ARQUIVOS DE ASMA, ALERGIA E IMUNOLOGIA

Review Article

Caring for the environment: reverse logistics and inhalation devices

Cuidando do ambiente – Logística reversa e dispositivos inalatórios

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ABSTRACT

Asthma is one of the most prevalent chronic diseases and represents a global public health problem, affecting more than 300 million people worldwide, with an estimated additional increase of 100 million cases by 2025. Asthma is a textbook disease of environmental origin, with exposure to infections, allergens, pollutants, and other environmental stressors implicated in its pathogenesis. The environmental impact of inhalation devices is increasingly important and has been rarely addressed and undervalued. Up to 88% of healthcare professionals are unaware that metered-dose aerosol devices contain a propellant gas that affects the ozone layer and causes global warming. Alternative treatment strategies are needed if we are to avoid worsening climate change. Given this scenario, there are excellent opportunities to make asthma treatment more effective, modern, safe, and eco-friendly.

Keywords: Asthma, metered dose inhalers, environment.

RESUMO

A asma é uma das doenças crônicas mais prevalentes e representa um problema de saúde pública global que afeta mais de 300 milhões de pessoas em todo o mundo, com um aumento adicional estimado de 100 milhões até 2025. A asma é uma doença típica de origem ambiental com exposição a infeções, alérgenos, poluentes e outros fatores estressores implicados na sua patogênese. O impacto ambiental causado pelos dispositivos inalatórios é cada vez mais importante, e pouco abordado ou valorizado. Até 88% dos profissionais de saúde não têm conhecimento que os dispositivos de aerossol dosimetrado contêm gás propelente que afeta a camada de ozônio e causa aquecimento global. São necessárias estratégias alternativas de tratamento se quisermos evitar a piora das alterações climáticas. Portanto, diante desse cenário existem oportunidades de ouro para tornar o tratamento da asma mais eficaz, moderno, seguro e ecológico.

Descritores: Asma, inaladores dosimetrados, meio ambiente.

Introduction

Asthma and chronic obstructive pulmonary disease (COPD) are among the most common chronic diseases worldwide. Exacerbation of these diseases may be prevented by improving the quality of the air we breathe. The most used device to treat both is the metered dose inhaler (MDI), which uses hydrofluorocarbons (HFCs) as propellants. HFCs are greenhouse gases contributing disproportionately to the climate crisis.[1]

According to the World Health Organization (WHO), asthma will affect 262 million people and cause 455,000 deaths worldwide in 2019.[2] Because

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of its chronic nature, asthma represents a significant financial burden on public health, both for the disease itself and for its treatment.

However, unlike other chronic diseases, allergic diseases are prevalent in children and young adults. Allergic diseases can affect school, work attendance, and productivity as well as have personal, social, and economic consequences.[2]

There has been great concern for many decades about the increasing incidence and prevalence of allergic diseases in both developed and developing countries. The reasons for these increases are complex, but likely include increased exposure to indoor and outdoor air pollution (with increases in allergic disease correlating with wealth and urbanization).[2]

Inhaler devices

The impact of inhalers on the environment is a growing concern; however, it is one that is rarely addressed or evaluated. Up to 88% of health care workers are unaware that inhalers devices should be disposed of at appropriate collection points, and up to 44% of them are unaware that MDIs contain propellants that deplete the ozone layer and cause global warming[3,4], even in small quantities after disposal.[3]

In the 1990s, MDIs with chlorofluorocarbon (CFC) propellants were replaced by dry powder inhalers (DPIs) and MDIs with HFC propellants, which are potentially less harmful than previous MDIs. The annual carbon (CO_2) footprint per patient can vary from 17 kg to 439 kg for these devices.[5]

Despite the ban on the use of CFC gas in metered dose aerosols after the signing of the Montreal Protocol, HFC gas continues to be used and its impact on the environment remains high. For instance, HFC-227 (Turbuhaler) and HFC-134a (spray) can have environmental impacts equivalent to the emissions from car trips of 185 km and 120 km, respectively, after one month of use.[4,6]

In contrast, soft mist and powder devices emit less than 1 kg of CO_2 per month, while pressurized sprays can emit up to 35 kg of CO_2 per month.[2,3] Think about it on a large scale and these numbers become even more alarming. Between 2009 and 2020, over 21 million units of sprayers will be sold in Brazil.[7] From this, we can imagine the magnitude of the environmental impact they have caused on a global scale. The environmental issue is urgent, and as health care workers and citizens, we must increasingly make our decisions based on our commitment to sustainability.

Challenges

One of the great challenges of the modern world is the generation of waste and how to dispose of it in an environmentally responsible manner. Expired or unused pharmaceutical waste is potentially hazardous to the environment and public health if improperly disposed of. Brazil is the seventh largest consumer of pharmaceuticals in the world, and the Brazilian population generates over 10,000 tons of such waste per year.[8]

Reverse logistics is an important tool for improving the management of this waste. Reverse logistics should be used to direct post-consumer products and packaging, such as batteries, tires, lamps, and pharmaceuticals and their packaging, for recycling or proper final disposal. Reverse logistics is essential to minimize the impact of potential hazards from thousands of pharmaceutical residues that can contaminate people, animals, rivers, lakes, or even crops, causing damage to our ecosystem.[8]

Propellants in MDIs are potent greenhouse gases that account for up to 13% of the carbon footprint of some health care facilities. Salbutamol is the most used MDI for patients with poorly controlled disease. Strategies replacing the overuse of MDIs with treatment regimens emphasizing inhaled corticosteroids have the potential to improve asthma control while significantly reducing greenhouse gas emissions.[9]

Real-world evidence shows that a combination of a long-acting beta-2 agonist and corticosteroids in a once-daily DPI can improve adherence and asthma control while reducing the carbon footprint9. Maintenance and reliever therapy (MART) with the same combination has simplified the treatment of asthma, improved control, and reduced greenhouse gas emissions.[9] Both treatment strategies are popular with patients, most of whom are willing to change their treatment to reduce their carbon footprint.

Global efforts by environmental and health policymakers to replace currently available MDIs with DPIs for asthma control would result in substantial reductions in greenhouse gas emissions with manageable costs or potential cost savings,

depending on the health care system in each region. Policies to reduce the use of MDIs deserve worldwide attention.[10]

Laws

Since 2020, Brazil has implemented a system for reverse logistics of medicines. This initiative was launched by signing the Decree No. 10,388, which established the system for the disposal of expired or unused household medicines.[11]

Initially, the system for reverse logistics will be implemented for pharmacies in state capitals and municipalities with over 500,000 inhabitants. Participation will be optional, provided that the sector ensures one collection point per 10,000 inhabitants. If they choose to participate, pharmacies must provide a visible location to place a container dispenser (anti-return) with plastic bags for consumers to dispose of expired and/or unused medicines.[11]

Upon implementation of this law, we as a society should demand a stronger policy for widespread and conscientious compliance and call for investments in artificial intelligence to create an application with free access for the population. In this way, users will be able to locate the collection points closest to where they live, within this platform linked to the reverse logistics program.

Environmental pollution

Asthma is one of the most common chronic diseases and a global public health problem, affecting over 300 million people worldwide, with an estimated increase of 100 million by 2025.[12,13] Asthma is a typical environmental disease, with exposure to infections, allergens, pollutants, and other environmental stressors significantly increasing the risk of new-onset asthma, asthma exacerbations, or other adverse asthma-related outcomes.[14]

Inhalable air pollutants (e.g., particulate matter [PM]) with an aerodynamic diameter equal to or less than 2.5 μm ($PM_{2.5}$) and equal to or less than 10 μm (PM_{10}), ozone (O_3), nitrogen dioxide (NO_2), sulfur dioxide (SO_2), and carbon monoxide (CO), have been recognized as one of the major environmental threats to human health in the latest World Health Organization (WHO) global air quality guidelines.[15] Other significant outdoor pollutants include volatile organic compounds, ammonia, methane, hydrocarbons, black carbon, and ultrafine particles of nanoscale size (less than 0.1 μm). Outdoor air pollutants are emitted by vehicles, heating systems, industry, refineries, power plants, agriculture, and more. Outdoor air pollutants can also be produced by natural phenomena such as fires, volcanic eruptions, dust storms, and erosion.[15]

Individual air pollutants have long been associated with asthma exacerbations and other adverse asthma-related outcomes, such as loss of asthma control, increased use of health care resources, decreased lung function, or reduced quality of life.[16,17]

Opportunities

Alternative treatment strategies are needed if we are to prevent the exacerbation of climate change. These strategies include promoting nonpharmacological therapies such as smoking cessation and pulmonary rehabilitation, empowering patients to achieve better disease control through written management plans, and promoting preventive therapies rather than relying solely on palliative therapies.

Pharmacological strategies include improving inhalation technique and using spacers; minimizing propellant release by using lower-volume MDIs and simpler dosing regimens; using dose counters to reduce waste; switching to inhalers with low global warming potential; and recycling inhalers.

Sales of asthma medicines in Brazil increased by 51% in the last 12 months compared to the same period last year. In 2023, between January and May, the increase was 33%. The state of Rio Grande do Sul leads the sales ranking with an increase of 38%, followed by Federal District, Paraná, and Goiás. The increase in asthma medication purchases may be related to the evolution of the market to treat it, greater patient concern about asthma, especially after the pandemic, and the increase in cases because of heat waves and increased air pollution.[18] Therefore, reverse logistics becomes even more important in the treatment of asthma.[18]

New propellants with lower global warming potential are on the horizon, and their introduction could provide an opportunity to improve the usability and sustainability of devices. This can be achieved by making them rechargeable, incorporating habits to optimize inhalation technique, adding integrated caps, optimizing materials for recycling, and adding dose counters to all MDIs.[1]

Conclusion

Control and monitoring of asthma remains a challenge worldwide. Although international guidelines recommend the interaction of secondary and primary care services as an effective strategy to control the disease, it is essential to adopt a preventive approach to improve the care of asthma patients. This starts with reducing the carbon footprint of inhalers via structural changes in inhaler manufacturing, universal implementation of reverse logistics, improved compliance with environmental controls, adoption of healthier lifestyles and correct use of prescribed medications.[19]

Therefore, there are golden opportunities to make asthma treatment more effective, modern, safe and environmentally friendly.

References

1. Wilkinson AJK, Anderson G. Sustainability in Inhaled Drug Delivery. Pharmaceut Med. 2020;34(3):191-9. doi: 10.1007/s40290-020-00339-8.
2. Denton E, O'Hehir RE, Hew M. The changing global prevalence of asthma and atopic dermatitis. Allergy. 2023 Aug;78(8):2079-80. doi: 10.1111/all.15754.
3. Urrutia-Pereira M, Chong-Neto HJ, Winders TA, Solé D. Environmental impact of inhaler devices on respiratory care: a narrative review. J Bras Pneumol. 2023;48(6): e20220270. doi:10.36416/1806-3756/e20220270.
4. OzonAction UN Environment (UNEP). Kigali Amendment to the Montreal Protocol, 2016 [Internet]. Available from: http://multimedia.3m.com/mws/media/1365924O/unep-fact-sheet-kigali-amendment-to-mp.pdf. Accessed Jan 10 2024.
5. 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):82-4. doi: 10.1136/thoraxjnl-2019-213744.
6. Intergovernmental Panel on Climate Change (IPCC). Climate Change 2014: Mitigation of Climate Change. 2014. Appendix 8 Page 731-40 [Internet]. Available from: https://www.ipcc.ch/site/assets/uploads/2018/02/WG1AR5_all_final.pdf. Accessed Jan 10 2024.
7. Brasil. gov.br. Serviços e Informações do Brasil. Saúde e Vigilância Sanitária. Consultar dados de vendas de medicamentos controlados, antimicrobianos e outros [Internet]. Available from: https://www.gov.br/pt-br/servicos/consultar-dados-de-vendas-de-medicamentos-controlados-antimicrobianos-e-outros. Accessed Jan 10 2024.
8. Conselho Regional de Farmácias do Paraná. Descarte de Medicamentos. Edição 04, junho de 2018 [Internet]. Available from: https://www.crf-pr.org.br/pagina/view/68/descarte-de-medicamentos. Accessed Jan 23 2024.
9. Wilkinson A, Woodcock A. The environmental impact of inhalers for asthma: A green challenge and a golden opportunity. Br J Clin Pharmacol. 2022;88(7):3016-22. doi: 10.1111/bcp.15135.
10. Kponee-Shovein K, Marvel J, Ishikawa R, Choubey A, Kaur H, Ngom K, et al. Impact of choice of inhalers for asthma care on global carbon footprint and societal costs: a long-term economic evaluation. J Med Econ. 2022;25(1):940-53. doi: 10.1080/13696998.2022.2088196.
11. Federação Brasileira das Redes Associativistas e Independentes de Farmácias - Febrafar. Entenda o Sistema de Logística Reversa de Medicamentos [Internet]. Available from: https://www.febrafar.com.br/entenda-logistica-reversa-de-medicamentos. Accessed Jan 23 2024.
12. WHO factsheet: Asthma 2017 [Internet]. Available from: https://www.who.int/news-room/fact-sheets/detail/asthma . Accessed Jan 23 2024.
13. Global Asthma Network. The Global Asthma Report [Internet]. Auckland; 2018. Available from: http://globalasthmareport.org/2018/index.html. Accessed Jan 23 2024.
14. Annesi-Maesano I, Forastiere F, Balmes J, Garcia E, Harkema J, Holgate S, et al. The clear and persistent impact of air pollution on chronic respiratory diseases: a call for interventions. Eur Respir J. 2021 Mar 18;57(3):2002981. doi: 10.1183/13993003.02981-2020.
15. World Health Organization. WHO global air quality guidelines: particulate matter (PM2.5 and PM10), ozone, nitrogen dioxide, sulfur dioxide and carbon monoxide [Internet]. Available from: https://www.who.int/publications/i/item/9789240034228 . Accessed Feb 07 2024.
16. Kim Y, Park EH, Ng CFS, Chung Y, Hashimoto K, Tashiro K, et al. Respiratory function declines in children with asthma associated with chemical species of fine particulate matter (PM2.5) in Nagasaki, Japan. Environ Health. 2021 Oct 21;20(1):110. doi: 10.1186/s12940-021-00796-x.
17. Altman MC, Kattan M, O'Connor GT, Murphy RC, Whalen E, LeBeau P, et al.; National Institute of Allergy and Infectious Disease's Inner City Asthma Consortium. Associations between outdoor air pollutants and non-viral asthma exacerbations and airway inflammatory responses in children and adolescents living in urban areas in the USA: a retrospective secondary analysis. Lancet Planet Health. 2023 Jan;7(1):e33-e44. doi: 10.1016/S2542-5196(22)00302-3.
18. Simone Blanes. Veja [Internet]. Vendas de medicamentos de asma registram aumento de 51% no Brasil. 26/07/2023. Available from: https://veja.abril.com.br/saude/vendas-de-medicamentos-de-asma-registram-aumento-de-51-no-brasil. Accessed Feb 06 2024.
19. Caminati M, Cegolon L, Bacchini M, Segala N, Dama A, Bovo C, et al. The potential role of local pharmacies to assess asthma control: an Italian cross-sectional study. BMC Public Health. 2021 Jan 5;21(1):19. doi: 10.1186/s12889-020-10080-1.

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