https://www.tandfonline.com/doi/full/10.3109/02770903.2010.535881>

**Background.** The National Asthma Education Prevention Program's (NAEPP) Expert Panel Report 3 (EPR3) guidelines have stressed the need for environmental control measures for asthma, but there is limited evidence of their efficacy. **Objective.** To examine the effectiveness of an in-home asthma intervention program for children and adults in Connecticut, we conducted a panel study to analyze quality-of-life indicators for asthmatic patients and the cost--benefit relationship in preventive care versus acute care. **Methods.** The Asthma Indoor Reduction Strategies (AIRS) program was developed to reduce acute asthma episodes and improve asthma control through patient education and a home environmental assessment. Follow-up was conducted at 2-week, 3-month, and 6-month intervals. Measured quality-of-life indicators included number of unscheduled acute care visits, days absent from school//work due to asthma, times rescue inhaler used, and number of symptom-free days. Repeated measures analysis of variance (ANOVA) was used to determine whether significant differences exist in quality-of-life indicators at follow-up compared to that at the initial visit. **Cost--benefit analysis** was conducted by tabulating costs associated with physician office visits and emergency department (ED) visits due to asthma for children and adults separately. **Results.** Twenty percent of participants in the program met the criteria for well-controlled asthma, 16%% for not well-controlled asthma, and 64%% for very poorly controlled asthma. At 6 months follow-up, the mean number of unscheduled acute care visits, days absent from school//work due to asthma, and times rescue inhaler used in the past week decreased by 87%%, 82%%, and 74%%, respectively, whereas the mean number of symptom-free days increased by 27%% compared to the initial visit. Furthermore, the percent of participants with very poorly controlled asthma decreased from 64%% at initial visit to 13%% at 6 months follow-up. All changes were statistically significant at  $p < 0.05$ . A net savings of \$26,720 per 100 participants was estimated at 6 months follow-up due to decreases in unscheduled acute care visits for adults and children. **Conclusion.** Significant improvement in quality-of-life and



decreases in healthcare resource utilization and costs were found after implementation of the AIRS program in Connecticut.</p></div>
<div>
<p>Otim, M. E., Jayasinha, R., Forbes, H., et al. (2015). "Building evidence for peer-led interventions: assessing the cost of the Adolescent Asthma Action program in Australia." *Aust J Prim Health* **21**(4): 438-443.  
<a href="https://www.publish.csiro.au/PY/PY14066">https://www.publish.csiro.au/PY/PY14066</a></p></div>
<div>
<p>Asthma is the most common chronic illness among adolescents in Australia. Aboriginal and Torres Strait Islander adolescents, in particular, face substantial inequalities in asthma-related outcomes. Triple A (Adolescent Asthma Action) is a peer-led education intervention, which aims to improve asthma self-management and reduce the uptake of smoking among adolescents. The aim of this study was to determine the cost of implementing the Triple A program in Australia. Standard economic costing methods were used. It involved identifying the resources that were utilised (such as personnel and program materials), measuring them and then valuing them. We later performed sensitivity analysis so as to identify the cost drivers and a stress test to test how the intervention can perform when some inputs are lacking. Results indicate that the estimated cost of implementing the Triple A program in five schools was \$41060, assuming that the opportunity cost of all the participants and venues was accounted for. This translated to \$8212 per school or \$50 per target student. From sensitivity analysis and a stress test, it was identified that the cost of the intervention (in practice) was \$14 per student. This appears to be a modest cost, given the burden of asthma. In conclusion, the Triple A program is an affordable intervention to implement in high schools. The potential asthma cost savings due to the program are significant. If the Triple A program is implemented nation-wide, the benefits would be substantial.</p></div>
<div>
<p>Parker, E. A., Israel, B. A., Robins, T. G., et al. (2008). "Evaluation of Community Action Against Asthma: a community health worker intervention to improve children's asthma-related health by reducing household environmental triggers for asthma." *Health Educ Behav* **35**(3): 376-395.  
<a href="https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4676080/pdf/nihms742124.pdf">https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4676080/pdf/nihms742124.pdf</a></p></div>
<div>
<p>This article describes the evaluation of a community-based participatory research (CBPR) community health worker (CHW) intervention to improve children's asthma-related health by reducing household environmental triggers for asthma. After randomization to an intervention or control group, 298 households in Detroit, Michigan, with a child, aged 7 to 11, with persistent asthma symptoms participated. The intervention was effective in increasing some of the measures of lung function (daily nadir Forced Expiratory Volume at one second [ $p = .03$ ] and daily nadir Peak Flow [ $p = .02$ ]), reducing the frequency of two symptoms ("cough that won't go away," "coughing with exercise"), reducing the proportion of children requiring unscheduled medical visits and reporting inadequate use of asthma controller medication, reducing caregiver report of depressive symptoms, reducing concentrations of dog allergen in the dust, and increasing some behaviors related to reducing indoor environmental triggers. The results suggest a CHW environmental intervention can improve children's asthma-related health, although the pathway for improvement is complex.</p></div>
<div>
<p>Penzias, R. E., Sanabia, V., Bhaumik, U., et al. (2019). "Parent experiences with a nurse-supervised community health worker asthma home-visiting program." *J Asthma* **56**(12): 1314-1324.  
<a href="https://www.tandfonline.com/doi/full/10.1080/02770903.2018.1536144">https://www.tandfonline.com/doi/full/10.1080/02770903.2018.1536144</a></p></div>
<div>
<p>Objective: This study seeks to identify helpful components of a nurse-supervised Community Health Worker (CHW) asthma home-visiting program, obtain feedback from parents and families about their experiences, and receive suggestions for new services that the program could provide. Methods: Likert scale ratings and semi-structured qualitative interviews were conducted with parents who were selected from a representative sample and previously participated in the program. Five-point Likert scale ratings from 1 (not helpful) to 5 (very helpful) were obtained for 11 program components. Interviews were analyzed using a grounded theory participatory approach. Data were analyzed and themes were identified by two different coders using Dedoose software. Results: A total of 22 participants were enrolled and 20 participants completed Likert scale ratings and qualitative</p></div>
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<p>Page 113 sur 129</p></div>
<div>
<p><a href="http://www.irdes.fr/documentation/syntheses-et-dossiers-bibliographiques.html">www.irdes.fr/documentation/syntheses-et-dossiers-bibliographiques.html</a>  
<a href="http://www.irdes.fr/documentation/syntheses/le-fardeau-de-l-asthme.pdf">www.irdes.fr/documentation/syntheses/le-fardeau-de-l-asthme.pdf</a>  
<a href="http://www.irdes.fr/documentation/syntheses/le-fardeau-de-l-asthme.epub">www.irdes.fr/documentation/syntheses/le-fardeau-de-l-asthme.epub</a></p></div>

interviews. Likert scale ratings (mean standard deviation [SD]) show that program strengths include asthma education (4.75 [0.55]), supplies (4.65 [0.99]), help with housing conditions (3.94 [1.56]), pest management (3.79 [1.69]) and greater access to community resources (3.70 [1.30]). The ratings suggest that families need more help with other social determinants of health, such as school, lack of enough money or food, and mental health and behavioral concerns (3.05 [1.78]). Interviews echoed these ratings and revealed several themes about family and parental stress, children's activity limitations, desire for outreach after the 12-month intervention, a need for help with other social determinants and more emotional support. Conclusions: This study shows that the program was well received and reveals the importance of addressing social determinants of health and behavioral health concerns.

Phan, H. T., Vu, G. V., Vu, G. T., et al. (2020). "Global Mapping of Research Trends on Interventions to Improve Health-Related Quality of Life in Asthma Patients." International Journal of Environmental Research and Public Health **17**(10).

<Go to ISI>://WOS:000539300900197

[https://mdpi-res.com/d\\_attachment/ijerph/ijerph-17-03540/article\\_deploy/ijerph-17-03540.pdf?version=1589875115](https://mdpi-res.com/d_attachment/ijerph/ijerph-17-03540/article_deploy/ijerph-17-03540.pdf?version=1589875115)

Globally, approximately 335 million people are being affected by asthma. Given that asthma is a chronic airway condition that cannot be cured, the disease negatively impacts physical health and results in losses of productivity of people experiencing asthma, leading to decrease in quality of life. This study aims at demonstrating the research trends worldwide and identifying the research gaps in interventions for improving quality of life of patients with asthma. Bibliometric approach and content analysis, which can objectively evaluate the productivity and research landscapes in this field, were utilized. In this study, we systematically quantified the development of research landscapes associated with interventions for improving quality of life of people experiencing asthma. Along with the gradual growth in the number of publications, these research topics have relatively expanded in recent years. While the understanding of the pathophysiology, diagnosis and treatment of asthma has been well-established, recent research has showed high interest in the control and management of asthma. Findings of this study suggest the need for more empirical studies in developing countries and further investigation into the effects of environment factors on asthma outcomes, as well as the economic burden of asthma.

Plich, A. et Abraham, T. G. (2019). "Combining pharmacy expertise with asthma educator certification: assessing the impact on inner-city asthma patients." BMC Health Serv Res **56**(8): 891-896.

<https://bmchealthservres.biomedcentral.com/track/pdf/10.1186/s12913-016-1482-7.pdf>

Objective: Asthma is one of the major causes of hospital readmissions in the South Bronx. The goal of this study was to assess the impact of asthma education provided by registered pharmacists with asthma educator certification (AE-C), on medication adherence and hospitalizations/Emergency Department (ED) visits. Methods: This was a retrospective chart review of patients seen in the pulmonary clinic from October 2014 to August 2015 for asthma education by AE-C pharmacists. Medical records were reviewed over an 18-month period - 9 months before and after the initial asthma education session. Data obtained included adherence to asthma controller inhalers based on pharmacy refill claims, asthma control using asthma control test (ACT) scores and asthma-related hospitalizations or ED visits within 30 days of asthma education. Pre-education data served as the pre-intervention group data and post-education data served as the post-intervention group data, allowing each patient to serve as their own control. Results: We found a statistically significant improvement in average medication adherence, i.e. asthma controller inhaler fills at pharmacy (46.3% vs 67.9%, p-value <0.001) and asthma control (15.71% vs 56.38%, p-value <0.001) between the pre-intervention and the post-intervention groups. Additionally, a lower hospitalization/ED utilization rate (31.2% vs 6.38%, p-value <0.001) was observed in the post-intervention group within 30 days of education. Conclusions: Asthma education provided by AE-C pharmacists had a positive impact on asthma care in our inner-city community. Improving medication adherence and asthma control as well as decreasing hospital utilization could potentially decrease health care costs in addition to improving quality of life.

Polivka, B. J., Chaudry, R. V., Crawford, J., et al. (2011). "Impact of an Urban Healthy Homes Intervention." *Journal of Environmental Health* **73**(9): 16-21.  
<http://www.jstor.org/stable/26329216>

[In the study described in this article, the authors evaluated the impact of an urban Healthy Homes intervention that included educational home visits. Their one-group, pre-post design used a structured interview at baseline and postintervention. The sample (N = 84) was comprised of low-income children younger than 18 years of age with an asthma diagnosis or with an asthmatic mother. Children were primarily male (62%), ≤10 years old (74%), and lived in a single family home (69%) with moisture (61%). Interventions included a personalized action plan, education, demonstrations, and home remediation as needed. Significant post-intervention decreases occurred in reported asthma symptoms for the child, school days missed, caregiver work days missed, and emergency department/urgent care center visits. Caregiver self-efficacy and quality of life increased significantly. The comprehensive home visitation intervention program effectively impacted asthma symptoms, lost school and work days, emergency use of the health care system, and improved caregiver quality of life and self-efficacy.]

Ramsay, J., Schwindt, T., Nguyen, T., et al. (2018). "Translating a Proven Pediatric Healthy Homes Asthma Intervention to Adults." *J Asthma Allergy* **19**(2): 222-232.  
<https://www.dovepress.com/getfile.php?fileID=80527>

Asthma is a serious public health concern, disproportionately affecting urban, minority populations. Chicago's West and Southwest sides are among the most burdened by asthma and environmental conditions that exacerbate asthma. Home-based, community health worker (CHW)-led interventions have repeatedly demonstrated effectiveness in addressing pediatric asthma. However, evidence of such interventions among adults is limited. Helping Chicago's Westside Adults Breathe and Thrive is a longitudinal cohort study that assesses the effectiveness of a CHW-led asthma and healthy homes intervention for adults. One of the first of its kind, the program aims to improve asthma control and quality of life among adults with poorly controlled asthma. This article provides a framework for implementing the intervention from start to finish. CHWs make five or six home visits over the course of 12 months, providing comprehensive and individualized asthma education to study participants. They work closely with participants to conduct home environmental assessments, collaboratively developing techniques to eliminate or avoid asthma triggers. They also assist with smoking cessation, comorbidities, and health system navigation. Between December 1, 2013, and August 31, 2015, 202 participants enrolled in the program. This article reports on successes, challenges, and recommendations from the program's first 21 months of operation.

Reddy, A. L., Gomez, M. et Dixon, S. L. (2017). "An Evaluation of a State-Funded Healthy Homes Intervention on Asthma Outcomes in Adults and Children." *J Public Health Manag Pract* **23**(2): 219-228.  
<https://www.ingentaconnect.com/content/wk/phh/2017/00000023/00000002/art00028>

CONTEXT: Reducing exposure to environmental triggers is a critical part of asthma management. OBJECTIVE: To evaluate the impact of a healthy homes intervention on asthma outcomes and assess the impact of different targeting strategies. SETTING: The New York State (NYS) Healthy Neighborhoods Program (HNP) operates in select communities with a higher burden of housing-related illness and associated risk factors. PARTICIPANTS: Residents with asthma were recruited through 3 mechanisms: door-to-door canvassing (CANVASSED), 752 residents in 457 dwellings; referrals from community partners (REFERRED), 573 residents in 307 dwellings; referrals of Medicaid enrollees with poorly controlled asthma (TARGETED), 140 residents in 140 dwellings. INTERVENTION: The NYS HNP provides visual assessments and low-cost interventions to identify and address asthma triggers and trigger-promoting conditions in the home environment. Conditions are reassessed during a revisit conducted 3 to 6 months after the initial visit. MAIN OUTCOME MEASURE(S): The analysis compares improvements across the 3 groups for measures of asthma self-management, health care access, morbidity, and environmental conditions. An asthma trigger score characterizing the extent of

multiple triggers in a dwelling was also calculated. RESULTS: Among 1465 adults and children, there were significant improvements in environmental conditions and self-reported self-management, health care access, and asthma morbidity outcomes for each group. The improvement was greatest in the TARGETED group for most outcomes, but selected measures of self-management and health care access were greater in the other groups. The mean improvement was significantly greater in the TARGETED group. CONCLUSION: Targeting the intervention to people with poorly controlled asthma maximizes improvements in trigger avoidance and asthma morbidity; however, other recruitment strategies are effective for impacting endpoints related to health care access and self-management. This evaluation demonstrates that a low-intensity home-based environmental intervention is effective as well as practical and feasible. Health care payers, state and local health departments, and others should consider investing in these home-based services as part of a comprehensive asthma care package.

Rodriguez-Martinez, C. E., Sossa-Briceno, M. P. et Castro-Rodriguez, J. A. (2018). "A cost-effectiveness threshold analysis of a multidisciplinary structured educational intervention in pediatric asthma." *Journal of Asthma* 55(5): 561-570.

<https://www.tandfonline.com/doi/full/10.1080/02770903.2017.1348512>

Objective: Asthma educational interventions have been shown to improve several clinically and economically important outcomes. However, these interventions are costly in themselves and could lead to even higher disease costs. A cost-effectiveness threshold analysis would be helpful in determining the threshold value of the cost of educational interventions, leading to these interventions being cost-effective. The aim of the present study was to perform a cost-effectiveness threshold analysis to determine the level at which the cost of a pediatric asthma educational intervention would be cost-effective and cost-saving. Methods: A Markov-type model was developed in order to estimate costs and health outcomes of a simulated cohort of pediatric patients with persistent asthma treated over a 12-month period. Effectiveness parameters were obtained from a single uncontrolled before-and-after study performed with Colombian asthmatic children. Cost data were obtained from official databases provided by the Colombian Ministry of Health. The main outcome was the variable quality-adjusted life-years (QALYs). Results: A deterministic threshold sensitivity analysis showed that the asthma educational intervention will be cost-saving to the health system if its cost is under US\$513.20. Additionally, the analysis showed that the cost of the intervention would have to be below US\$967.40 in order to be cost-effective. Conclusions: This study identified the level at which the cost of a pediatric asthma educational intervention will be cost-effective and cost-saving for the health system in Colombia. Our findings could be a useful aid for decision makers in efficiently allocating limited resources when planning asthma educational interventions for pediatric patients.

Schechter, S. B., Lakhane, D., Peretz, P. J., et al. (2021). "Community Health Worker Intervention to Address Social Determinants of Health for Children Hospitalized With Asthma." *Hosp Pediatr* 11(12): 1370-1376.

<https://publications.aap.org/hospitalpediatrics/article-abstract/11/12/1370/183422/Community-Health-Worker-Intervention-to-Address?redirectedFrom=fulltext>

BACKGROUND: Social determinants of health (SDOH) contribute to racial disparities in asthma outcomes. Community health worker (CHW) programs represent a promising way to screen for SDOH and connect patients to resources, but the impact of CHW programs in the inpatient pediatric setting has been examined in few studies. In this study, we aimed to evaluate a CHW program for children hospitalized with asthma in a predominantly Hispanic community by examining rates of SDOH and social resource navigation. METHODS: This pilot study involved a CHW intervention to improve pediatric asthma care. Patients were included if they were hospitalized with asthma over an 18-month period and enrolled in the CHW program during their hospitalization. In an intake interview, CHWs screened caregivers for SDOH and provided tailored social resource navigation. Descriptive statistics were used to assess rates of social risk factors and social resource navigation. RESULTS: Eighty patients underwent SDOH screening. The majority of patients were Hispanic (81.3%, n = 65). Half of caregivers reported food or housing insecurity over the past 12 months (50.0%, n = 40), and most reported

inadequate housing conditions (63.8%, n = 51). CHWs coordinated social resources for the majority of families (98.8%, n = 79), with the most common being food resources (42.5%, n = 34), housing resources (82.5%, n = 66), and appointment navigation (41.3%, n = 33). CONCLUSIONS: CHWs identified a high burden of unmet social needs and provided associated social resource navigation in a largely Hispanic pediatric population hospitalized for asthma. CHW programs have potential to improve asthma outcomes by linking high-risk patients with social resources.

Shaak, S., Brown, K., Reichart, C., et al. (2022). "Community health workers providing asthma education." *J Asthma* **59**(3): 572-579.  
<https://www.tandfonline.com/doi/full/10.1080/02770903.2020.1862184>

**Objectives:** Children living in urban areas experience disproportionate rates of asthma. Substandard housing conditions in some urban areas contribute to greater exposure to household asthma triggers. This article examines the geographic connection between pediatric asthma and substandard housing in one mid-sized city in Pennsylvania and the effectiveness of a home-based Community Health Worker (CHW) intervention targeted at this high-risk area to improve families' abilities to manage their children's asthma. **Methods:** The CHWs provided education and resources to families of children diagnosed with mild, moderate or severe persistent asthma. A pre and post-test design was implemented to evaluate if the CHW intervention improved the family's ability to successfully manage their child's asthma. Eighty-one patients completed the program over a six-month period. **Results:** Results showed significant improvements in the areas of asthma knowledge, fewer missed days of school, fewer days with asthma symptoms, reduction in wheezing and fewer sleep disturbances. There was also a significant decrease in the number of Emergency Department visits and hospital days. **Conclusions:** By teaching asthma management skills and by addressing in-home triggers, home-based CHW led interventions can be an affordable and effective way for caregivers and children with asthma to improve asthma management.

Shreeve, K., Woods, E. R., Sommer, S. J., et al. (2021). "Community Health Workers in Home Visits and Asthma Outcomes." *Pediatrics* **147**(4).

**BACKGROUND:** The Community Asthma Initiative (CAI) was included in the New England Asthma Innovations Collaborative, which received a Centers for Medicare and Medicaid Services (CMS) Innovation grant. Under this grant, CAI transitioned from a mixed community health worker and nurse model to a nurse-supervised community health worker model. CMS limited enrollment to patients with Medicaid and encouraged 3 home visits per family. **METHODS:** A total of 389 patients enrolled under the CMS grant at Boston Children's Hospital from 2013 to 2015 (CMS group) were compared with 733 CAI patients with Medicaid enrolled from 2005 to 2012 (comparison group). Changes in 5 asthma-related measures (emergency department visits, hospitalizations, physical activity limitations, missed school days, and parent and/or guardian missed workdays) were compared between baseline and 6 and 12 months postenrollment. Measures were analyzed as dichotomous variables using logistic regression. Numbers of occurrences were analyzed as continuous variables. Changes in quality of life (QoL) among the CMS group were examined through a 13-question survey with activity and emotional health subscales. **RESULTS:** Although patients in both groups exhibited improvement in all measures, the CMS group had greater odds of decreased hospitalizations (odds ratio 3.13 [95% confidence interval 1.49-6.59]), missed school days (1.91 [1.09-3.36]), and parent and/or guardian missed workdays (2.72 [1.15-6.41]) compared to the comparison group. Twelve months postenrollment, the CMS group experienced improvement in all QoL questions and subscales (all P values <.01). **CONCLUSIONS:** The CMS group showed improved outcomes for hospitalizations and missed school and workdays compared to the comparison group. The CMS group also exhibited significant improvement in QoL.

Tapp, H., Hebert, L. et Dulin, M. (2011). "Comparative effectiveness of asthma interventions within a practice based research network." *BMC Health Serv Res* **11**.  
<https://bmchealthservres.biomedcentral.com/track/pdf/10.1186/1472-6963-11-188.pdf>

**Background:** Asthma is a chronic lung disease that affects more than 23 million people in the United States, including 7 million children. Asthma is a difficult to manage chronic condition associated with disparities in health outcomes, poor medical compliance, and high healthcare costs. The research network coordinating this project includes hospitals, urgent care centers, and outpatient clinics within Carolinas Healthcare System that share a common electronic medical record and billing system allowing for rapid collection of clinical and demographic data. This study investigates the impact of three interventions on clinical outcomes for patients with asthma. Interventions are: an integrated approach to care that incorporates asthma management based on the chronic care model; a shared decision making intervention for asthma patients in underserved or disadvantaged populations; and a school based care approach that examines the efficacy of school-based programs to impact asthma outcomes including effectiveness of linkages between schools and the healthcare providers.

**Methods/Design:** This study will include 95 Practices, 171 schools, and over 30,000 asthmatic patients. Five groups (A-E) will be evaluated to determine the effectiveness of three interventions. Group A is the usual care control group without electronic medical record (EMR). Group B practices are a second control group that has an EMR with decision support, asthma action plans, and population reports at baseline. A time delay design during year one converts practices in Group B to group C after receiving the integrated approach to care intervention. Four practices within Group C will receive the shared decision making intervention (and become group D). Group E will receive a school based care intervention through case management within the schools. A centralized database will be created with the goal of facilitating comparative effectiveness research on asthma outcomes specifically for this study. Patient and community level analysis will include results from patient surveys, focus groups, and asthma patient density mapping. Community variables such as income and housing density will be mapped for comparison. Outcomes to be measured are reduced hospitalizations and emergency department visits; improved adherence to medication; improved quality of life; reduced school absenteeism; improved self-efficacy and improved school performance.

**Discussion:** Identifying new mechanisms that improve the delivery of asthma care is an important step towards advancing patient outcomes, avoiding preventable Emergency Department visits and hospitalizations, while simultaneously reducing overall healthcare costs.

Tschudy, M. M., Sharfstein, J., Matsui, E., et al. (2017). "Something new in the air: Paying for community-based environmental approaches to asthma prevention and control." *J Allergy Clin Immunol* **140**(5): 1244-1249.  
[https://www.jacionline.org/article/S0091-6749\(17\)30223-3/pdf](https://www.jacionline.org/article/S0091-6749(17)30223-3/pdf)

Despite the recommendation in national asthma guidelines to target indoor environmental exposures, most insurers generally have not covered the outreach, education, environmental assessments, or durable goods integral to home environmental interventions. However, emerging payment approaches offer new potential for coverage of home-based environmental intervention costs. These opportunities are becoming available as public and private insurers shift reimbursement to reward better health outcomes, and their key characteristic is a focus on the value rather than the volume of services. These new payment models for environmental interventions can be divided into 2 categories: enhanced fee-for-service reimbursement and set payments per patient that cover asthma-related costs. Several pilot programs across the United States are underway, and as they prove their value and as payment increasingly becomes aligned with better outcomes at lower cost, these efforts should have a bright future. Physicians should be aware that these new possibilities are emerging for payment of the goods and services needed for indoor environmental interventions for their patients with asthma.

Turcotte, D. A., Alker, H., Chaves, E., et al. (2014). "Healthy homes: in-home environmental asthma intervention in a diverse urban community." *American journal of public health* **104**(4): 665-671.  
<https://pubmed.ncbi.nlm.nih.gov/24524511>  
<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4025713/pdf/AJPH.2013.301695.pdf>

**OBJECTIVES:** We evaluated health outcomes associated with in-home interventions in low-income urban households with children with asthma. **METHODS:** A comprehensive health and environmental assessment and subsequent intervention were completed in 116 households with 170 enrolled

children with asthma. Home health workers provided household safety, asthma prevention education, and targeted environmental intervention to decrease asthma triggers and improve household safety. We collected environmental data with questionnaire and dust samples and health information with a questionnaire incorporating the American Academy of Pediatrics Children's Health Survey for Asthma and other instruments at baseline and at follow-up 11 to 12 months later to evaluate the impact of the intervention on the health of the child and family in Lowell, Massachusetts, from September 2009 to January 2012. RESULTS: The diverse study population of low-income children showed a statistically significant health improvement from baseline to follow-up. The cost of the interventions (not including personnel) was \$36 240, whereas the estimated medical savings over a 4-week assessment period was \$71 162, resulting in an estimated annual savings of about \$821 304. CONCLUSIONS: Low-cost, multicomponent interventions decrease all measures of asthma severity and health care utilization in a diverse population of urban children.

Turcotte, D. A., Woskie, S., Gore, R., et al. (2019). "Asthma, COPD, and home environments: Interventions with older adults." *Ann Allergy Asthma Immunol* **122**(5): 486-491.

BACKGROUND: We describe a multifaceted home environmental intervention project involving low-income older adults with asthma who have a greater risk of asthma-related respiratory impacts because they spend up to 90% of their time in the home where many allergens and respiratory irritants are found. Although sufficient evidence suggests that home interventions are effective in improving health of children with asthma, the Task Force on Community Preventive Services has stated that evidence is insufficient for the effectiveness of home interventions on adults with asthma. OBJECTIVE: To evaluate the hypothesis that multifaceted home environmental interventions improve the respiratory health and reduce asthma triggers for older adults with asthma. METHODS: We conducted community health worker-led interventions in the homes of 86 low-income older adults (age 62 or older) diagnosed with asthma, residing in public and private subsidized housing in Lowell, Massachusetts, from 2014 to 2017. Health and environmental assessment at baseline and follow-up 1 year later included collecting data on respiratory health, quality of life, medication use, doctor/emergency room/hospital visits, using the St. George Respiratory Questionnaire and Asthma Control Test and evaluation of asthma trigger activities and exposures through questionnaires and home surveys. Interventions included education on asthma and environmental triggers and environmental remediation. RESULTS: Statistically significant reductions in self-reported environmental asthma triggers and health improvements were found in the following areas: doctor visits, use of antibiotics for chest problems, respiratory symptoms and quality of life indicators, and asthma control (ACT score). CONCLUSION: Our results provide evidence that multifaceted home interventions are effective in improving the environmental quality and respiratory health of an older adult population with asthma.

Tursynbek, A. et al., e. (2011). "Economic Value of Home-Based, Multi-Trigger, Multicomponent Interventions with an Environmental Focus for Reducing Asthma Morbidity A Community Guide Systematic Review." *Am J Prev Med* **41**(251): S33-S47.  
<https://www.asthmacommunitynetwork.org/system/files/Economic%20Values%20of%20Asthma%20Interventions.pdf>

Welker, K., Nabors, L., Lang, M., et al. (2018). "Educational and home-environment asthma interventions for children in urban, low-income, minority families." *Journal of Asthma* **55**(12): 1301-1314.  
<https://doi.org/10.1080/02770903.2018.1424185>

Wilkerson, R. R. (2005). "A multifaceted, home based, environmental intervention reduced asthma related morbidity in children with atopic asthma." *Evid Based Nurs* **8**(2): 43.  
<https://ebn.bmj.com/content/ebnurs/8/2/43.full.pdf>

## Approches méthodologiques

Bhuia, M. R., Islam, M. A., Nwaru, B. I., et al. (2020). "Models for estimating and projecting global, regional and national prevalence and disease burden of asthma: a systematic review." *Int J Chron Obstruct Pulmon Dis* **10**(2): 020409.

<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7774028/pdf/jogh-10-020409.pdf>

**BACKGROUND:** Statistical models are increasingly being used to estimate and project the prevalence and burden of asthma. Given substantial variations in these estimates, there is a need to critically assess the properties of these models and assess their transparency and reproducibility. We aimed to critically appraise the strengths, limitations and reproducibility of existing models for estimating and projecting the global, regional and national prevalence and burden of asthma. **METHODS:** We undertook a systematic review, which involved searching Medline, Embase, World Health Organization Library and Information Services (WHOLIS) and Web of Science from 1980 to 2017 for modelling studies. Two reviewers independently assessed the eligibility of studies for inclusion and then assessed their strengths, limitations and reproducibility using pre-defined quality criteria. Data were descriptively and narratively synthesised. **RESULTS:** We identified 108 eligible studies, which employed a total of 51 models: 42 models were used to derive national level estimates, two models for regional estimates, four models for global and regional estimates and three models for global, regional and national estimates. Ten models were used to estimate the prevalence of asthma, 27 models estimated the burden of asthma - including, health care service utilisation, disability-adjusted life years, mortality and direct and indirect costs of asthma - and 14 models estimated both the prevalence and burden of asthma. Logistic and linear regression models were most widely used for national estimates. Different versions of the DisMod-MR- Bayesian meta-regression models and Cause Of Death Ensemble model (CODEm) were predominantly used for global, regional and national estimates. Most models suffered from a number of methodological limitations - in particular, poor reporting, insufficient quality and lack of reproducibility. **CONCLUSIONS:** Whilst global, regional and national estimates of asthma prevalence and burden continue to inform health policy and investment decisions on asthma, most models used to derive these estimates lack the required reproducibility. There is a need for better-constructed models for estimating and projecting the prevalence and disease burden of asthma and a related need for better reporting of models, and making data and code available to facilitate replication.

Bhuia, M. R., Nwaru, B. I., Weir, C. J., et al. (2017). "Models for estimating and projecting global, regional and national prevalence and disease burden of asthma: protocol for a systematic review." *J Asthma* **7**(5): e015441.

<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5791547/pdf/bmjopen-2016-015441.pdf>

**INTRODUCTION:** Models that have so far been used to estimate and project the prevalence and disease burden of asthma are in most cases inadequately described and irreproducible. We aim systematically to describe and critique the existing models in relation to their strengths, limitations and reproducibility, and to determine the appropriate models for estimating and projecting the prevalence and disease burden of asthma. **METHODS:** We will search the following electronic databases to identify relevant literature published from 1980 to 2017: Medline, Embase, WHO Library and Information Services and Web of Science Core Collection. We will identify additional studies by searching the reference list of all the retrieved papers and contacting experts. We will include observational studies that used models for estimating and/or projecting prevalence and disease burden of asthma regarding human population of any age and sex. Two independent reviewers will assess the studies for inclusion and extract data from included papers. Data items will include authors' names, publication year, study aims, data source and time period, study population, asthma outcomes, study methodology, model type, model settings, study variables, methods of model derivation, methods of parameter estimation and/or projection, model fit information, key findings and identified research gaps. A detailed critical narrative synthesis of the models will be undertaken in relation to their strengths, limitations and reproducibility. A quality assessment checklist and scoring framework will be used to determine the appropriate models for estimating and projecting the prevalence and disease burden of asthma. **ETHICS AND DISSEMINATION:** We will not collect any primary data for this review, and hence there is no need for formal National Health Services Research



Ethics Committee approval. We will present our findings at scientific conferences and publish the findings in the peer-reviewed scientific journal.

Ehteshami-Afshar, S., Zafari, Z., Hamidi, N., et al. (2019). "A Systematic Review of Decision-Analytic Models for Evaluating Cost-Effectiveness of Asthma Interventions." *Value Health* **22**(9): 1070-1082.  
[https://www.valueinhealthjournal.com/article/S1098-3015\(19\)30193-7/pdf](https://www.valueinhealthjournal.com/article/S1098-3015(19)30193-7/pdf)

**OBJECTIVE:** To demonstrate the landscape of model-based economic studies in asthma and highlight where there is room for improvement in the design and reporting of studies. **DESIGN:** A systematic review of the methodologies of model-based, cost-effectiveness analyses of asthma-related interventions was conducted. Models were evaluated for adherence to best-practice modeling and reporting guidelines and assumptions about the natural history of asthma. **METHODS:** A systematic search of English articles was performed in MEDLINE, EMBASE, and citations within reviewed articles. Studies were summarized and evaluated based on their adherence to the Consolidated Health Economic Evaluation Reporting Standards (CHEERS). We also studied the underlying assumptions about disease progression, heterogeneity in disease course, comorbidity, and treatment effects. **RESULTS:** Forty-five models of asthma were included (33 Markov models, 10 decision trees, 2 closed-form equations). Novel biological treatments were evaluated in 12 studies. Some of the CHEERS' reporting recommendations were not satisfied, especially for models published in clinical journals. This was particularly the case for the choice of the modeling framework and reporting on heterogeneity. Only 13 studies considered any subgroups, and 2 explicitly considered the impact of comorbidities. Adherence to CHEERS requirements and the quality of models generally improved over time. **CONCLUSION:** It would be difficult to replicate the findings of contemporary model-based evaluations of asthma-related interventions given that only a minority of studies reported the essential parameters of their studies. Current asthma models generally lack consideration of disease heterogeneity and do not seem to be ready for evaluation of precision medicine technologies.

Einarson, T. R., Bereza, B. G., Nielsen, T. A., et al. (2016). "Systematic review of models used in economic analyses in moderate-to-severe asthma and COPD." *J Med Econ* **19**(4): 319-355.  
<https://www.tandfonline.com/doi/full/10.3111/13696998.2015.1116991>

**BACKGROUND:** Respiratory diseases exert a substantial burden on society, with newer drugs increasingly adding to the burden. Economic models are often used, but seldom reviewed. **PURPOSE:** To summarize economic models used in economic analyses of drugs treating moderate-to-severe/very severe asthma or chronic obstructive pulmonary disease (COPD). **METHODS:** This study searched Medline and Embase from inception to the end of February 2015 for cost-effectiveness/utility analyses that examined at least one drug against placebo, another drug, or other standard therapy in asthma or COPD. Two reviewers independently searched and extracted data with differences adjudicated via consensus discussion. Data extracted included model used and its qualities, validation methods, treatments compared, disease severity, analytic perspective, time horizon, data collection (pro- or retrospective), input rates and sources, costs and sources, planned sensitivity analyses, criteria for cost-effectiveness, reported outcomes, and sponsor. **RESULTS:** This study analyzed 53 articles; 14 (25%) on asthma and 39 (75%) COPD. Markov models were commonly used for both asthma and COPD-related economic evaluations. Relatively few studies validated their model. For asthma-related studies, 10 examined inhaled corticosteroids and nine studied omalizumab. Placebo or standard therapy was the comparison in 11 studies and active drugs in the remainder. **CONCLUSIONS:** Few studies include validation of their models. Furthermore, controversy concerning some results was uncovered in this study, which needs to be avoided in the future.

Huggins, C., Diaz-Fuentes, G., Roglieri, J., et al. (2017). "Developing core economic outcome sets for asthma studies: a protocol for a systematic review." *J Asthma* **7**(8): e017054.  
<https://bmjopen.bmj.com/content/bmjopen/7/8/e017054.full.pdf>

**INTRODUCTION:** Core outcome sets are standardised lists of outcomes, which should be measured and reported in all clinical studies of a specific condition. This study aims to develop core outcome sets

for economic evaluations in asthma studies. Economic outcomes include items such as costs, resource use or quality-adjusted life years. The starting point in developing core outcome sets will be conducting a systematic literature review to establish a preliminary list of reporting items to be considered for inclusion in the core outcome set. METHODS AND ANALYSIS: We will conduct literature searches of peer-reviewed studies published from January 1990 to January 2017. These will include any comparative or observational studies (including economic models) and systematic reviews reporting economic outcomes. All identified economic outcomes will be tabulated together with the major study characteristics, such as population, study design, the nature and intensity of the intervention, mode of data collection and instrument(s) used to derive an outcome. We will undertake a 'realist synthesis review' to analyse the identified economic outcomes. The outcomes will be summarised in the context of evaluation perspectives, types of economic evaluation and methodological approaches. Parallel to undertaking a systematic review, we will conduct semistructured interviews with stakeholders (including people with personal experience of asthma, health professionals, researchers and decision makers) in order to explore additional outcomes which have not been considered, or used, in published studies. The list of outcomes generated from the systematic review and interviews with stakeholders will form the basis of a Delphi survey to refine the identified outcomes into a core outcome set. ETHICS AND DISSEMINATION: The review will not involve access to individual-level data. Findings from our systematic review will be communicated to a broad range of stakeholders including clinical guideline developers, research funders, trial registries, ethics committees and other regulators.

Jacob, C., Haas, J. S., Bechtel, B., et al. (2017). "Assessing Asthma Severity Based on Claims Data: A Systematic Review." *European Journal of Health Economics* **18**(2): 227-241.

**Introduction** Asthma is one of the most common chronic diseases in Germany. Substantial economic evaluation of asthma cost requires knowledge of asthma severity, which is in general not part of claims data. Algorithms need to be defined to use this data source. **Aims and objectives** The aim of this study was to systematically review the international literature to identify algorithms for the stratification of asthma patients according to disease severity based on available information in claims data. **Methods** A systematic literature review was conducted in September 2015 using the DIMDI SmartSearch, a meta search engine including several databases with a national and international scope, e.g. BIOSIS, MEDLINE, and EMBASE. Claims data based studies that categorize asthma patients according to their disease severity were identified. **Results** The systematic research yielded 54 publications assessing asthma severity based on claims data. Thirty-nine studies used a standardized algorithm such as HEDIS, Leidy, the GINA based approach or CACQ. Sixteen publications applied a variety of different criteria for the severity categorisation such as asthma diagnoses, asthma-related drug prescriptions, emergency department visits, and hospitalisations. **Conclusion** There is no best practice method for the categorisation of asthma severity with claims data. Rather, a combination of algorithms seems to be a pragmatic approach. A transfer to the German context is not entirely possible without considering particular conditions associated with German claims data.

Kirsch, F. (2016). "Economic Evaluations of Multicomponent Disease Management Programs with Markov Models: A Systematic Review." *Value Health* **19**(8): 1039-1054.  
[https://www.valueinhealthjournal.com/article/S1098-3015\(16\)30580-0/fulltext?returnURL=https%3A%2F%2Flinkinghub.elsevier.com%2Fretrieve%2Fpii%2FS1098301516305800%3Fshowall%3Dtrue](https://www.valueinhealthjournal.com/article/S1098-3015(16)30580-0/fulltext?returnURL=https%3A%2F%2Flinkinghub.elsevier.com%2Fretrieve%2Fpii%2FS1098301516305800%3Fshowall%3Dtrue)

**BACKGROUND:** Disease management programs (DMPs) for chronic diseases are being increasingly implemented worldwide. **OBJECTIVES:** To present a systematic overview of the economic effects of DMPs with Markov models. The quality of the models is assessed, the method by which the DMP intervention is incorporated into the model is examined, and the differences in the structure and data used in the models are considered. **METHODS:** A literature search was conducted; the Preferred Reporting Items for Systematic Reviews and Meta-Analyses statement was followed to ensure systematic selection of the articles. Study characteristics e.g. results, the intensity of the DMP and usual care, model design, time horizon, discount rates, utility measures, and cost-of-illness were

extracted from the reviewed studies. Model quality was assessed by two researchers with two different appraisals: one proposed by Philips et al. (Good practice guidelines for decision-analytic modelling in health technology assessment: a review and consolidation of quality assessment. *Pharmacoeconomics* 2006;24:355-71) and the other proposed by Caro et al. (Questionnaire to assess relevance and credibility of modeling studies for informing health care decision making: an ISPOR-AMCP-NPC Good Practice Task Force report. *Value Health* 2014;17:174-82). RESULTS: A total of 16 studies (9 on chronic heart disease, 2 on asthma, and 5 on diabetes) met the inclusion criteria. Five studies reported cost savings and 11 studies reported additional costs. In the quality, the overall score of the models ranged from 39% to 65%, it ranged from 34% to 52%. Eleven models integrated effectiveness derived from a clinical trial or a meta-analysis of complete DMPs and only five models combined intervention effects from different sources into a DMP. The main limitations of the models are bad reporting practice and the variation in the selection of input parameters. CONCLUSIONS: Eleven of the 14 studies reported cost-effectiveness results of less than \$30,000 per quality-adjusted life-year and the remaining two studies less than \$30,000 per life-year gained. Nevertheless, if the reporting and selection of data problems are addressed, then Markov models should provide more reliable information for decision makers, because understanding under what circumstances a DMP is cost-effective is an important determinant of efficient resource allocation.

## Les travaux de l'Irdes

Afrite, A., Allonier, C., Com-Ruelle, L., et al. (2008). "L'asthme en France en 2006 : prévalence et contrôle des symptômes." *Questions D'economie De La Sante (Irdes)*(138): 8.  
<http://www.irdes.fr/Publications/Qes/Qes138.pdf>

En 2006, 6,26 millions de personnes en France métropolitaine déclarent avoir souffert d'asthme à un moment quelconque de leur vie et, parmi elles, 4,15 millions continuent à en souffrir, soit 6,7 % de la population. Les hommes sont globalement autant concernés que les femmes mais il existe des différences selon l'âge. Moins d'un asthmatique sur deux a recours à un traitement de fond, c'est-à-dire une thérapeutique indiquée pour réduire et maîtriser l'intensité des symptômes liés à l'hyperréactivité bronchique caractérisant cette maladie chronique. Chez six asthmatiques sur dix, le niveau de contrôle des symptômes est insuffisant : partiellement dans 46 % des cas et totalement dans 15 %. Parmi ces derniers, un quart ne prend pas de traitement de fond. Toutes choses égales par ailleurs, être obèse, fumer, vivre dans un ménage à faibles revenus ou de structure monoparentale augmente le risque d'avoir un asthme totalement non contrôlé. Ces résultats sont issus de l'Enquête santé et protection sociale (ESPS) réalisée en population générale ; elle intègre un questionnement spécifique sur l'asthme afin d'identifier les personnes asthmatiques et le niveau de contrôle de leurs symptômes.

Afrite, A., Allonier, C., Com-Ruelle, L., et al. (2011). L'asthme en France en 2006 : prévalence, contrôle et déterminants. *Les rapports de l'Irdes ; 1820*. Paris Irdes: 117.  
<http://www.irdes.fr/Publications/Rapports2011/rap1820.pdf>

En 2006, 6,25 millions de personnes en France métropolitaine déclarent avoir souffert d'asthme à un moment quelconque de leur vie, 4,15 millions continuent à en souffrir, soit 6,7 % de la population. Les hommes sont globalement autant concernés que les femmes mais il existe des différences selon l'âge. Moins d'un asthmatique sur deux a recours à un traitement de fond indiqué en cas de persistance des symptômes. Chez six asthmatiques sur dix, le niveau de contrôle des symptômes est insuffisant : partiellement dans 46 % des cas et totalement dans 15 %. Parmi ces derniers, un quart ne prend pas de traitement de fond. Toutes choses égales par ailleurs, être obèse, fumer, vivre dans un ménage à faibles revenus ou de structure monoparentale augmente le risque d'avoir un asthme totalement non contrôlé. Ces résultats sont issus de l'enquête santé et protection sociale (ESPS) réalisée en population générale. Cette enquête intègre un questionnement spécifique sur l'asthme afin d'identifier les personnes asthmatiques et le niveau de contrôle de leurs symptômes.

Afrite, A., Allonier, C. et Com-Ruelle, L. (2009). "Assessment of asthma control and its socio-economic determinants: 2nd European Conference - Human ecology and public Health, 25-28 november 2009." European Journal of Public Health **19**(Suppl 1): 60-61

Allonier, C., Afrite, A., Delmas, M. C., et al. (2009). "Prévalence de l'asthme par stade de sévérité en France et déterminants du non-contrôle de l'asthme." Revue Des Maladies Respiratoires **26**(HS 1): 1S35-31S36.

Cette étude a pour but d'estimer la prévalence de l'asthme par stade de sévérité et niveau de contrôle et d'étudier les facteurs associés au non-contrôle de l'asthme. L'étude s'appuie sur des données de l'Enquête santé et protection sociale (ESPS) 2006.

Com-Ruelle, L. (2001). "Epidémiologie de l'asthme chez l'enfant : l'éclairage de l'enquête CreDES." Pédiatrie Pratique(126): 1-3, 6 fig., 3 tabl.

Com-Ruelle, L. (2001). "Les preuves d'un réel problème de santé publique. L'asthme en France selon les stades de sévérité, commentaires du rapport CreDES n°1290." Reseaux Asthme(12): 6-10.

Com-Ruelle, L. (2003). L'asthme selon les stades de sévérité. Asthme et allergies respiratoires : bilan de 10 années d'études épidémiologiques : communication à la Direction générale de la santé.

Com-Ruelle, L. (2015). Quels enjeux économiques : coût de l'asthme selon le niveau de contrôle : communication orale au Colloque de la Fédération Française de Pneumologi. 19 septembre., Paris : Faculté de médecine.

Com-Ruelle, L., Crestin, B. et Dumesnil, S. (2000). L'asthme en France selon les stades de sévérité. Rapport CreDES. Paris CreDES : 182, 155 tabl., 130 graph., ann.  
<http://www.irdes.fr/Publications/Bibliographies/bibresusom/2000/rap1290.htm>

Cette étude sur l'asthme est basée sur des données issues de l'Enquête Santé et Protection Sociale (ESPS) menée par le CREDES en 1998. Les auteurs analysent la prévalence de l'asthme selon un classement en quatre stades de sévérité. Ils précisent l'influence des caractéristiques socio-économiques et environnementales sur la prévalence et la sévérité de l'asthme et décrivent l'état de santé, la qualité de vie et le recours aux soins des asthmatiques.

Com-Ruelle, L., Crestin, B. et Dumesnil, S. (2000). "L'asthme en France selon les stades de sévérité." Questions D'economie De La Sante (CreDES)(25): 4 , 3 graph., 1 enc.  
<http://www.irdes.fr/Publications/Qes/Qes25.pdf>

Cette étude sur l'asthme est basée sur des données issues de l'Enquête Santé et Protection Sociale (ESPS) menée par le CREDES en 1998. Les auteurs analysent la prévalence de l'asthme selon un classement en quatre stades de sévérité. Ils précisent l'influence des caractéristiques socio-économiques et environnementales sur la prévalence et la sévérité de l'asthme et décrivent l'état de santé, la qualité de vie et le recours aux soins des asthmatiques.

Com-Ruelle, L., Da Poian, T. et Le, G., N. (2010). "Les dépenses médicales de ville des asthmatiques en 2006." Questions D'economie De La Sante (Irdes)(152): 8.  
<http://www.irdes.fr/Publications/2010/Qes152.pdf>

En France, selon les résultats de l'appariement des données de l'Enquête santé et protection sociale (ESPS) 2006 avec celles de l'Assurance maladie, la dépense médicale totale en soins de ville des asthmatiques est une fois et demie supérieure à celle des non-asthmatiques en raison de leur asthme, du niveau de contrôle de leurs symptômes, mais aussi d'autres maladies plus fréquentes chez eux. Six asthmatiques sur dix ont toutefois leurs symptômes insuffisamment contrôlés et seuls 12,5 % d'entre eux ont consulté un pneumologue de ville, le médecin généraliste restant pour tous les asthmatiques en première ligne de leur suivi. Les médicaments arrivent en tête des dépenses de ville liées à l'asthme

mais se concentrent, selon les classes thérapeutiques, sur une part de consommateurs variables. Un tiers des asthmatiques n'a eu aucun traitement antiasthmatique. Ceci suggère que les professionnels de santé ont encore des marges de manœuvre pour améliorer la prise en charge des malades sur le plan médical ainsi qu'en termes d'éducation thérapeutique et de mesures environnementales.

Com-Ruelle, L., Dumesnil, S. et Lemaitre, D. (1997). Asthme : la place de l'hôpital. Rapport Credes. Paris CREDES: 95 , tabl., graph., ann.

<https://www.irdes.fr/Publications/Rapports1997/rap1163.pdf>

Ce rapport a pour objectif d'analyser la prise en charge de l'asthme à l'hôpital et son coût. Les données présentées sont issues d'études existantes, de chiffres fournis par certains organismes (CNAMTS, INSERM), de données recensées dans la base PMSI et également des données de la deuxième Enquête Nationale sur les hospitalisés (ENH) réalisée par le CREDES en 1991/1992. Les deux premières parties de ce rapport sont consacrées à la présentation générale de l'asthme et exposent les aspects cliniques et épidémiologiques de la maladie. La troisième partie situe la part de l'hôpital dans le coût global de l'asthme. Le coût économique de l'asthme à l'hôpital est étudié sous divers angles : la structure du coût total de l'asthme (coût en ville/coût à l'hôpital, coût direct/coût indirect) selon diverses sources de données nationales et internationales, la structure de la consommation des patients asthmatiques hospitalisés en hospitalisation complète selon différentes variables (âge, lieu d'hospitalisation).

Com-Ruelle, L., Grandfils, N., Midy, F., et al. (2002). "Les déterminants du coût de l'asthme persistant en Ile-de-France." Questions D'economie De La Sante (Credes)(58): 4.

<http://www.irdes.fr/Publications/Qes/Qes58.pdf>

En 1999, l'Union Régionale des Caisses d'Assurance Maladie d'Ile-de-France (URCAM-IdF) a initié une enquête sur la prise en charge médicale de l'asthme. Cette enquête a été menée par les médecins conseils de la région auprès de bénéficiaires des trois grands régimes, âgés de 10 à 44 ans. Les résultats ont été publiés en juin 2001 par l'URCAM-IdF. A la demande de cet organisme, le CREDES a associé un volet économique à cette enquête afin d'explorer le lien entre les aspects économiques et médicaux de la maladie. La synthèse présentée ici se focalise sur les déterminants du coût de l'asthme persistant en Ile-de-France. Les résultats complets de cette étude sont présentés dans le rapport " Les déterminants du coût de l'asthme en Ile-de-France ", CREDES n° 1397, novembre 2002.

Com-Ruelle, L., Grandfils, N., Midy, F., et al. (2002). Les déterminants du coût de l'asthme persistant en Ile-de-France. Rapport Credes. Paris Credes : 118 , 123 tabl.

<https://www.irdes.fr/Publications/Rapports2002/rap1397.pdf>

En 1999, l'Union Régionale des Caisses d'Assurance Maladie d'Ile-de-France (URCAM-IdF) a initié une enquête sur la prise en charge médicale de l'asthme. Cette enquête a été menée par les médecins conseils de la région auprès de bénéficiaires des trois grands régimes, âgés de 10 à 44 ans. Les résultats ont été publiés en juin 2001 par l'URCAM-IdF. A la demande de cet organisme, le CREDES a associé un volet économique à cette enquête afin d'explorer le lien entre les aspects économiques et médicaux de la maladie. La première partie de ce rapport est méthodologique, la seconde partie propose une description des patients inclus dans l'étude d'un point de vue médical et économique. Enfin, la dernière partie vise à identifier les déterminants du coût de l'asthme persistant et à préciser leurs impacts sur les différents postes de soins (ambulatoire, pharmacie, hôpital).

Com-Ruelle, L. et Midy, F. (2003). "Déterminants du coût de l'asthme persistant en Ile-de-France." Reseaux Respiratoire(7): 6-8.

Ce travail sur les déterminants du coût de l'asthme persistant complète d'une étude de l'Union Régionale des Caisses d'Assurance Maladie d'Ile-de-France (URCAM-IdF) portant sur la prise en charge médicale des patients asthmatiques de 10 à 44 ans vivant en Ile-de-France. Il met en regard la dimension médicale et la dimension économique de l'asthme persistant.

Delmas, M. C., Guignon, N., Leynaert, B., Com Ruelle, L. et al. (2014). "Évolution de la prévalence de l'asthme chez l'enfant en France : enquêtes nationales de santé en milieu scolaire 2003-2008." Bulletin Epidemiologique Hebdomadaire(20): 360-365.

Les données sur les tendances de la prévalence de l'asthme chez l'enfant en France sont rares. Les enquêtes nationales de santé en milieu scolaire sont effectuées sur des échantillons d'élèves tirés au sort, alternativement en grande section de maternelle, cours moyen 2e année (CM2) et troisième. La prévalence cumulée de l'asthme et les prévalences des symptômes d'asthme au cours des 12 derniers mois ont été estimées à partir des données des enquêtes effectuées en classe de CM2 en 2007-2008 et en troisième en 2008-2009. Elles ont été comparées aux prévalences estimées lors des précédentes enquêtes (CM2 en 2004-2005 et troisième en 2003-2004). La prévalence cumulée de l'asthme était de 14 % en CM2 et de 16% en troisième. Dans chaque niveau scolaire, la prévalence des sifflements dans l'année écoulée était de 10 %. Par rapport aux précédentes enquêtes, on observait une augmentation de la prévalence cumulée de l'asthme et de la prévalence au cours de l'année écoulée de certains symptômes d'asthme. En revanche, la proportion d'élèves asthmatiques ayant eu des symptômes fréquents ou graves dans l'année écoulée était restée stable quel que soit le niveau scolaire. Les tendances observées devront être confirmées par les données des enquêtes à venir. Les données disponibles à ce jour ne montrent pas d'amélioration du contrôle de l'asthme chez l'enfant (résumé d'auteur).

Delmas, M. C., Guignon, N., Leynaert, B., et al. (2009). "Prévalence de l'asthme chez l'enfant en France." Archives De Pédiatrie **16**(9): 1261-1269.

A partir de trois enquêtes nationales : l'enquête décennale santé 2003 de l'Institut national des statistiques et des études économiques (Insee), et les enquêtes du cycle triennal en milieu scolaire effectuées en classe de troisième en 2003-2004 et en cours moyen deuxième année (CM2) en 2004-2005, cet article synthétise les résultats de ces enquêtes et fournit des estimations de la prévalence de l'asthme et des symptômes évocateurs d'asthme chez l'enfant sur l'ensemble du territoire français.

Delmas, M. C., Guignon, N., Leynaert, B., Com-Ruelle, L. et al. (2009). "Prévalence de l'asthme chez l'enfant en France : communications scientifiques du 13e congrès de pneumologie de langue française. Lyon, 16 au 19 août." Revue Des Maladies Respiratoires **26**(HS n° 1): 1533.

Delmas, M. C., Leynaert, B., Com-Ruelle, L., et al. (2008). Asthme : prévalence et impact sur la vie quotidienne. Analyse des données de l'enquête décennale santé 2003 de l'Insee. Saint-Maurice I.n.V.S.: 90 , 75 tabl.

L'enquête décennale santé 2003, effectuée auprès d'un échantillon représentatif de ménages de France métropolitaine, a couvert le champ de la santé respiratoire grâce à un auto-questionnaire distribué aux participants âgés d'au moins 11 ans. L'analyse a porté sur 1 675 enfants âgés de 11-14 ans et 20 982 adultes âgés de 15 ans ou plus. Au total, 12,7 % des enfants ont répondu avoir déjà eu de l'asthme, 8,3 % déclarant avoir eu des sifflements dans les douze derniers mois. Chez les adultes, la prévalence de l'asthme actuel, défini par la survenue d'une crise d'asthme dans les douze derniers mois ou la prise actuelle d'un traitement pour asthme, était estimée à 6,0 %, et la prévalence des sifflements dans les douze derniers mois était de 12,0 %. L'asthme était associé à une moins bonne qualité de vie et à une fréquence accrue des limitations fonctionnelles et des restrictions dans certaines activités du quotidien. Concernant la vie professionnelle, on observait chez les asthmatiques un risque accru d'avoir interrompu leur travail pour raison de santé pendant au moins un mois ou changé d'activité, ainsi que des taux de chômage au moment de l'enquête et d'inactivité pour raison de santé plus élevés. Enfin, les asthmatiques actuels recouraient plus fréquemment aux soins médicaux. L'enquête décennale santé 2003 est la première enquête en population générale ayant utilisé des questionnaires standardisés sur la santé respiratoire. Bien que les résultats ne soient pas directement comparables à ceux observés au début des années 90 dans les centres français ayant participé aux enquêtes internationales sur l'asthme, les tendances différentes observées pour la prévalence de l'asthme et pour la prévalence des symptômes d'asthme suggèrent une amélioration du

traitement des patients asthmatiques. Néanmoins, le retentissement de l'asthme sur la vie quotidienne est marqué (Résumé d'auteur).

Doz, M., Chouaid, C., Com-Ruelle, L., et al. (2013). "The association between asthma control, health care costs, and quality of life in France and Spain." *Bmc Pulmonary Medicine* **13**: 1-24.  
<http://www.biomedcentral.com/content/pdf/1471-2466-13-15.pdf>

Background: Current asthma management guidelines are based on the level of asthma control. The impact of asthma control on health care resources and quality of life (QoL) is insufficiently studied. EUCOAST study was designed to describe costs and QoL in adult patients according to level of asthma control in France and Spain. Methods: An observational cost of illness study was conducted simultaneously in both countries among patients age greater or equal to 18 with a diagnosis of asthma for at least 12 months. Patients were recruited prospectively by GPs in 2010 in four waves to avoid a seasonal bias. Health care resources utilization of the three months before the inclusion was collected through physician questionnaires. Asthma control was evaluated using 2009 GINA criteria over a 3-month period. QoL was assessed using EQ-5D-3LW. Results: 2,671 patients (France: 1,154; Spain: 1,517) were enrolled. Asthma was controlled in 40.6% [95% CI: 37.7% - 43.4%] and 29.9% [95% CI: 27.6% - 32.3%] of French and Spanish patients respectively. For all types of costs, the percentage of patients using health care resources varied significantly according to the level of asthma control. The average cost (euros/3-months/patient) of controlled asthma was €85.4 (SD: 153.5) in France compared with €314.0 (SD: 2,160.4) for partially controlled asthma and €537.9 (SD: 2,355.7) for uncontrolled asthma ( $p < 0.0001$ ). In Spain, the corresponding figures were €152.6 (SD: 162.1), €241.2 (SD: 266.8), and €556.8 (SD: 762.4). EQ-5D-3LW score was higher ( $p < 0.0001$ ) in patients with controlled asthma compared to partially controlled and uncontrolled asthma in both countries (respectively 0.88; 0.78; 0.63 in France and 0.89; 0.82; 0.69 in Spain). Conclusions: In both countries, patients presenting with uncontrolled asthma had a significantly higher asthma costs and lower scores of QoL compared to the others.

Gangneux, J. P., Morel, B., Blans, F. X., et al. (2022). Evaluation multicentrique et randomisée de l'impact des conseillers en environnement intérieur sur le contrôle de l'asthme: l'étude Ecenvir : poster. Rennes : CHU.

L'étude Ecenvir est un essai clinique, multicentrique, prospectif et randomisé qui vise à évaluer l'impact des conseillers en environnement intérieur (CEI) sur le niveau de contrôle de l'asthme.

Grandfils, N. et Lecomte, T. (1994). Approche médico-économique de l'asthme. *Rapport Credes*. Paris Credes: 97, 17 graph., 16 tabl., ann.

Les données de cette approche médico-économique de l'asthme proviennent de l'enquête "Santé et Protection Sociale" menée par le Centre de Recherche - d'Etude et de Documentation en Economie de la Santé (Credes) en collaboration avec la Caisse Nationale de l'Assurance Maladie des Travailleurs Salariés (Cnamts) sur la période 1988-1991. L'analyse porte sur les aspects suivants : taux de prévalence de l'asthme, caractéristiques des asthmatiques, morbidité et consommation médicale par types de soins.

Laforest, L., Com-Ruelle, L., Broquet, M., et al. (2011). "Coût de l'asthme en France." *Revue Du Praticien (La)* **61**(3): 336-338, 331 fig., 331 tabl.

Avec près de 7 % des Français concernés, l'asthme constitue un véritable problème de santé publique non seulement sur le plan clinique mais aussi sur le plan économique. En 2001, le coût global de l'asthme en France était estimé à 1,5 milliard d'euros. D'après l'Institut de recherche et documentation en économie de la santé (IRDES) les dépenses de soins ambulatoires des asthmatiques en 2006 étaient supérieures de 60 % à celles de sujets non asthmatiques quel que soit leur état de santé (1605 contre 1100 euros), à âge et sexe comparables. Ces coûts sont inhérents à la prise en charge chronique de l'asthme ainsi que des exacerbations consécutives au contrôle insuffisant de la maladie et génératrices d'une surconsommation de soins non programmés. Les coûts peuvent aussi

être induits par les comorbidités associées. En 2006, les coûts ambulatoires spécifiquement liés à l'asthme étaient estimés à 331 euros en moyenne par patient.

Laforest, L., Com-Ruelle, L., Devouassoux, G., et al. (2008). "Enjeux économiques de l'asthme sévère." Presse médicale **37**(1): 117-128.

L'asthme sévère et réfractaire est un problème de santé publique compte tenu des risques de mortalité, de la morbidité qu'il engendre, ainsi que de son impact sur la qualité de vie des patients. Ses conséquences sur le plan économique ne doivent pas être oubliées. L'ensemble des études publiées suggère une augmentation de la consommation de soins en fonction du degré de sévérité de l'asthme. La consommation de soins des asthmatiques sévères pourrait en partie être réduite par certaines mesures (adéquation du traitement, éducation des patients, meilleure coordination des soins, traitement de comorbidités associées), tout en gardant à l'esprit les difficultés spécifiques aux asthmes sévères et réfractaires. Si de nouveaux traitements de l'asthme sévère sont prometteurs d'un point de vue clinique, il convient de se poser la question de leur coût et de leur indication en pratique médicale.

Lecomte, T. (1989). Dépense de soins et morbidité. Paris Credes: 106 , 129 graph., 103 ann., 101 tabl.

Présentation des dépenses de soins médicaux de chaque groupe de maladies à partir de l'enquête nationale sur la santé et les soins médicaux 1980/1981 réalisée par l'INSEE en collaboration avec le CREDOC. Les maladies cardio-vasculaires entraînent la plus forte part des dépenses de soins (16 %), le second poste de dépenses correspond aux pathologies dentaires (10 %). Viennent ensuite les maladies de l'appareil digestif (9,7 %), les maladies ostéo-articulaires (9,2 %), les traumatismes (8 %) et les tumeurs (6 %). Les dépenses de soins de médecins et de pharmacie ont pour origine les mêmes principaux groupes de maladies. Les analyses de laboratoire sont faites essentiellement pour des pathologies cardio-vasculaires mais aussi endocriniennes, génito-urinaires et pour l'établissement de diagnostics. 50 % des dépenses d'hospitalisation sont attribuables à 4 groupes de maladies : cardio-vasculaires, digestives, traumatismes et tumeurs.

Sanyal, S., Rochereau, T., Maesano, C. N., et al. (2018). "Long-Term Effect of Outdoor Air Pollution on Mortality and Morbidity: A 12-Year Follow-Up Study for Metropolitan France." International Journal of Environmental Research and Public Health **15**: 1-8.

<https://www.mdpi.com/1660-4601/15/11/2487>

Short-term effects of air pollution are documented more than long-term effects. We investigated 12-year impacts of ambient air pollutants on cardiovascular and respiratory morbidity and mortality at the departmental level in metropolitan France.

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Les recommandations de prise en charge 2021

Raherison-Semjen, C., Guilleminault, L., Billiard, I., et al. (2021). "[Updated guidelines for management of asthmatic patients (from 12 years and older). Short version]." *Rev Mal Respir* **38**(10): e1-e13.

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