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Page | 132

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## The Impact of Climate Change on Respiratory Health: Advancements in Personalized Health Care and Adaptation Strategies

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### ABSTRACT

Climate change is now acknowledged as a major determinant of chronic respiratory diseases including asthma and chronic obstructive pulmonary disease (COPD). The aim of this review is to explore the relationship between climate change and respiratory diseases, including how climate factors like pollution, temperature and allergens exacerbate these diseases. The review focuses on the recent developments in the field of personalized health care, such as the health-based environmental-risk-counselling and the application of digital health services that are intended to provide treatment options specific to the patient's environment. Furthermore, it explores the importance of the integrated approach which requires both mitigation and adaptation measures to respond to the climate change health effects. The present review finally offers a reflection on how the ideas about climate change could be better integrated into the debates on health technologies for the respiratory diseases, in order to enhance the health promotion and disease prevention strategies.

Keywords: Climate Change, Respiratory Health, Asthma, Chronic Obstructive Pulmonary Disease (COPD), Personalized Health Care and Environmental Counseling

### INTRODUCTION

Climate change is a contemporary problem that influences the climate of the present world and the well-being of people in the present time [1, 2, 3]. Once, our atmosphere, oceans, land, and ice were merely concepts introduced in lectures; today, they are real and growing forces, which compound other problems [4, 5]. The following are some of the consequences that also have a direct bearing on people and, more so, their health, since the world is experiencing an upsurge in the incidence of Non-Communicable Diseases (NCDs) [6, 7]. Climate change as a subject is under discussion, and one of the areas is the effects of climate change on human health [8]. Apart from the frequency and incidence of air pollution events, especially when ozone and respirable particulate matter are included, exposure is also associated with the emergence of new asthma cases and allergic rhinitis, as well as the worsening of chronic obstructive airway disease (COAD) [9]. Such diseases are often referred to as the 'diseases of poverty' because most of the affected individuals come from the low-income bracket [10]. Global climate change is linked with weather-related diseases in that high levels of ozone and particulate matter in the atmosphere aggravate asthma or cause it [11]. The health effects of air pollution are the most visible and common, and

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traditional medical interventions do not have the capacity to handle the increasing and worsening of the disease [12]. For these subject NCD populations, they will thus continue to get new cases of these diseases because of conditions that may not have been well managed as a result of poor health care access and the impacts of pollutants on the human body [13]. Ideas of climate change and health, for example, respiratory diseases, and their social and political relations require action [14]. Each country has its own means of promoting and enforcing the reduction of air emissions, the protection of people's health, and funding for the evaluation of the potential adverse effects of climate change [15]. Hence, it is possible to reduce the direct and indirect effects of climate change on respiratory health across all regions by allocating resources for preventive and protective measures and strengthening health systems [16].

## METHODS

### Search Strategy

A systematic search was conducted using the following databases: PubMed, Scopus, Web of Science, and Google Scholar. The keywords used included 'climate change', 'respiratory health', 'asthma', 'COPD', 'personalized health care', 'environmental counselling', 'digital health solutions', 'adaptation', 'strategies'. Only articles published in English in the last ten years were included to make sure only up to date information was included.

### Selection Criteria

#### Inclusion Criteria

**Relevance:** A systematic review of articles that are directly related to the effects of climate change on respiratory diseases including asthma and COPD.

**Advancements:** Studies conducted on the improvements in the health care delivery systems and changes that may be of use in respiratory illnesses.

**Publication Date:** Articles to be included are those published between the years 2014 to 2024 to include the most recent literature.

**Language:** English language to make it easily understandable and easily accessible to the public especially those who do not understand other languages used in writing publications.

#### Exclusion Criteria

**Irrelevance:** We excluded articles that did not discuss climate change effects on respiratory health or the articles that discussed other diseases which are not related to respiratory diseases.

**Outdated Information:** Articles that are more than a decade old, except for the classic papers that serve to set the background.

**Non-Peer-Reviewed Sources:** To maintain the quality of the included studies only the peer-reviewed articles were considered for the review.

### Data Extraction and Analysis

Data was extracted from selected articles focusing on:

**Impact of Climate Change:** Impact of climate on respiratory health; for example, on temperature, humidity, and air quality.

**Personalized Health Care:** Improvements in the specificity of interventions for environmental context and health status of the patient.

**Adaptation Strategies:** Present and future measures in place or being considered to change the healthcare delivery systems in light of climate change.

**Emerging Technologies:** Technologies in the area of digital health and environmental surveillance for the improvement of the management of respiratory health.

The extracted data were then sorted into different themes to help in providing a systematic review of the study findings. An effort was made in the current work to highlight the trend, innovation, and the gaps of the existing research.

### Quality Assessment

The quality of the included studies was assessed based on:

**Methodological Rigor:** The formulation and implementation of research, such as group comparison, participants' number, and data analysis.

**Relevance:** The applicability of the findings to the use of the impact of climate change on respiratory health.

**Evidence Strength:** The quality of the evidence that is being presented such as the comprehensiveness and the coherence of the findings.

### The Interplay between Human Activity, Environmental Changes, and Respiratory Health

It has been described as the study of how people use the environment and it borrows from disciplines such as geography, sociology, economics, demography and even medicine [17]. Some of the aspects of human This is an Open Access article distributed under the terms of the Creative Commons Attribution License (<http://creativecommons.org/licenses/by/4.0>), which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

behaviour and the environment which affect population health include incidences of diseases and this approach is therefore useful [18]. It covers diseases that are linked to a person's lifestyle, for example, smoking, poor diet, and inactivity, as well as those brought about by environmental factors [19]. Various aspects of the environment and human intervention have also been seen to have contributed to diseases and deaths in recent years; the WHO has noted a growing tendency in this respect [20]. Respiratory diseases are the most prevalent at the moment and are predicted to grow further in the future, especially in children and the ageing population [21]. This trend shows that there is a need to conduct more research and assessment on how climate change affects the respiratory health [22]. Climate change affects respiratory diseases in both a direct way by changes in temperature and humidity and in an indirect way by factors such as flooding, air pollution, and allergens from pollen and moulds [23]. For instance, temperature change and humidity that are indicators of climate change can aggravate respiratory diseases through altering the degree of allergens and pollutants. It also increases the rate of growth of fungi and pollen which are notorious allergens for asthma and other respiratory diseases sufferers [22]. Among all the environmental factors, pollen has the greatest impact on the state of respiratory health [24]. It is one of the main determinant of both the onset and flaring up of respiratory diseases such as asthma and COPD [25]. The only negative factor is that pollen can lead to allergy, aggravate asthma and therefore raise prevalence rates and symptoms [26]. Also, the allergens like those from the Lipid Transfer Protein (LTP) which are proteins that are found in pollen can bring about respiratory irritation and make it hard to manage chronic respiratory disorders [27]. Climate change is associated with the respiratory health impact in a direct and an indirect way [26]. For instance, temperature and humidity can affect the respiratory symptoms and disease course at the most basic level [28]. In a ways, climate change may cause changes in the environment which in turn will lead to the aggravation of respiratory illnesses [29]. For instance, floods lead to increased cases of mold while high temperatures lead to increase in the number of allergens in air [30]. The relationship between climate change and asthma and other allergic conditions, respiratory infections, and chronic obstructive pulmonary diseases is not a straight one. Climate changes affect the manifestation of symptoms and the application of drugs for treatment of respiratory diseases [31]. For instance, during climate change impacts, asthma and other respiratory patients, and chronic illness patients may require the utilization of more drugs, and yet their conditions may be exacerbated [32]. Also, the costs of having respiratory diseases are quite expensive, to an extent of affecting one's financial status [32]. Pharmacological interventions and hospitalisations are very costly when infections or allergen exposure happens during a climatic shift [33]. Consequently, this economic impact underscores the significance of environmental factors in the treatment of respiratory diseases as well as in preventing occurrence of such diseases [34]. In other to achieve this the study employs credible survey data to determine the regional burden of Chronic Lower Respiratory Diseases (CLRDs) and the impact of climate change on these diseases [34]. Population-based studies can provide insight into the link between climate change and respiratory health and they can provide a guide on how other population-based studies can be conducted with climate factors [35]. It is complicated to comprehend or describe how people's actions, environmental processes, and lung health are related [35]. It is therefore crucial to get information on how climate change influence respiratory diseases and the direct and indirect effects of climate change so that better strategies and interventions can be put in place to serve the public health [34]. So, based on the evidence and analysing the problem, the authorities and the representatives of the healthcare sector can counter the challenges of climate change and improve the well-being of vulnerable citizens [35].

#### **The Global Challenge of Chronic Respiratory Conditions: Asthma, COPD, and Their Exacerbation by Environmental Changes**

Asthma and chronic obstructive pulmonary disease (COPD) are long term illnesses of the respiratory system which are a major burden to the health systems globally as shown in Table 1. These diseases are seen by inflammation of the airway and constriction of the bronchi which presents with symptoms of dyspnoea, wheezing, chest tightness and cough [36, 37]. Asthma is usually a condition that is brought about by certain stimuli in the environment including allergens infections and irritants, and this leads to excessive wheezing and breathlessness [37]. The relationship between environmental factors and asthmatic symptoms underlines the necessity of avoiding contact with the potential triggers of asthma to control and reduce the risk of asthmatic attacks [38]. COPD is a difficult and devastating disease characterized mainly by chronic bronchitis and emphysema, which is a worsening of lung function [39]. Both conditions are inflammatory in nature and smoke intake, passive smoking and air pollution pose high risk for the conditions [40]. Asthma and COPD are influence by environmental factors that cause an increase in severity of the disease and are aggravated by air pollution in the form of PM and O<sub>3</sub> [41].

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Cause inflammation of the airways and thus increase the sensitivity of the respiratory system and worsening of chronic respiratory diseases [42]. Contact with certain allergens, for instance, pollens and molds, may bring about an asthmatic attack and hence increase the incidences and severity of the attack [43]. Climate change exacerbates these problems by changing the distribution of pollutants in the air and allergens [40]. COPD exacerbation is a major challenge to both the patients and the healthcare facilities. In the United States of America for instance, acute exacerbations of COPD are responsible for over 12 [40]. Estimates are that there are 6 million physician visits per year with this condition, and it can be quite serious [38]. These hospitalisations represent a substantial component of these visits, indicating the severity of the exacerbations and the necessity for advanced respiratory treatment [40]. Such inflammation during exacerbations may have permanent consequences for the patient's health, raise the probability of further exacerbations, and worsen the course of the disease [44]. It is important to know the processes which underlie these diseases and how they are connected with other factors of the environment in order to control and prevent them [45]. Through identifying environmental factors and enhancing healthcare, the health care systems can enhance the lives of those with chronic respiratory diseases and therefore reduce the burden of these diseases on the society [46]. Preventive measures; minimizing the contact with pollutants and treatment regimes should be pursued in order to enhance the quality of life for the patients with chronic respiratory diseases [47].

### **Medical Interventions and Strategies for Improving Respiratory Health in Vulnerable Populations**

Improving respiratory health in vulnerable populations should therefore involve medical management, devices, vaccination, and prevention as shown in Table 2. These interventions are intended to enhance the quality of life and decrease the impact of respiratory diseases by addressing certain aspects of the diseases [48,49]. Medications play a vital role in the treatment of chronic respiratory diseases, including asthma and COPD, which can be stabilised with inhaled corticosteroids, bronchodilators and leukotriene receptor antagonists [50]. Correct inhalers like the nebulizers and the peak flow meters facilitate the correct delivery of drugs to the lungs [51]. Vaccines also help in the prevention of respiratory diseases and are important for persons at risk who are more likely to suffer severe consequences of these diseases [52]. Prevention is also through administration of flu vaccines to prevent influenza which may cause asthma and COPD exacerbations and pneumococcal vaccines against pneumonia which is a frequent severe complication of chronic respiratory diseases [53]. These steps are important in the prevention of environmental factors affecting the respiratory health. Avoiding outdoor activities in the days when air pollution is high will lower the intake of pollutants and the intensity of respiratory problems [54]. In the communities that are more impacted by air pollution, limiting the traffic in certain areas or creating 'clean air zones' may help to protect such population [55]. Rules that regulate industrial emissions, encourage the use of cleaner transport, and enhance the planning of cities are able to prevent pollution [56]. Population-oriented interventions are directed at various ecological and social determinants of respiratory health, for example, mass media campaigns on air pollution, community-based campaigns on air cleaner use, and measures to enhance indoor air quality [52]. Nevertheless, there is a lack of strong data on the effectiveness of these interventions and it is necessary to carry out more studies to assess their impact on respiratory health and to identify the most effective ways of their implementation [53]. Some of the challenges that affect the actualization of the effectiveness of the strategies include; Heterogeneity of diseases among the susceptible population, since different people may present different manifestations of the same disease in relation to the climate and pollution; Competition between climate change and pollution and other diseases that may cause respiratory diseases; and issues to do with healthcare access, costs, and health literacy [54]. It means that the efforts to reduce the impact of the disease, along with increasing the access to the health care services, providing the information about how to manage the disease and supporting the patients in the community are needed [57]. It is therefore important that interventions are targeted at the individual so as to get the best results [57]. Application of evidence based and individualized medicine to disease phenotype, and to environmental and life style factors can improve management [56]. Future research should concentrate on identifying the effects of different prevention and control measures on respiratory health and on identifying the best strategies and mix of measures to address the effects of climate change and air pollution [57].

### **The Evolution of Personalized Health Care and Environmental Adaptation in the Context of Climate Change**

Personalized care therefore is a revolution in health care delivery in that it entails delivering service in a way that is responsive to the special needs of the individual through identification of their environment, family history, and even the neighborhood as shown Table 3. This approach is now becoming more advanced and developing the use of new technologies and understanding of the environment as ways of

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improving the treatment outcomes especially for those with chronic respiratory diseases [58]. This stands as a major shift from the conventional medicine, which has a 'one fits all' approach in the treatment procedures [59]. A recent addition to the strategy of individualised health care is the so called health-based environmental counselling, which entails the identification of an individual's environmental risks and the incorporation of the identified risk factors into the patient's management plan [60]. The idea of "dosing" in relation to environmental exposure means that interventions are adjusted according to the level and kind of environmental stimuli that a person is exposed to at a certain time, for example, suggesting certain medications or changes in behaviour based on current environmental conditions [60]. This is a very forward-thinking strategy as it reduces the effects of unfavourable environmental conditions on the patient's respiratory system, and therefore the treatment given is well suited for the environmental conditions under which the patient exists [61]. Combination of digital health technologies with environmental systems could help in the transformation of respiratory care [62]. Enabling digital platforms to have feedback of the environment, the level of pollutants could be constantly checked and treatments suggested to the patient could be changed accordingly [63]. Such technologies can be wearable that monitor the air quality and health indicators, or the home automation systems that regulate indoor climate based on outdoor conditions. However, these innovations are still in the embryonic stage to be implemented on a large scale and their efficiency for the promotion of respiratory health in climate change is yet to be proven [64]. Some of the current approach and works in progress in the field of clinical medicine include randomized field trials which offer a strict guideline for the assessment of the effectiveness of a particular treatment [65]. These trials have shown that citywide or regional clean air initiatives are effective, for instance, by cutting vehicle emissions that enhance lung health and reduce instances of asthma [66]. But these measures are largely on the mitigation side not the adaptation side of climate change [67]. This paper therefore recommends the use of both mitigation and adaptive measures in order to reduce the health effects of climate change. Modern technologies, including smartphone applications for digital health and environmental monitoring, combined with the more conventional public health approaches, may help enhance the healthcare system's ability to respond to the challenges of climate change and environmental risk factors in the development of chronic respiratory diseases.

**Table 1: key aspects of asthma and chronic obstructive pulmonary disease (COPD), their environmental impacts and related burden**

Aspect	Asthma	Chronic Obstructive Pulmonary Disease (COPD)	References
Definition	Chronic respiratory disease characterized by airway inflammation and narrowing	Chronic respiratory disease including chronic bronchitis and emphysema	[36]
Key Symptoms	Wheezing, shortness of breath, chest tightness, coughing	Chronic cough, sputum production, shortness of breath, wheezing	[37, 38]
Pathophysiology	Inflammation and constriction of airways due to various triggers	Inflammation leading to mucus production (chronic bronchitis) and destruction of alveoli (emphysema)	[39]
Triggers	Allergens, respiratory infections, irritants	Smoking, secondhand smoke, air pollution	[40]
Environmental Factors	Exposure to allergens such as pollen and molds, air pollution including PM and ozone	Exposure to particulate matter (PM), ozone (O <sub>3</sub> ), and other pollutants	[41]
Climate Change Impact	Increased allergen levels, altered patterns of air pollution, more frequent severe weather events	Higher concentrations of ground-level ozone, increased pollen counts, more frequent extreme weather	[40, 41]

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Exacerbation	Aggravation of symptoms leading to severe asthma attacks	Sudden worsening of symptoms requiring medical intervention	[42, 43]
Annual Physician Visits	Not specified; varies by region and severity	Over 12.6 million visits in the United States annually	[44, 45]
Hospitalization Rate	Not specified; varies by severity and region	Significant portion of exacerbations result in hospitalization	[40]
Treatment	Inhaled corticosteroids, bronchodilators, leukotriene receptor antagonists	Inhaled bronchodilators, corticosteroids, combination inhalers, and other medications	[41,42]
Preventive Measures	Avoidance of known triggers, use of air purifiers, monitoring air quality	Smoking cessation, management of indoor air quality, use of prescribed medications	[42,44]
Recent Advances	Development of personalized health care incorporating environmental monitoring and digital health tools	Integration of advanced health technologies and environmental feedback mechanisms	[43,45]
Challenges	Variability in disease presentation, difficulty in isolating environmental effects from other factors	Compliance issues, especially in disadvantaged populations, complexity in managing combined effects	[44,45,46,47]

**Table 2: Various interventions aimed at improving respiratory health in vulnerable populations**

Intervention Type	Description	Examples	Goals	Challenges	References
Medications	Pharmaceutical treatments to control symptoms and manage chronic respiratory conditions	<ul style="list-style-type: none"> <li>- <b>Asthma:</b> Inhaled corticosteroids, bronchodilators, leukotriene receptor antagonists</li> <li>- <b>COPD:</b> Inhaled bronchodilators, corticosteroids, combination inhalers</li> </ul>	<ul style="list-style-type: none"> <li>Control inflammation and airway constriction</li> <li>- Improve lung function and alleviate symptoms</li> </ul>	<ul style="list-style-type: none"> <li>Adherence to medication</li> <li>- Variation in individual responses</li> <li>- Potential side effects</li> </ul>	[48,49]
Devices	Tools that assist in the delivery of medications and monitoring of respiratory function.	<ul style="list-style-type: none"> <li>- <b>Nebulizers:</b> Convert liquid medication to mist</li> <li>- <b>Peak Flow Meters:</b> Measure lung function and detect worsening symptoms</li> </ul>	<ul style="list-style-type: none"> <li>Ensure effective medication delivery</li> <li>- Monitor respiratory status for timely intervention</li> </ul>	<ul style="list-style-type: none"> <li>Proper usage and maintenance</li> <li>- Accessibility and cost of devices</li> </ul>	[50,51]

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Vaccines	Immunizations to prevent respiratory infections and complications in individuals with chronic conditions.	<ul style="list-style-type: none"> <li>- <b>Influenza Vaccine:</b> Prevents flu, which can exacerbate asthma and COPD</li> <li>- <b>Pneumococcal Vaccine:</b> Protects against pneumonia</li> </ul>	<ul style="list-style-type: none"> <li>Reduce incidence of severe infections</li> <li>- Prevent exacerbations of chronic respiratory diseases</li> </ul>	<ul style="list-style-type: none"> <li>Vaccine availability and access</li> <li>- Vaccine hesitancy</li> </ul>	[52,53]
Preventive Measures	Strategies to minimize exposure to environmental pollutants and reduce respiratory symptom severity.	<ul style="list-style-type: none"> <li>- <b>Avoidance:</b> Minimize outdoor activities during high pollution</li> <li>- <b>Public Health Advisories:</b> Air quality forecasts and recommendations</li> </ul>	<ul style="list-style-type: none"> <li>- Reduce exposure to harmful pollutants</li> <li>- Mitigate the severity of respiratory symptoms</li> </ul>	<ul style="list-style-type: none"> <li>Compliance with recommendations</li> <li>- Variability in air quality and access to advisories</li> </ul>	[54, 55]
Community-Based Interventions	Initiatives aimed at improving environmental and social factors affecting respiratory health on a community level.	<ul style="list-style-type: none"> <li>- <b>Public Awareness Campaigns:</b> Education on air pollution impacts</li> <li>- <b>Clean Air Zones:</b> Restricted areas with lower pollution levels</li> </ul>	<ul style="list-style-type: none"> <li>- Increase community awareness</li> <li>- Improve overall air quality</li> <li>- Support vulnerable populations</li> </ul>	<ul style="list-style-type: none"> <li>- Limited evidence of effectiveness</li> <li>- Need for further research on best practices</li> </ul>	[56,57]
Tailoring Interventions	Customizing treatment and preventive measures to the individual's	<ul style="list-style-type: none"> <li>- <b>Personalized Medicine Approaches:</b> Adjustments to medication regimens</li> </ul>	<ul style="list-style-type: none"> <li>- Enhance effectiveness of interventions</li> <li>- Address</li> </ul>	<ul style="list-style-type: none"> <li>- Complexity of personalized care</li> <li>- Requirement for comprehensive data and continuous assessment</li> </ul>	[56,57]

**Table 3: Advancements in personalized health care for managing chronic respiratory conditions**

Category	Description	Examples/Technologies	Goals	Challenges	References
Personalized Health Care	Tailoring medical treatment based on individual characteristics, including environmental exposures and familial factors.	<ul style="list-style-type: none"> <li>- Personalized medication regimens</li> <li>- Continuous health monitoring</li> </ul>	<ul style="list-style-type: none"> <li>Optimize treatment efficacy</li> <li>- Adapt to changing environmental conditions</li> </ul>	<ul style="list-style-type: none"> <li>Data integration</li> <li>- Variability in individual responses</li> <li>- Privacy concerns</li> </ul>	[58,59]
Environmental Counseling	Assessing and integrating environmental exposures	<ul style="list-style-type: none"> <li>- Air quality assessments</li> <li>- Pollen count monitoring</li> </ul>	<ul style="list-style-type: none"> <li>Align treatment with current environmental</li> </ul>	<ul style="list-style-type: none"> <li>Accuracy of environmental data</li> <li>- Real-time</li> </ul>	[60,61]

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	into treatment plans.		l conditions - Minimize exposure	adaptation	
Dosing" of Environmental Exposures	Tailoring interventions based on the amount and type of environmental exposures.	Adjustment of medication dosages - Lifestyle modification recommendations	Mitigate impact of pollutants - Enhance personalized treatment plans	Measurement of exposure levels - Individual variability	[62,63]
Digital Health Solutions	Use of digital platforms to monitor and adjust treatment based on environmental data.	Wearable air quality monitors - Smart home air quality systems	Continuous monitoring of environmental impact - Dynamic adjustment of treatments	Development and validation of technologies - Cost and accessibility	[64,65]
Current Clinical Approaches	Utilizing randomized field trials and regional interventions to assess treatment efficacy and environmental impacts.	Citywide clean air initiatives - Vehicle emission reduction programs	Demonstrate benefits of clean air interventions - Improve lung function and asthma prevalence	Limited scope of current studies - Focus on mitigation rather than adaptation	[66,67]
Comprehensive Adaptation Strategies	Combining mitigation with adaptation strategies to address health impacts of climate change.	- Integration of advanced health technologies - Personalized treatment plans	Address current and future environmental impacts - Enhance healthcare resilience	Balancing mitigation and adaptation - Ensuring effective implementation	[66,67]

### CONCLUSION

The association between climate change and respiratory health is a difficult issue, where the incidence and severity of respiratory diseases such as asthma and COPD have become worse because of environmental factors. New approaches to the provision of healthcare including environmental counseling and digital health solutions that are now available and provide potential ways of managing these conditions by providing interventions that are compatible with the patient's environment. However, these innovations are still in their infancy and there is a need for more studies especially, randomized controlled trials and effectiveness studies. The assessment of health risks of climate change therefore requires both mitigation and adaptation measures. This approach should link up the use of technology with other public health measures so as to strengthen the health care systems and better the respiratory health of the vulnerable groups. Future works should aim at building on these strategies and finding out how well they work in different environments.

### ABBREVIATIONS

**COPD:** Chronic obstructive pulmonary disease

**NCDs:** Non-Communicable Diseases

**COAD:** Chronic obstructive airway disease

**LPT:** Lipid Transfer Protein

**CLRDs:** Chronic Lower Respiratory Diseases

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## DATA AVAILABILITY STATEMENT

The data that support the findings of this review are available from the corresponding author, upon reasonable request.

## DISCLOSURE STATEMENT

No potential conflict of interest was reported by the author(s)

## TABLES

**Table 1: key aspects of asthma and chronic obstructive pulmonary disease (COPD), their environmental impacts and related burden**

**Table 2: Various interventions aimed at improving respiratory health in vulnerable populations**

**Table 3: Advancements in personalized health care for managing chronic respiratory conditions**

## REFERENCES

1. Xu J, Shi Y, Chen G, Guo Y, Tang W, Wu C, Liang S, Huang Z, He G, Dong X, Cao G. Joint effects of long-term exposure to ambient fine particulate matter and ozone on asthmatic symptoms: prospective cohort study. *JMIR Public Health and Surveillance*. 2023 Aug 3;9:e47403. [jmir.org](http://jmir.org)
2. Cheng CG, Yen SY, Hsiao CC, Lin YY, Chang YH, Chen YH, Cheng CA. Short-Term Exposure Effect of Ambient Fine Particulate Matter, Ozone and Cold Temperature on Emergency Room Visits for Asthma Patients. *Toxics*. 2023 Jan 19;11(2):94. [mdpi.com](http://mdpi.com)
3. Biagioni B, Annesi-Maesano I, D'Amato G, Cecchi L. The rising of allergic respiratory diseases in a changing world: from climate change to migration. *Expert Review of Respiratory Medicine*. 2020 Oct 2;14(10):973-86. [\[HTML\]](#)
4. Viegi G, Maio S, Fasola S, Baldacci S. Global burden of chronic respiratory diseases. *Journal of aerosol medicine and pulmonary drug delivery*. 2020 Aug 1;33(4):171-7. [\[HTML\]](#)
5. Poto R, Loffredo S, Palestra F, Marone G, Patella V, Varricchi G. Angiogenesis, lymphangiogenesis, and inflammation in chronic obstructive pulmonary disease (COPD): few certainties and many outstanding questions. *Cells*. 2022 May 23;11(10):1720. [mdpi.com](http://mdpi.com)
6. Johnson KB, Wei WQ, Weeraratne D, Frisse ME, Misulis K, Rhee K, Zhao J, Snowdon JL. Precision medicine, AI, and the future of personalized health care. *Clinical and translational science*. 2021 Jan;14(1):86-93. [wiley.com](http://wiley.com)
7. Burns J, Boogaard H, Polus S, Pfadenhauer LM, Rohwer AC, Van Erp AM, Turley R, Rehfuess EA. Interventions to reduce ambient air pollution and their effects on health: an abridged Cochrane systematic review. *Environment International*. 2020 Feb 1;135:105400. [sciencedirect.com](http://sciencedirect.com)
8. Rose TC, Daras K, Cloke J, Rodgers S, Farrell P, Ahmed S, Barr B. Impact of local air quality management policies on emergency hospitalisations for respiratory conditions in the North West Coast region of England: a longitudinal controlled ecological study. *International Journal for Equity in Health*. 2021 Dec;20:1-0. [springer.com](http://springer.com)
9. Naclerio R, Ansotegui IJ, Bousquet J, Canonica GW, d'Amato G, Rosario N, Pawankar R, Peden D, Bergmann KC, Bielory L, Caraballo L. International expert consensus on the management of allergic rhinitis (AR) aggravated by air pollutants: impact of air pollution on patients with AR: current knowledge and future strategies. *World Allergy Organization Journal*. 2020 Mar 1;13(3):100106.
10. Zhou Y, Guo Y, Liu Y. Health, income and poverty: Evidence from China's rural household survey. *International journal for equity in health*. 2020 Dec;19:1-2.
11. Deng SZ, Jalaludin BB, Antó JM, Hess JJ, Huang CR. Climate change, air pollution, and allergic respiratory diseases: a call to action for health professionals. *Chinese medical journal*. 2020 Jul 5;133(13):1552-60.
12. Kelly FJ, Fussell JC. Air pollution and public health: emerging hazards and improved understanding of risk. *Environmental geochemistry and health*. 2015 Aug;37:631-49.
13. Manisalidis I, Stavropoulou E, Stavropoulos A, Bezirtzoglou E. Environmental and health impacts of air pollution: a review. *Frontiers in public health*. 2020 Feb 20;8:14.
14. D'Amato G, Vitale C, De Martino A, Viegi G, Lanza M, Molino A, Sanduzzi A, Vatrella A, Annesi-Maesano I, D'Amato M. Effects on asthma and respiratory allergy of Climate change and air pollution. *Multidisciplinary respiratory medicine*. 2015 Dec;10(1):1-8.

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15. Whitmee S, Haines A, Beyrer C, Boltz F, Capon AG, de Souza Dias BF, Ezeh A, Frumkin H, Gong P, Head P, Horton R. Safeguarding human health in the Anthropocene epoch: report of The Rockefeller Foundation–Lancet Commission on planetary health. *The lancet*. 2015 Nov 14;386(10007):1973–2028.
16. Bikomeye JC, Rublee CS, Beyer KM. Positive externalities of climate change mitigation and adaptation for human health: a review and conceptual framework for public health research. *International journal of environmental research and public health*. 2021 Mar 3;18(5):2481.
17. Harden KP, Koellinger PD. Using genetics for social science. *Nature human behaviour*. 2020 Jun 1;4(6):567–76.
18. Sarkar C, Webster C. Urban environments and human health: Current trends and future directions. *Current Opinion in Environmental Sustainability*. 2017 Apr 1;25:33–44.
19. Egger G, Dixon J. Beyond obesity and lifestyle: a review of 21st century chronic disease determinants. *BioMed research international*. 2014;2014(1):731685.
20. Tsai HJ, Wu PY, Huang JC, Chen SC. Environmental pollution and chronic kidney disease. *International Journal of Medical Sciences*. 2021;18(5):1121.
21. Soriano JB, Kendrick PJ, Paulson KR, Gupta V, Abrams EM, Adedoyin RA, Adhikari TB, Advani SM, Agrawal A, Ahmadian E, Alahdab F. Prevalence and attributable health burden of chronic respiratory diseases, 1990–2017: a systematic analysis for the Global Burden of Disease Study 2017. *The Lancet Respiratory Medicine*. 2020 Jun 1;8(6):585–96.
22. Troeger C, Blacker B, Khalil IA, Rao PC, Cao J, Zimsen SR, Albertson SB, Deshpande A, Farag T, Abebe Z, Adetifa IM. Estimates of the global, regional, and national morbidity, mortality, and aetiologies of lower respiratory infections in 195 countries, 1990–2016: a systematic analysis for the Global Burden of Disease Study 2016. *The Lancet infectious diseases*. 2018 Nov 1;18(11):1191–210.
23. Deng SZ, Jalaludin BB, Antó JM, Hess JJ, Huang CR. Climate change, air pollution, and allergic respiratory diseases: a call to action for health professionals. *Chinese medical journal*. 2020 Jul 5;133(13):1552–60.
24. d'Amato G, Chong-Neto HJ, Monge Ortega OP, Vitale C, Ansotegui I, Rosario N, Haahtela T, Galan C, Pawankar R, Murrieta-Aguttes M, Cecchi L. The effects of climate change on respiratory allergy and asthma induced by pollen and mold allergens. *Allergy*. 2020 Sep;75(9):2219–28.
25. Abramson MJ, Perret JL, Dharmage SC, McDonald VM, McDonald CF. Distinguishing adult-onset asthma from COPD: a review and a new approach. *International journal of chronic obstructive pulmonary disease*. 2014 Sep 9:945–62.
26. Wang XY, Ma TT, Wang XY, Zhuang Y, Wang XD, Ning HY, Shi HY, Yu RL, Yan D, Huang HD, Bai YF. Prevalence of pollen-induced allergic rhinitis with high pollen exposure in grasslands of northern China. *Allergy*. 2018 Jun;73(6):1232–43.
27. Zemelka-Wiacek M. Metal Allergy: State-of-the-Art Mechanisms, Biomarkers, Hypersensitivity to Implants. *Journal of Clinical Medicine*. 2022 Nov 25;11(23):6971.
28. Mao N, Zhang D, Li Y, Li Y, Li J, Zhao L, Wang Q, Cheng Z, Zhang Y, Long E. How do temperature, humidity, and air saturation state affect the COVID-19 transmission risk?. *Environmental Science and Pollution Research*. 2023 Jan;30(2):3644–58.
29. Mecenas P, Bastos RT, Vallinoto AC, Normando D. Effects of temperature and humidity on the spread of COVID-19: A systematic review. *PLoS one*. 2020 Sep 18;15(9):e0238339.
30. Harmooshi NN, Shirbandi K, Rahim F. Environmental concern regarding the effect of humidity and temperature on 2019-nCoV survival: fact or fiction. *Environmental Science and Pollution Research*. 2020 Oct;27:36027–36.
31. Eguiluz-Gracia I, Mathioudakis AG, Bartel S, Vijverberg SJ, Fuertes E, Comberiati P, Cai YS, Tomazic PV, Diamant Z, Vestbo J, Galan C. The need for clean air: the way air pollution and climate change affect allergic rhinitis and asthma. *Allergy*. 2020 Sep;75(9):2170–84.
32. Biagioni B, Annesi-Maesano I, D'Amato G, Cecchi L. The rising of allergic respiratory diseases in a changing world: from climate change to migration. *Expert Review of Respiratory Medicine*. 2020 Oct 2;14(10):973–86.
33. Pacheco SE, Guidos-Fogelbach G, Annesi-Maesano I, Pawankar R, d'Amato G, Latour-Staffeld P, Urrutia-Pereira M, Kesic MJ, Hernandez ML, American Academy of Allergy A, Respiratory Health Committee. Climate change and global issues in allergy and immunology. *Journal of Allergy and Clinical Immunology*. 2021 Dec 1;148(6):1366–77.

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34. Biagioni B, Cecchi L, D'Amato G, Annesi-Maesano I. Environmental influences on childhood asthma: climate change. *Pediatric Allergy and Immunology*. 2023 May;34(5):e13961.
35. Li Y, Peterson ME, Campbell H, Nair H. Association of seasonal viral acute respiratory infection with pneumococcal disease: a systematic review of population-based studies. *BMJ open*. 2018 Apr 1;8(4):e019743.
36. Soriano JB, Kendrick PJ, Paulson KR, Gupta V, Abrams EM, Adedoyin RA, Adhikari TB, Advani SM, Agrawal A, Ahmadian E, Alahdab F. Prevalence and attributable health burden of chronic respiratory diseases, 1990–2017: a systematic analysis for the Global Burden of Disease Study 2017. *The Lancet Respiratory Medicine*. 2020 Jun 1;8(6):585–96.
37. Douros K, Everard ML. Time to say goodbye to bronchiolitis, viral wheeze, reactive airways disease, wheeze bronchitis and all that. *Frontiers in pediatrics*. 2020 May 5;8:218.
38. Mthembu N, Ikwegbue P, Brombacher F, Hadebe S. Respiratory viral and bacterial factors that influence early childhood asthma. *Frontiers in Allergy*. 2021 Jul 22;2:692841.
39. Rodrigues SD, Cunha CM, Soares GM, Silva PL, Silva AR, Goncalves-de-Albuquerque CF. Mechanisms, pathophysiology and currently proposed treatments of chronic obstructive pulmonary disease. *Pharmaceuticals*. 2021 Sep 26;14(10):979.
40. Alfahad AJ, Alzaydi MM, Aldossary AM, Alshehri AA, Almughem FA, Zaidan NM, Tawfik EA. Current views in chronic obstructive pulmonary disease pathogenesis and management. *Saudi Pharmaceutical Journal*. 2021 Dec 1;29(12):1361–73.
41. Hadzic S, Wu CY, Avdeev S, Weissmann N, Schermuly RT, Kosanovic D. Lung epithelium damage in COPD—an unstoppable pathological event?. *Cellular signalling*. 2020 Apr 1;68:109540.
42. Szalontai K, Gémes N, Furák J, Varga T, Neuperger P, Balog JÁ, Puskás LG, Szebeni GJ. Chronic obstructive pulmonary disease: epidemiology, biomarkers, and paving the way to lung cancer. *Journal of clinical medicine*. 2021 Jun 29;10(13):2889.
43. Erbas B, Jazayeri M, Lambert KA, Katelaris CH, Prendergast LA, Tham R, Parrodi MJ, Davies J, Newbiggin E, Abramson MJ, Dharmage SC. Outdoor pollen is a trigger of child and adolescent asthma emergency department presentations: a systematic review and meta-analysis. *Allergy*. 2018 Aug;73(8):1632–41.
44. Peters MC, Mauger D, Ross KR, Phillips B, Gaston B, Cardet JC, Israel E, Levy BD, Phipatanakul W, Jarjour NN, Castro M. Evidence for exacerbation-prone asthma and predictive biomarkers of exacerbation frequency. *American journal of respiratory and critical care medicine*. 2020 Oct 1;202(7):973–82.
45. Tan KS, Lim RL, Liu J, Ong HH, Tan VJ, Lim HF, Chung KF, Adcock IM, Chow VT, Wang DY. Respiratory viral infections in exacerbation of chronic airway inflammatory diseases: novel mechanisms and insights from the upper airway epithelium. *Frontiers in cell and developmental biology*. 2020 Feb 25;8:99.
46. Haque M, Islam T, Rahman NA, McKimm J, Abdullah A, Dhingra S. Strengthening primary health-care services to help prevent and control long-term (chronic) non-communicable diseases in low-and middle-income countries. *Risk management and healthcare policy*. 2020 May 18:409–26.
47. Grigorieva E, Lukyanets A. Combined effect of hot weather and outdoor air pollution on respiratory health: Literature review. *Atmosphere*. 2021 Jun 19;12(6):790.
48. Godman B, Haque M, McKimm J, Abu Bakar M, Sneddon J, Wale J, Campbell S, Martin AP, Hoxha I, Abilova V, Anand Paramadhas BD. Ongoing strategies to improve the management of upper respiratory tract infections and reduce inappropriate antibiotic use particularly among lower and middle-income countries: findings and implications for the future. *Current medical research and opinion*. 2020 Feb 1;36(2):301–27.
49. Saketkoo LA, Russell AM, Jensen K, Mandizha J, Tavee J, Newton J, Rivera F, Howie M, Reese R, Goodman M, Hart P. Health-related quality of life (HRQoL) in sarcoidosis: diagnosis, management, and health outcomes. *Diagnostics*. 2021 Jun 15;11(6):1089.
50. Matera MG, Page CP, Calzetta L, Rogliani P, Cazzola M. Pharmacology and therapeutics of bronchodilators revisited. *Pharmacological reviews*. 2020 Jan 1;72(1):218–52.
51. Sorino C, Negri S, Spanevello A, Visca D, Scichilone N. Inhalation therapy devices for the treatment of obstructive lung diseases: the history of inhalers towards the ideal inhaler. *European Journal of internal medicine*. 2020 May 1;75:15–8.

52. Simon S, Joean O, Welte T, Rademacher J. The role of vaccination in COPD: influenza, SARS-CoV-2, pneumococcus, pertussis, RSV and varicella zoster virus. *European Respiratory Review*. 2023 Sep 30;32(169).
53. Fekete M, Pako J, Nemeth AN, Tarantini S, Varga JT. Prevalence of influenza and pneumococcal vaccination in chronic obstructive pulmonary disease patients in association with the occurrence of acute exacerbations. *Journal of Thoracic Disease*. 2020 Aug;12(8):4233.
54. Mebrahtu TF, McEachan RR, Yang TC, Crossley K, Rashid R, Hossain R, Vaja I, Bryant M. Differences in public's perception of air quality and acceptability of a clean air zone: A mixed-methods cross sectional study. *Journal of Transport & Health*. 2023 Jul 1;31:101654.
55. Nieuwenhuijsen MJ. Urban and transport planning pathways to carbon neutral, liveable and healthy cities; A review of the current evidence. *Environment international*. 2020 Jul 1;140:105661.
56. Kvedar J, Coye MJ, Everett W. Connected health: a review of technologies and strategies to improve patient care with telemedicine and telehealth. *Health affairs*. 2014 Feb 1;33(2):194-9.
57. Manisalidis I, Stavropoulou E, Stavropoulos A, Bezirtzoglou E. Environmental and health impacts of air pollution: a review. *Frontiers in public health*. 2020 Feb 20;8:14.
58. Wijnenbeek MS, Moor CC, Johannson KA, Jackson PD, Khor YH, Kondoh Y, Rajan SK, Tabaj GC, Varela BE, van der Wal P, van Zyl-Smit RN. Home monitoring in interstitial lung diseases. *The Lancet Respiratory Medicine*. 2023 Jan 1;11(1):97-110.
59. Kopp JB, Anders HJ, Susztak K, Podestà MA, Remuzzi G, Hildebrandt F, Romagnani P. Podocytopathies. *Nature Reviews Disease Primers*. 2020 Aug 13;6(1):68.
60. Hickie IB, Scott EM, Cross SP, Iorfino F, Davenport TA, Guastella AJ, Naismith SL, Carpenter JS, Rohleder C, Crouse JJ, Hermens DF. Right care, first time: a highly personalised and measurement-based care model to manage youth mental health. *Medical Journal of Australia*. 2019 Nov;211:S3-46.
61. Jin YH, Cai L, Cheng ZS, Cheng H, Deng T, Fan YP, Fang C, Huang D, Huang LQ, Huang Q, Han Y. A rapid advice guideline for the diagnosis and treatment of 2019 novel coronavirus (2019-nCoV) infected pneumonia (standard version). *Military medical research*. 2020 Dec;7:1-23.
62. Honkoop P, Usmani O, Bonini M. The current and future role of technology in respiratory care. *Pulmonary Therapy*. 2022 Jun;8(2):167-79.
63. Dunn J, Coravos A, Fanarjian M, Ginsburg GS, Steinhubl SR. Remote digital health technologies for improving the care of people with respiratory disorders. *The Lancet Digital Health*. 2024 Apr 1;6(4):e291-8.
64. Alami H, Rivard L, Lehoux P, Ag Ahmed MA, Fortin JP, Fleet R. Integrating environmental considerations in digital health technology assessment and procurement: Stakeholders' perspectives. *Digital Health*. 2023 Dec;9:20552076231219113.
65. Chevance A, Ravaud P, Cornelius V, Mayo-Wilson E, Furukawa TA. Designing clinically useful psychopharmacological trials: challenges and ways forward. *The Lancet Psychiatry*. 2022 Jul 1;9(7):584-94.
66. McEachan RR, Rashid R, Santorelli G, Tate J, Thorpe J, McQuaid JB, Wright J, Pickett KE, Pringle K, Bojke L, Jones S. Study Protocol. Evaluating the life-course health impact of a city-wide system approach to improve air quality in Bradford, UK: A quasi-experimental study with implementation and process evaluation. *Environmental Health*. 2022 Dec 5;21(1):122.
67. Faure M. Climate change adaptation and compensation. In *Research Handbook on Climate Change Adaptation Law* 2022 Jun 14 (pp. 105-134). Edward Elgar Publishing.

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