

References

1. Jeswani HK, Azapagic A. [Life cycle environmental impacts of inhalers](#). Journal of Cleaner Production. 2019;237:117733. doi:10.1016/j.jclepro.2019.117733
2. Dalla Lana School of Public Health, University of Toronto I of H Policy, Management and Evaluation. [Inhalers](#). Centre for Sustainable Health Systems. Accessed January 7, 2021.
3. Hove M van, Leng G. [A more sustainable NHS](#). BMJ. 2019;366:l4930. doi:10.1136/bmj.l4930.
4. Tennison I, Roschnik S, Ashby B, et al. [Health care's response to climate change: a carbon footprint assessment of the NHS in England](#). The Lancet Planetary Health. 2021;5(2):e84-e92. doi:10.1016/S2542-5196(20)30271-0
5. Wintemute K, Chang B, Green S, Wilson J, Busque G. [Climate Impact of Inhalers: A call for professional practice change](#). Presented: June 17, 2021; Toronto. Accessed September 22, 2021.
6. Tier Assignment Committee Information Sheet: Inhalation Drugs Impacted by COVID-19. Health Canada; 2020:4.
7. [Asthma Fact Sheet](#). The Lung Association. Published January 20, 2015. Accessed August 25, 2021.
8. Liew KL, Wilkinson A. [P280 How do we choose inhalers? patient and physician perspectives on environmental, financial and ease-of-use factors](#). Thorax. 2017;72(Suppl 3):A235-A237. doi:10.1136/thoraxjnl-2017-210983.422
9. Wilkinson AJK, Braggins R, Steinbach I, Smith J. [Costs of switching to low global warming potential inhalers. An economic and carbon footprint analysis of NHS prescription data in England](#). BMJ Open. 2019;9(10):e028763. doi:10.1136/bmjopen-2018-028763
10. Janson C, Henderson R, Löfdahl M, Hedberg M, Sharma R, Wilkinson AJK. [Carbon footprint impact of the choice of inhalers for asthma and COPD](#). Thorax. 2020;75(1):82-84. doi:10.1136/thoraxjnl-2019-213744
11. Colombo SJ, Chen J, Ter-Mikaelian MT. [Carbon Storage in Ontario's Forests, 2000-2100](#). Applied Research and Development Branch; 2007:8.
12. Lehtimäki L, Björnsdóttir U, Janson C, Haahtela T. [Minimising the environmental impact of inhaled therapies](#). European Respiratory Journal. 2020;55(5). doi:10.1183/13993003.00721-2020
13. Tack G, Tjia-Leong E, Davies L, Warburton CJ. [P229 Factors affecting inhaler choice and adherence in urban Liverpool](#). Thorax. 2011;66(Suppl 4):A161-A161. doi:10.1136/thoraxjnl-2011-201054c.229
14. Barry PW, O'Callaghan C. [Inhalational drug delivery from seven different spacer devices](#). Thorax. 1996;51(8):835-840. doi:10.1136/thx.51.8.835
15. Wilkinson AJK, Anderson G. [Sustainability in Inhaled Drug Delivery](#). Pharm Med. 2020;34(3):191-199. doi:10.1007/s40290-020-00339-8
16. Sivarajasingam V. [Understanding patient's knowledge of inhaler recycling](#). BJGP Life: Bright Ideas and Innovation, Research. Accessed October 20, 2021.
17. [Six tests, treatments to question in respiratory medicine](#). Choosing Wisely Canada. Accessed September 3, 2021.
18. Chapman, K. R., Boulet, L. P., Rea, R. M., & Franssen, E. (2008). [Suboptimal asthma control: Prevalence, detection and consequences in general practice](#). European Respiratory Journal, 31(2), 320–325. doi.org/10.1183/09031936.00039707

19. Evans, J., Chen, Y., Camp, P. G., Bowie, D. M., & McRae, L. (2014). [Estimating the prevalence of COPD in Canada: Reported diagnosis versus measured airflow obstruction](#) - ARCHIVED (No. 82-003-X; Health Reports). <https://www150.statcan.gc.ca/n1/pub/82-003-x/2014003/article/11908-eng.pdf>
20. Kavanagh J, Jackson DJ, Kent BD. [Over- and under-diagnosis in asthma](#). *Breathe*. 2019;15(1):e20-e27. doi:10.1183/20734735.0362-2018
21. Aaron SD, Vandemheen KL, FitzGerald JM, et al. [Reevaluation of Diagnosis in Adults With Physician-Diagnosed Asthma](#). *JAMA*. 2017;317(3):269-279. doi:10.1001/jama.2016.19627
22. Pakhale S, Sumner A, Coyle D, Vandemheen K, Aaron S. [\(Correcting\) misdiagnoses of asthma: a cost effectiveness analysis](#). *BMC Pulmonary Medicine*. 2011;11(1):27. doi:10.1186/1471-2466-11-27.
23. Aaron SD, Vandemheen KL, Boulet L-P, et al. [Overdiagnosis of asthma in obese and nonobese adults](#). *CMAJ*. 2008;179(11):1121-1131. doi:10.1503/cmaj.081332
24. Diab, N., Gershon, A. S., Sin, D. D., Tan, W. C., Bourbeau, J., Boulet, L.-P., & Aaron, S. D. (2018). [Underdiagnosis and Overdiagnosis of Chronic Obstructive Pulmonary Disease](#). *American Journal of Respiratory and Critical Care Medicine*, 198(9), 1130–1139. doi:10.1164/rccm.201804-0621CI
25. [Global Strategy for Asthma Management and Prevention, Full Report](#). Global Initiative for Asthma; 2021.
26. Reddel HK, FitzGerald JM, Bateman ED, et al. [GINA 2019: a fundamental change in asthma management: Treatment of asthma with short-acting bronchodilators alone is no longer recommended for adults and adolescents](#). *European Respiratory Journal*. 2019;53(6). doi:10.1183/13993003.01046-2019
27. Quirt J, Hildebrand KJ, Mazza J, Noya F, Kim H. [Asthma](#). *Allergy Asthma Clin Immunol*. 2018;14(Suppl 2):50. doi:10.1186/s13223-018-0279-0
28. Lougheed MD, Lemiere C, Ducharme FM, et al. [Canadian Thoracic Society 2012 guideline update: Diagnosis and management of asthma in preschoolers, children and adults](#). *Can Respir J*. 2012;19(2):127-164.
29. O'Donnell DE, Hernandez P, Aaron S, et al. [Canadian Thoracic Society COPD guidelines: summary of highlights for family doctors](#). *Can Respir J*. 2003;10(8):463-466. doi:10.1155/2003/831291
30. Ebell MH, Lundgren J, Youngpairoj S. [How long does a cough last? Comparing patients' expectations with data from a systematic review of the literature](#). *Ann Fam Med*. 2013;11(1):5-13. doi:10.1370/afm.1430
31. Mitra A, Hannay D, Kapur A, Baxter G. [The natural history of acute upper respiratory tract infections in children](#). *Primary Health Care Research & Development*. 2011;12(4):329-334. doi:10.1017/S1463423611000193
32. Shields MD, Thavagnanam S. [The difficult coughing child: prolonged acute cough in children](#). *Cough*. 2013;9(1):11. doi:10.1186/1745-9974-9-11
33. Smucny JJ, Flynn CA, Becker LA, Glazier RH. [Are \[\[beta\].sub.2\]-agonists effective treatment for acute bronchitis or acute cough in patients without underlying pulmonary disease? A systematic review](#). (Original Research). *Journal of Family Practice*. 2001;50(11):945-952.
34. Yang CL, Hicks EA, Mitchell P, et al. [Canadian Thoracic Society 2021 Guideline update: Diagnosis and management of asthma in preschoolers, children and adults](#). *Canadian*

Journal of Respiratory, Critical Care, and Sleep Medicine. 2021;0(0):1-14.
doi:10.1080/24745332.2021.1945887

35. Salpeter SR, Ormiston TM, Salpeter EE. [Meta-Analysis: Respiratory Tolerance to Regular \$\beta\$ 2-Agonist Use in Patients with Asthma](#). *Annals of Internal Medicine*. 2004;140(10):802-813. doi:10.7326/0003-4819-140-10-200405180-00010
36. Stanford RH, Shah MB, D'Souza AO, Dhamane AD, Schatz M. [Short-acting \$\beta\$ -agonist use and its ability to predict future asthma-related outcomes](#). *Annals of Allergy, Asthma & Immunology*. 2012;109(6):403-407. doi:10.1016/j.anai.2012.08.014
37. Suissa S, Ernst P, Boivin JF, et al. [A cohort analysis of excess mortality in asthma and the use of inhaled beta-agonists](#). *Am J Respir Crit Care Med*. 1994;149(3):604-610. doi:10.1164/ajrccm.149.3.8118625
38. Nwaru, B. I., Ekström, M., Hasvold, P., Wiklund, F., Telg, G., & Janson, C. (2020). [Overuse of short-acting \$\beta\$ 2-agonists in asthma is associated with increased risk of exacerbation and mortality: A nationwide cohort study of the global SABINA programme](#). *European Respiratory Journal*, 55(4). doi:10.1183/13993003.01872-2019
39. Bloom, C. I., Cabrera, C., Arnetorp, S., Coulton, K., Nan, C., van der Valk, R. J. P., & Quint, J. K. (2020). [Asthma-Related Health Outcomes Associated with Short-Acting \$\beta\$ 2-Agonist Inhaler Use: An Observational UK Study as Part of the SABINA Global Program](#). *Advances in Therapy*, 37(10), 4190–4208. doi:10.1007/s12325-020-01444-5
40. Stoloff SW, Stempel DA, Meyer J, Stanford RH, Carranza Rosenzweig JR. [Improved refill persistence with fluticasone propionate and salmeterol in a single inhaler compared with other controller therapies](#). *Journal of Allergy and Clinical Immunology*. 2004;113(2):245-251. doi:10.1016/j.jaci.2003.10.011
41. Björnsdóttir, U. S., Sigurðardóttir, S. T., Jonsson, J. S., Jonsson, M., Telg, G., Thuresson, M., Naya, I., & Gizurarson, S. (2014). [Impact of changes to reimbursement of fixed combinations of inhaled corticosteroids and long-acting \$\beta\$ 2-agonists in obstructive lung diseases: A population-based, observational study](#). *International Journal of Clinical Practice*, 68(7), 812–819. doi:10.1111/ijcp.12473
42. O'Byrne PM, Bisgaard H, Godard PP, et al. [Budesonide/Formoterol Combination Therapy as Both Maintenance and Reliever Medication in Asthma](#). *Am J Respir Crit Care Med*. 2005;171(2):129-136. doi:10.1164/rccm.200407-884OC
43. O'Byrne PM, FitzGerald JM, Bateman ED, et al. [Inhaled Combined Budesonide–Formoterol as Needed in Mild Asthma](#). *New England Journal of Medicine*. 2018;378(20):1865-1876. doi:10.1056/NEJMoa1715274
44. Rabe KF, Atienza T, Magyar P, Larsson P, Jorup C, Lalloo UG. [Effect of budesonide in combination with formoterol for reliever therapy in asthma exacerbations: a randomised controlled, double-blind study](#). *The Lancet*. 2006;368(9537):744-753. doi:10.1016/S0140-6736(06)69284-2
45. Beasley R, Holliday M, Reddel HK, et al. [Controlled Trial of Budesonide–Formoterol as Needed for Mild Asthma](#). *New England Journal of Medicine*. 2019;380(21):2020-2030. doi:10.1056/NEJMoa1901963.
46. Hardy J, Baggott C, Fingleton J, et al. [Budesonide-formoterol reliever therapy versus maintenance budesonide plus terbutaline reliever therapy in adults with mild to moderate asthma \(PRACTICAL\): a 52-week, open-label, multicentre, superiority, randomised](#)

- [controlled trial](#). The Lancet. 2019;394(10202):919-928. doi:10.1016/S0140-6736(19)31948-8
47. Cheng QJ, Huang SG, Chen YZ, et al. [Formoterol as reliever medication in asthma: a post-hoc analysis of the subgroup of the RELIEF study in East Asia](#). BMC Pulmonary Medicine. 2016;16(1):8. doi:10.1186/s12890-015-0166-0
 48. Bateman ED, Reddel HK, O'Byrne PM, et al. [As-Needed Budesonide–Formoterol versus Maintenance Budesonide in Mild Asthma](#). New England Journal of Medicine. 2018;378(20):1877-1887. doi:10.1056/NEJMoa1715275
 49. AstraZeneca Canada Inc. [Product Monograph: Symbicort \(R\) Turbuhaler \(R\)](#). Published online. February 8, 2021.
 50. Melani AS, Bonavia M, Cilenti V, et al. [Inhaler mishandling remains common in real life and is associated with reduced disease control](#). Respiratory Medicine. 2011;105(6):930-938. doi:10.1016/j.rmed.2011.01.005
 51. Duarte-de-Araújo A, Teixeira P, Hespanhol V, Correia-de-Sousa J. [COPD: misuse of inhaler devices in clinical practice](#). Int J Chron Obstruct Pulmon Dis. 2019;14:1209-1217. doi:10.2147/COPD.S178040
 52. Giraud V, Roche N. [Misuse of corticosteroid metered-dose inhaler is associated with decreased asthma stability](#). Eur Resp J. 2002;19(2):246-251. doi:10.1183/09031936.02.00218402
 53. Melani AS, Zanchetta D, Barbato N, et al. [Inhalation technique and variables associated with misuse of conventional metered-dose inhalers and newer dry powder inhalers in experienced adults](#). Annals of Allergy, Asthma & Immunology. 2004;93(5):439-446. doi:10.1016/S1081-1206(10)61410-X
 54. Volerman A, Carpenter D, Press VG. [What can be done to impact respiratory inhaler misuse: exploring the problem, reasons, and solutions](#). Expert Rev Respir Med. 2020;14(8):791-805. doi:10.1080/17476348.2020.1754800
 55. Vanderman AJ, Moss JM, Bailey JC, Melnyk SD, Brown JN. [Inhaler Misuse in an Older Adult Population](#). The Consultant Pharmacist. 2015;30(2):92-100. doi:10.4140/TCP.n.2015.92
 56. Volerman A, Toups MM, Hull A, Press VG. [A Feasibility Study of a Patient-Centered Educational Strategy for Rampant Inhaler Misuse among Minority Children with Asthma](#). J Allergy Clin Immunol Pract. 2019;7(6):2028-2030. doi:10.1016/j.jaip.2019.01.044
 57. AL-Jahdali H, Ahmed A, AL-Harbi A, et al. [Improper inhaler technique is associated with poor asthma control and frequent emergency department visits](#). Allergy Asthma Clin Immunol. 2013;9(1):8. doi:10.1186/1710-1492-9-8
 58. Basheti IA, Reddel HK, Armour CL, Bosnic-Anticevich SZ. [Improved asthma outcomes with a simple inhaler technique intervention by community pharmacists](#). Journal of Allergy and Clinical Immunology. 2007;119(6):1537-1538. doi:10.1016/j.jaci.2007.02.037
 59. Martin MA, Catrambone CD, Kee RA, et al. [Improving asthma self-efficacy: Developing and testing a pilot community-based asthma intervention for African American adults](#). J Allergy Clin Immunol. 2009;123(1):153-159.e3. doi:10.1016/j.jaci.2008.10.057
 60. Deerojanawong J, Sakolnakorn V, Prapphal N, Hanrutakorn C, Sritippayawan S. [Evaluation of Metered- Dose Inhaler Administration Technique among Asthmatic Children and Their Caregivers in Thailand](#). Asian Pacific journal of allergy and immunology / launched by the Allergy and Immunology Society of Thailand. 2009;27:87-93.

61. Thompson CJ, Irvine MT, Grathwohl CK, Roth MB. [Misuse of Metered-dose Inhalers in Hospitalized Patients](#). Chest. 1994;105(3):715-717. doi:10.1378/chest.105.3.715
62. Harnett CM, Hunt EB, Bowen BR, et al. [A study to assess inhaler technique and its potential impact on asthma control in patients attending an asthma clinic](#). Journal of Asthma. 2014;51(4):440-445. doi:10.3109/02770903.2013.876650
63. [How to Use a Dry Powder Inhaler](#) | Allergy & Asthma Network. Accessed December 2, 2021.
64. Juntunen-Backman K, Kajosaari M, Laurikainen K, et al. [Comparison of Easyhaler Metered-Dose, Dry Powder Inhaler and a Pressurised Metered-Dose Inhaler plus Spacer in the Treatment of Asthma in Children: Clinical Drug Investigation](#). 2002;22(12):827-835. doi:10.2165/00044011-200222120-00003
65. Smith IJ, Parry-Billings M. [The inhalers of the future? A review of dry powder devices on the market today](#). Pulmonary Pharmacology & Therapeutics. 2003;16(2):79-95. doi:10.1016/S1094-5539(02)00147-5
66. Starup-Hansen J, Dunne H, Sadler J, Jones A, Okorie M. [Climate change in healthcare: Exploring the potential role of inhaler prescribing](#). Pharmacology Research & Perspectives. 2020;8(6):e00675. doi:10.1002/prp2.675
67. Müller V, Gálffy G, Eszes N, et al. [Asthma control in patients receiving inhaled corticosteroid and long-acting beta2-agonist fixed combinations](#). A real-life study comparing dry powder inhalers and a pressurized metered dose inhaler extrafine formulation. BMC Pulmonary Medicine. 2011;11(1):40. doi:10.1186/1471-2466-11-40
68. Virchow JC, Crompton GK, Dal Negro R, et al. [Importance of inhaler devices in the management of airway disease](#). Respiratory Medicine. 2008;102(1):10-19. doi:10.1016/j.rmed.2007.07.031
69. Song CWS, Mullon MJ, Regan NA, Roth CBJ. [Instruction of Hospitalized Patients by Respiratory Therapists on Metered-Dose Inhaler Use Leads to Decrease in Patient Errors](#). Respiratory Care. 2005;50(8):1040-1045.
70. Feng L. Metered-Dose Inhaler prescription audit. Hamilton, Canada. August 2021.