



Review Article

Respiratory health in Africa: Strides and challenges

Gregory E. Erhabor

Department of Medicine, Obafemi Awolowo University/Obafemi Awolowo University Teaching Hospitals Complex, Ile-Ife, Osun State, Nigeria.

***Corresponding author:**

Gregory E. Erhabor,
Department of Medicine,
Obafemi Awolowo University/
Obafemi Awolowo University
Teaching Hospitals Complex,
Ile-Ife, 220282, Osun State,
Nigeria.

gregerhabor@gmail.com

Received : 07 December 2020

Accepted : 13 December 2020

Published : 23 January 2021

DOI

10.25259/JPATS_30_2020

Quick Response Code:



ABSTRACT

The challenges of Respiratory Medicine in Africa go beyond the coronavirus disease 2019 (COVID-19). Communicable diseases such as Pneumonia and Tuberculosis are still important public health challenges, although considerable strides in the management have been made. Non-communicable respiratory diseases are also increasing in burden and the risk factors are pervasive in Africa. The COVID-19 pandemic had exposed the weakness of the health system in most parts of Africa and this is an opportunity for stakeholders to come together to develop sustainable strategies to build resilient health systems. A number of African initiatives such as the Pan African Thoracic Society are at the forefront to improve Respiratory health in Africa and must work in collaboration with the global community to achieve this objective.

Keywords: Coronavirus disease 2019, Pandemic, Respiratory health, Africa, Global community

INTRODUCTION

As the world is embroiled with coronavirus disease 2019 (COVID-19), it is noteworthy that the challenges of respiratory medicine in Africa go beyond COVID-19. Respiratory diseases pose a major problem with increasing trends across the continent. A number of factors have been attributed to as drivers for the growing problem of respiratory diseases in Africa. These include biological, political, economic, environmental, socio-cultural, technological drivers, and others (including globalization, urbanization, and industrialization, social determinants, and inequalities). Communicable and non-communicable diseases are largely on the increase across the continent. Two of the targets of the Sustainable Development Goals 3 is to end the epidemics of AIDS, tuberculosis (TB), malaria, and neglected tropical diseases and combat hepatitis, water-borne diseases, and other communicable diseases, and to reduce by one-third premature mortality from non-communicable diseases by the year 2030.^[1] Although some sporadic progress has been made, a decade to this target, the African continent is still far from achieving any of these goals as action to meet the goals is not yet progressing at speed required.^[1]

COMMUNICABLE DISEASES

The long-running battle against communicable respiratory diseases is still on. Spread by infectious agents, such as bacteria, viruses, fungi, or parasites, most of these diseases are transmitted mainly through inhalation or contact with bodily fluids/droplets. Of paramount importance among the communicable respiratory diseases are acute respiratory tract infections

This is an open-access article distributed under the terms of the Creative Commons Attribution-Non Commercial-Share Alike 4.0 License, which allows others to remix, tweak, and build upon the work non-commercially, as long as the author is credited and the new creations are licensed under the identical terms.

©2020 Published by Scientific Scholar on behalf of Journal of the Pan African Thoracic Society

(ARIs), especially pneumonia, TB, and now more recently, coronavirus infections. Poor hygiene practices and ineffective vaccination programs perpetuate a number of these diseases in our environment.

ARIs

ARIs are major causes of presentations at emergency units, hospital admission, and deaths in Africa. Pneumococcal infection is a major cause of morbidity and mortality worldwide, mainly affecting extremes of age. It is the most common infectious cause of death in children globally, resulting in more childhood deaths than any other infectious disease. A child dies of pneumonia every 39 s with about 2,200 deaths every day. WHO estimates that 1.6 million deaths are caused by pneumonia annually with 0.7–1 million deaths occurring in children aged under 5 years and 600,000–900,000 deaths in adults, especially in the elderly.^[2]

Annually, about 1400 cases of pneumonia/100,000 children are recorded every year, with the greatest incidence occurring in South Asia (2500 cases/100,000 children) and West and Central Africa (1620 cases/100,000 children). More than 90% of pneumococcal pneumonia deaths in children occur in developing countries and pneumococcal meningitis kills or disables 40–75% of children who get infected. Pneumonia deaths among children have been linked to poverty and poor socioeconomic conditions, including poor sanitation, lack of portable water, indoor air pollution, and poor accessibility to healthcare. These factors remain endemic in Africa.^[3]

The incidence of community-acquired pneumonia among the elderly is 4 times higher compared to those under 65 years with approximately 3 episodes/1000 persons in those aged between 65 years and 69 years with an exponential increase to 22 episodes/1000 persons between the ages of 85 years and 89 years.^[4] Exacerbations are the most important causes of chronic obstructive pulmonary disease (COPD) deaths and these are usually triggered by infections, of which *Streptococcus pneumoniae* is one of the organisms frequently implicated. Exacerbations of COPD will be greatly reduced by vaccination. However, there are no policies or programs for adult vaccination in most parts of Sub-Saharan Africa and Africa as a whole.

To combat ARIs in Africa, prompt diagnosis and identification of etiological factors are important for measuring the burden of disease. There is also a need to implement appropriate preventive or treatment strategies and develop more effective interventions.^[5] Efforts must also be geared toward improving the socioeconomic condition of the people, provide basic amenities, strengthen the expanded immunization program for children, implement vaccination policies for the elderly, and increase health awareness at all levels.

TB

TB is the leading cause of death from a single infectious agent globally.^[6] Four epidemics of TB have occurred in the last four decades. The first global resurgence happened in the early eighties, with an increase in the incidence of TB, rather than the erstwhile decline till that period. The second epidemic was engendered by TB/HIV co-infection, popularly referred to as the “Twin epidemics.”^[7] The Third TB epidemic is that of multi-drug resistant TB which was discovered in 1991, while the fourth epidemic is the emergence of extreme drug resistance.^[8] In 1993, WHO declared TB a public health emergency and a clarion call was made to governments to make TB a priority and scale-up intervention and control.^[6]

Africa is home to over 1 billion people and is disproportionately affected by TB with 2.6 million of the 10.4 million global TB cases, making the continent a key geographical area for health interventions.^[6] Globally, TB is responsible for more years of healthy life lost (2.5% of all disability-adjusted life years, or DALYs) than any other infectious disease.^[9]

The unprecedented growth of the TB epidemic in Africa is attributable to several factors, the most important being the HIV epidemic.^[10] Over the past decade, the TB caseload has increased in countries of eastern and southern Africa that are most affected by HIV.^[7] Untreated HIV infection causes a progressive decline in the number of CD4+ T lymphocytes. HIV-infected people are more susceptible to new tuberculous infections and to re-infection, and they progress more frequently and more quickly to overt disease; however, the risk of developing active disease increases as the CD4+ cell count declines. Continuing poverty, poor infrastructure, fragile health systems, poor budgeting for health, far less than the minimum required; political instability and terrorism, leading to the increasing number of internally displaced people in parts of the continent, have further compounded the already difficult situation.^[11] These have equally inhibited TB management, contributing in no small measure to setbacks in implementing effective TB control measures.

The true burden of drug-resistant TB on the continent is poorly described with very few countries having results from a formal survey. An interesting modeling study was undertaken by Musa *et al.*^[12] to understand trends and burden of drug resistance TB on the continent. Using available data sources, including surveys and published studies in Sub-Saharan Africa, the region with the highest prevalence was in the South of Africa, with 3.1% (2.1–4.2%) of TB cases being drug-resistant. This was followed by central (2.1%; 1.1–3.0%), western (1.9%; 1.2–2.6%), and eastern (1.7%; 1.1–2.2%) regions of Sub-Saharan Africa. These prevalence estimates correlate well with recent surveys in the region.

It is not all a gloomy situation for TB in Africa. Many strides are being made; the introduction of Directly Observed

Therapy Short Course in the early 1990s brought about some improvement in the management of poorly-treated TB and access to treatment is increasing and expanding daily, though the COVID-19 pandemic has affected in some ways. There are ongoing Research and Development projects that are developing newer and patient-friendly diagnostics, especially non-sputum-based tests.^[13]

Detection and treatment of latent TB have also taken a priority position in most African countries. This commendable initiative provides opportunities to treat the seedbed of infection before the development of active disease.

Community models for treating both drug-sensitive and resistant cases have been implemented. The introduction of the short multi-drug resistant TB regimen is a welcome development, with about 40% of countries having implemented it. Bedaquiline has also been introduced in some countries.^[14] Management of TB in Africa is still strongly driven by international aids. As long as these trends continue, it will be difficult for governments in Africa to face the realities of the epidemic. There is a need to reverse this trend for individual nations to take full responsibility for their citizens and chart a course forward. There are great potentials for TB control in Africa if socio-political and economic issues are addressed and each national government walks the talk by committing substantial funds to the program. This, with lots of inter-sectoral and intra-sectoral collaborations, Africa is surely on its way of being TB free.

COVID-19

COVID-19, caused by an RNA betacoronavirus known as severe acute respiratory syndrome coronavirus 2 was first reported in Wuhan, the capital city of the Hubei province in China, in December 2019. Since then, it has caused a pandemic with a great impact on the health and economic systems globally. With over 25 million cases and over eight hundred thousand deaths and still counting, the world is truly facing a communicable disease of dire proportions.^[15] The impact on respiratory health is huge as the lungs are the major organs affected. Most infected persons present to the emergency units with symptoms of acute respiratory illness, which ranges from mild to severe with increasing severity found among the elderly and those with comorbidities.^[16]

The advent of COVID on the global stage has exposed the fragile healthcare system in Africa and further worsened it. Many countries were not prepared for the magnitude of problems posed by COVID-19; however, African nations were especially challenged in view of already poor health infrastructure, lack of political will, delayed epidemic response to disease, delayed presentation at hospitals, poor information dissemination, and attendant stigmatization

following infection. All these contribute to the upward trend in cases and mortality that Africa is experiencing now.^[16]

One important lesson of COVID-19 is the need for epidemic/pandemic preparedness and technological advancements in our healthcare systems. The vast neglect of the health parastatal in Africa became unduly glaring as the world faced this great health challenge. There is an urgent need to galvanize efforts toward strict enforcement of containment measures, promulgation of sustained hygiene practices in the prevention of communicable disease, upgrade of hospitals and healthcare facilities, establishment of more isolation centers, and mass production of protective equipment.^[17] This should not just be done as a reaction to the current trend but should become routine. Developing a vaccine is of great importance to mitigate the effect of the disease; however, with reports of new mutants being discovered, it is obvious we still have a great challenge before us. In spite of the odds, governments of nations must map a strategy for continual progress in spite of the disease. No single country can solve the problem of COVID-19; we have to explore a universal approach.

NON-COMMUNICABLE DISEASES

Africa shares a huge burden of chronic respiratory diseases (CRDs). It is rather concerning that despite still grappling with the challenges of communicable respiratory diseases, non-communicable diseases such as Asthma and COPD are also taking their tolls. In recent times, illnesses which were previously considered diseases of affluence such as obstructive sleep apnea and obesity hypoventilation syndrome are also on the increase due to the adoption of a westernized lifestyle and diet.

Asthma

Many studies have been conducted to assess the prevalence of asthma in Africa. The International Study of Asthma and Allergies in Childhood Phases 1–3 was conducted in many centres in the world to determine prevalence and severity of asthma, allergic rhinoconjunctivitis, and atopic eczema. Phase 3 study found increasing prevalence in Africa with high prevalence found in Cape Town, South Africa (20.3%), Polokwane, South Africa (18.0%), Reunion Island (21.5%), Brazzaville, Congo (19.9%), Nairobi, Kenya (18.0%), Urban Ivory Coast (19.3%), and Conakry, Guinea (18.6%), compared to other countries studied.^[18] The Asthma insights and reality in the Maghreb study found low prevalence in Algeria (3.45%), Morocco (3.89%), and Tunisia (3.53%).^[19] A systematic analysis of studies estimated Asthma cases in Africa to be 34.1 million (12.1%) among children <15 years, 64.9 million (11.8%) among people aged <45 years, and 74.4 million (11.7%)

in the total population.^[20] This varies depending on what diagnostic criteria were used.

One of the big problems of asthma is poor knowledge of the disease and continual traditional management of disease without taking cognizance of current guidelines. Particularly, in many centers, clinicians still favor the use of beta 2 agonists as the first-line treatment of asthma. The use of continuous beta-agonists causes B-receptor downregulation, decreased bronchoprotection, rebound hyperresponsiveness, decreased bronchodilator response, increased allergic response, and increased eosinophilic airway inflammation. Using greater than three canisters per year is associated with a higher risk of emergency department presentations and greater than twelve canisters per year is associated with a higher risk of death.^[21]

The wide variation in the prevalence of asthma can partly be explained by poverty, climate, exposure to tobacco smoke, viral infection, air pollution, chemical irritants, helminth infections, diet, and well-known allergens such as house dust mite, cockroach, dog, and cat dander. Sensitization to pet allergy is becoming more frequent in urban areas.

The increasing prevalence has been attributed to increasing urbanization and air pollution. Asthma is still vastly underdiagnosed and undertreated, even in tertiary hospitals, because of poor education and lack of availability and affordability of asthma medications, resulting in preventable loss of lives.^[22] There is still poor government involvement and active support to strengthen research and patient care in asthma.

To reduce the burden of asthma in Africa, there must be concerted efforts by the physicians, patients, stakeholders, and the different national governments. Other things that can be done include increasing public awareness through the media, mass education in schools, churches, and mosques, and massive distribution of asthma information materials. The government plays a major role in making policies that favor healthcare and establishment of standard healthcare facilities nationwide or mitigates the burden of asthma on patients and caregivers by subsidizing the cost of care for asthmatic patients.

COPD

COPD poses a global public health challenge. It is currently the third leading cause of death worldwide. About 300 million people were found to have COPD globally in 2017. The occurrence of COPD in the general population has been projected to be greater than 10% among those aged 40 years and above. More than 90% of COPD deaths occur in low-and-middle income countries, where healthcare is not readily accessible or affordable.

The Burden of Obstructive Lung Disease (BOLD) study, a multinational, multi-center study conducted to determine the prevalence of COPD globally, found an overall prevalence of 7.7% in Nigeria and 19% in South Africa.^[23] COPD is the only chronic disease showing a progressive upward trend in both death rates and illness. The total global deaths from COPD increased by 12% from 1995 to 2017.^[24]

COPD burden is projected to increase in the coming decades because of continued exposure to smoking and the aging population. Other drivers of increasing prevalence include indoor pollution (biomass fuel exposure), exposure to noxious gases, previous TB, and HIV/AIDS. It is well known that cigarette smoking is a major cause of COPD in developed countries. However, indoor pollution is becoming an important cause of COPD in low-income countries.

It has been found that advanced stages of COPD occurred more globally than earlier reported, a burden that is expected to increase with the aging population. Data from the BOLD study found the prevalence of stage II or higher COPD was 10.1% overall, with 11.8% for men and 8.5% for women. GOLD stage II COPD in African men and women was found to be 22.2% and 16.7% in South Africa.^[25]

COPD is a preventable disease and it is better to prevent the etiological factors that predispose to the disease. With the increasing trends in COPD, there is a need to continue to increase awareness of the risk factors and focus on preventive measures to slow down the progression. As advancements in technology and improvement in health facilities lead to an increasing aged population, better policies should be put in place to cater for this subset of the population vis a vis vaccination policy for the elderly and responding to the social priorities and critical need of the aged.

Occupational lung diseases and cancers

Africa also faces the problem of occupational lung diseases. Increase in mining activities is partly said to be responsible for this. A number of challenges driving the prevalence of occupational lung disease include lack of regulations and legislations that focus on the work environment and even where regulations exist, they are rather weak and not enforced. Others are increasing exposure to particulate matter in the workplace which leads to rapid deterioration of lung functions.

Lung cancers are also on the increase with the increase in smoking rates among the population in Africa. However, many non-smoking related cancers are now being seen, probably a reflection of lifestyle changes, exposure to outdoor pollution, and effect of westernization in Africa.

There are still gaps in quantifying the true burden regarding prevalence, morbidity, and mortality of CRDs in Africa.

IMPORTANT RISKS

Smoking

The problem of cigarette smoking is of paramount importance. WHO estimates that there are about 1.3 billion smokers worldwide and this is projected to increase to 1.6 billion smokers in 2025. Smoking results in over 8 million deaths annually with over 7 million of those deaths attributable to direct tobacco use, while about 1.2 million results from exposure to second-hand smoke by non-smokers.^[26]

More than 80% of the world's tobacco users live in low- and middle-income countries. Among sub-Saharan African youths, the rates of smoking are said to range from 1.4% in Zimbabwe and 1.5% in Nigeria to 34.4% in Cape Town, South Africa. In Kenya, 7.2% of school-going adolescents smoke cigarettes, while 8.5% use other forms of tobacco products. Overall, the national smoking prevalence among men in sub-Saharan Africa varies between 20% and 60% and the annual cigarette consumption rates are on the rise for both men and women, according to the global tobacco survey data.^[27]

Smoking has been implicated in many respiratory diseases and is the key etiological factor in the development of COPD and lung cancers. It serves as a trigger factor and leads to progression of asthma and other respiratory diseases. Smoking cessation must be adequately emphasized and encouraged among patients with respiratory illness if we will have a decrease in morbidity and mortality from non-communicable diseases.

Household air pollution (HAP)

HAP from cooking with solid fuel is a growing challenge in Africa. Although there has been a decline in the proportion of the world's households relying mainly on solid fuels for cooking, the population in Sub-Saharan Africa has not kept up with this global trend with 83% of residents in Sub-Saharan Africa still continuing to use solid fuel for cooking.^[28] According to WHO 2018 update, more than 130/100,000 deaths are attributable to HAP in Africa region, which is the largest globally.^[23] Deaths associated with solid fuel rose by 18% between 1990 and 2013 and cost the African economy approximately USD 232 billion in 2013.^[29] This disproportionately affects the poor and rural communities, women and children.^[30] In Africa, 352 million children are exposed to HAP,^[31] and more than 50% of premature deaths due to pneumonia among children under 5 years are caused by the particulate matter inhaled from HAP.^[32]

The negative health effect of exposure to HAP has been well documented across Africa and it ranges from respiratory, cardiovascular, neurocognitive, reproductive, and other health effects. Among respiratory health problems associated with HAP are acute lower respiratory infections among children, pneumonia in adults, lung function decrement,

COPD, asthma, TB, interstitial lung disease, bronchiectasis, reduced human macrophage oxidative burst, and diminished inflammatory cytokine responses. HAP is also associated with lung, mouth, laryngeal, and pharyngeal cancers. More so, HAP has been associated with adverse pregnancy and perinatal outcomes.^[28,31,33-36]

The health, economic, and environmental consequences of HAP is substantial, although various efforts have been made to reduce the effect of HAP which contribute substantially to number one environmental cause of death in Africa. Poverty is still prevalent in most African countries and many nations lack facilities for providing real-time air quality index. The adoption and use of fuel-efficient and improved cook-stoves are still minimal in rural communities and alternative clean fuels such as liquefied petroleum gas and electricity are largely unavailable. Therefore, an integrated and sustainable approach by all stakeholders; global agencies, governments, non-governmental institutions, other policymakers, professional thoracic societies, scientists, health-care providers, communities, and individuals would be needed to mitigate the public health, climatic and economic effects of HAP.

AFRICAN INITIATIVES

There have been concerted efforts aimed at mitigating the challenges highlighted above and there are many initiatives across the continent; this section highlights a few.

National societies

Many Thoracic Societies, such as the Nigerian Thoracic Society, South African Thoracic Society, East African Thoracic Society, and among others, have sprung up to rise to the challenges of respiratory diseases in Africa.

Pan African thoracic society (PATS)

Finally, the PATS was formed by a steering committee to holistically combat issues of the chest as a continent. The PATS is made up of Respiratory Physicians and Allied Professionals, who have been on the frontline of providing care for respiratory diseases. It was established with the overall aim of promoting lung health in Africa through education, training, research, and advocacy. In the last few years, PATS has grown substantially, becoming a voice for lung health in Africa, undertaking educational, research, and advocacy initiatives and building African capacity to address the challenges of improving lung health on the continent.

Collaboration of national and international societies

A number of initiatives have also come into action to see to it that Africa provides the right and appropriate response

to the problem of respiratory diseases. One of such is the collaboration between National Thoracic Societies in Africa/PATS with Thoracic Societies from developed economies such as American Thoracic Society (ATS), European Respiratory Society, and American College of Chest Physicians (ACCP), International Union against TB and Lung Disease, Forum of International Respiratory Societies, and among others.

PATS-methods in epidemiological, clinical, and operational research program

The MECOR program, done in collaboration with ATS and PATS, was initiated by Professor Stephen Gordon of the Liverpool School of Tropical Medicine. It a multi-level research method training course intended for clinicians, investigators, academicians, and public health professionals who primarily work with pulmonary diseases. The overall goal of the MECOR Program is to aid the improvement of global lung health through the development of local, country, and regional lung disease research capacity in low and middle-income countries and it has provided an avenue for training budding and upcoming respiratory physicians.

East Africa training initiatives (EATI)

Furthermore, worth mentioning is the EATI, which is a collaborative effort between the ACCP, the World Lung Foundation, the Swiss Lung Foundation, and the Ethiopian Ministry of Health aimed at helping to develop capacity in the area of respiratory medicine through the development of a Respiratory fellowship training program. The EATI has successfully provided pulmonary medicine training in Ethiopia and has helped to build capacity for local leadership.^[37] This initiative and others similar to it should be further encouraged.

African journal of respiratory medicine

This journal was published by Bryan Pearson. Stephen Gordon was one of the foundational editors; later, I and Dr. Evans Amukoye served as Co-Editor-in-Chiefs, with others on the Editorial board. I want to especially appreciate the efforts of everyone toward the AJRM as this has given birth to the more recent Journal of PATS (JPATS).

JPATS

This is another great initiative to stimulate research and review the latest developments in the field of Pulmonology (adult and pediatric), Critical Care, Sleep, and Thoracic Surgery. It is heart-warming to see that these initiatives are helping to meet the gaps that previously exist.

There are a number of areas that still require attention. Concerted efforts should be focused toward strengthening

Africa's weak health systems, particularly in the aspect of respiratory medicine through infrastructural and human capacity development. Futuristically, I think the goal should be to allow for effective globalization of respiratory medicine with physicians from more advanced nations and developing countries collaborating toward improving the burden of diseases. This collaboration should be multi-faceted and should include training, research, patient care, and the development of technology to advance respiratory medicine.

If there is anything the COVID-19 pandemic has taught us, it is that the world is one global community, and we cannot live in isolation. Disease anywhere is disease everywhere. The artificial boundaries that separate nations were completely broken during the pandemic and we must harness this lesson and think globally while we act locally. Africans must not relent in their efforts to combat COVID-19 and other respiratory diseases, threatening the lives of our people. We must continue to advance strategies, enact policies, and be proactive in the management of chest diseases across the continent. As health professionals and front-liners in this pandemic, our ultimate goal of preserving lives remains sacrosanct!

Acknowledgements

I want to acknowledge Prof. O.O. Adewole, Dr. O.F. Awopeju, Dr. B.O. Adeniyi, and Dr. A.O. Arawomo for their inputs to this editorial.

Declaration of patient consent

Patient's consent not required as patients identity is not disclosed or compromised.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

REFERENCES

1. Sustainable Development Goals-17 Goals to Transform Our World. Available from: <https://www.un.org/sustainabledevelopment>. [Last accessed on 2020 Sep 01].
2. Pneumonia. Available from: <https://www.who.int/news-room/fact-sheets/detail/pneumonia>. [Last accessed on 2020 Sep 01].
3. Pneumonia. Available from: <https://www.data.unicef.org/topic/child-health/pneumonia>. [Last accessed on 2020 Sep 01].
4. Chebib N, Cuvelier C, Malézieux-Picard A, Parent T, Roux X, Fassier T, *et al.* Pneumonia prevention in the elderly patients: The other sides. *Aging Clin Exp Res* 2019. Doi: 10.1007/s40520-019-01437-7.

5. Zar HJ, Andronikou S. Advances in the diagnosis of pneumonia in children. *BMJ* 2017;358:j2739.
6. World Health Organization, Global TB Report; 2017. Available from: http://www.who.int/tb/publications/global_report/gtbr2016_executive_summary.pdf. [Last accessed on 2020 Sep 01].
7. USAID Report on the Twin Epidemics: HIV AND TB Co-Infection; 2014. Available from: <https://www.usaid.gov/news-information/fact-sheets/twin-epidemics-hiv-and-tb-co-infection>. [Last accessed on 2020 Sep 01].
8. Floyd K, Glaziou P, Zumla A, Raviglione M. The global tuberculosis epidemic and progress in care, prevention, and research: An overview in year 3 of the End TB era. *Lancet Respir Med* 2018;6:299-314.
9. World Health Organization. Global Tuberculosis Control: Surveillance, Planning and Financing, WHO/HTM/TB/2006.362. Geneva: World Health Organization; 2006.
10. Chatterjee D, Pramanik AK. Tuberculosis in the African continent: A comprehensive review. *Pathophysiology* 2015;22:73-83.
11. Kambela L. Terrorism in Africa: A Manifestation of New Wars. Available from: <https://www.accord.org.za/conflict-trends/terrorism-in-africa>. [Last accessed on 2020 Sep 01].
12. Musa BM, Adamu AL, Galadanci NA, Zubayr B, Odoh CN, Aliyu MH. Trends in prevalence of multi drug resistant tuberculosis in Sub-Saharan Africa: A systematic review and meta-analysis. *PLoS One* 2017;12:e0185105.
13. Adewole OO, Erhabor GE, Adewole TO, Ojo AO, Oshokoya H, Wolfé LM, *et al.* Proteomic profiling of eccrine sweat reveals its potential as a diagnostic biofluid for active tuberculosis. *Proteomics Clin Appl* 2016;10:547-53.
14. Guglielmetti L, Hewison C, Avaliani Z, Hughes J, Kiria N, Lomtadze N, *et al.* Examples of bedaquiline introduction for the management of multidrug-resistant tuberculosis in five countries. *Int J Tuberc Lung Dis* 2017;21:167-74.
15. Coronavirus Cases; 2020. Available from: <https://www.worldometers.info/coronavirus/coronavirus-cases/#daily-cases>. [Last accessed on 2020 Aug 30].
16. Arawomo AO, Ajibade AI, Adeniyi B, Aigbirior J, Erhabor GE. Coronavirus disease 2019 (COVID-19): Clinical perspectives and on-going challenges. *West Afr J Med* 2020;37:295-316.
17. Hellewell J, Abbott S, Gimma A, Bosse NI, Jarvis CI, Russell TW, *et al.* Feasibility of controlling COVID-19 outbreaks by isolation of cases and contacts. *Lancet Glob Health* 2020;8:e488-96.
18. ISAAC Phase Three. Available from: <http://www.isaac.auckland.ac.nz/phases/phasethree/phasethree.html>. [Last accessed on 2020 Sep 01].
19. Bourdin A, Doble A, Godard P. The asthma insights and reality in the Maghreb (AIRMAG) study: Perspectives and lessons. *Respir Med* 2009;103 Suppl 2:S38-48.
20. Adeloye D, Chan KY, Rudan I, Campbell H. An estimate of asthma prevalence in Africa: A systematic analysis. *Croat Med J* 2013;54:519-31.
21. Global Initiative for Asthma (GINA). Global Strategy for Asthma Management and Prevention, GINA 2020 Report; 2020. Available from: <https://ginasthma.org/gina-reports/>. [Last accessed on 2020 Sep 01].
22. Erhabor GE, Agbroko SO, Bamigboye P, Awopeju OF. Prevalence of asthma symptoms among university students 15 to 35 years of age in Obafemi Awolowo University, Ile-Ife, Osun State. *J Asthma* 2006;43:161-4.
23. Obaseki DO, Erhabor GE, Gnatiuc L, Adewole OO, Buist SA, Burney PG. Chronic airflow obstruction in a Black African population: Results of BOLD study, Ile-Ife, Nigeria. *COPD* 2016;13:42-9.
24. Lortet-Tieulent J, Soerjomataram I, López-Campos JL, Ancochea J, Coebergh JW, Soriano JB. International trends in COPD mortality, 1995-2017. *Eur Respir J* 2019;54:1901791.
25. Buist AS, McBurnie MA, Vollmer WM, Gillespie S, Burney P, Mannino DM, *et al.* International variation in the prevalence of COPD (the BOLD Study): A population-based prevalence study. *Lancet* 2007;370:741-50.
26. World Health Organization on Tobacco. Available from: <https://www.who.int/news-room/fact-sheets/detail/tobacco>.
27. Townsend L, Flisher AJ, Gilreath T, King G. A systematic review of tobacco use among Sub-Saharan African youth. *J Subst Use* 2006;11:245-69.
28. Bede-Ojimadu O, Orisakwe OE. Exposure to wood smoke and associated health effects in Sub-Saharan Africa: A systematic review. *Ann Glob Health* 2020;86:32.
29. Available from: https://www.who.int/gho/phe/indoor_air_pollution/burden/en. [Last accessed on 2020 Sep 01].
30. Wright CY, Mathee A, Piketh S, Langerman K, Makonese T, Bulani S, *et al.* Global statement on air pollution and health: Opportunities for Africa. *Ann Glob Health* 2019;85:144.
31. Fullerton DG, Bruce N, Gordon SB. Indoor air pollution from biomass fuel smoke is a major health concern in the developing world. *Trans R Soc Trop Med Hyg* 2008;102:843-51.
32. Silent Suffocation in Africa Air Pollution; 2019. Available from: <https://www.unicef.org/media/55081/file>.
33. World Health Organisation. Household Air Pollution and Health. Geneva: World Health Organisation; 2018. Available from: <http://www.who.int/news-room/fact-sheets/detail/household-air-pollution-and-health>. [Last accessed on 2020 Sep 01].
34. Das I, Jagger P, Yeatts K. Biomass cooking fuels and health outcomes for women in Malawi. *Ecohealth* 2017;14:7-19.
35. Smith KR, Pillarisetti A. Household air pollution from solid cookfuels and its effects on health. In: Mock CN, Nugent R, Kobusingye O, Smith KR, editors. *Injury Prevention and Environmental Health*. 3rd ed. Washington, DC: The International Bank for Reconstruction and Development, The World Bank; 2017.
36. Gordon SB, Bruce NG, Grigg J, Hibberd PL, Kurmi OP, Lam KB, *et al.* Respiratory risks from household air pollution in low and middle income countries. *Lancet Respir Med* 2014;2:823-60.
37. Sherman CB, Carter EJ, Braendli O, Getaneh A, Schluger NW. The east African training initiative. A model training program in pulmonary and critical care medicine for low-income countries. *Ann Am Thorac Soc* 2016;13:451-5.

How to cite this article: Erhabor GE. Respiratory health in Africa: Strides and challenges. *J Pan Afr Thorac Soc* 2021;2(1):11-7.