

REPUBLIC OF KENYA



MINISTRY OF HEALTH

Kenya Asthma Management Guideline



**NATIONAL TUBERCULOSIS, LEPROSY
AND LUNG DISEASE PROGRAM**

Kenya Asthma Management Guideline

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FOREWORD

Bronchial asthma is the most common chronic respiratory disease in the world. The World Health Organization (WHO) estimates that more than 330 million people are currently living with asthma globally. In Kenya, it has been estimated that about 7.5% of the Kenyan population, nearly 4 million people, are currently living with asthma. World over the disease tends to be underdiagnosed and undertreated which leads to high levels of morbidity and avoidable deaths. The consequences of poorly controlled asthma, including physical, mental, social, and economic impacts, are magnified in the poor on account of poor access to asthma services and sub-optimal quality of those services. Sadly, asthma is associated with significant stigma and discrimination.

In Kenya, limited studies suggest that a significant proportion of people with asthma are either not treated at all or are improperly treated with overuse of reliever medicines often taken as oral formulations. Anecdotal data also suggest that oral systemic steroids are widely used by people with asthma in Kenya despite the risk of adverse events associated with the frequent or prolonged use of these medicines. As a country, we are yet to establish robust and sustainable programs for the care and treatment of people with asthma. This situation needs to be addressed and the MoH in partnership with stakeholders is committed to ensuring that asthma care and treatment, provided through high-quality programs for chronic respiratory disease, is made available to all who need it. These national asthma management guidelines will go a long way to support this effort by setting the minimum standards that asthma care should be pegged on. As a ministry, we will work towards embedding asthma care in Universal Health Care (UHC). Using the UHC platform will ensure that quality asthma services are available in primary care settings with referral networks strengthened for those who may require secondary and tertiary care. These national asthma guidelines will also ensure that treatment for asthma is standardized in both the public and the non-state health care sector.

It is commendable that these guidelines were developed through a multi-stakeholder engagement process and have incorporated views and opinions of a wide array of people and organizations including persons living with asthma. As a ministry, we value multi-stakeholder engagement and partnerships because the government alone cannot solve the myriad challenges that afflict the health sector. At the heart of the MoH is a commitment to ensure health care services reach every person in the country preferably at their doorstep. That commitment is enshrined in Kenya's community health strategy. Thus, as a ministry and working closely with partners, we will endeavor to embed asthma care among the health interventions to be delivered at the community level by community health care workers. In the design of approaches to implement these guidelines, we will pay particular attention to the integration of asthma care in our community health strategies. To optimize these approaches, relevant implementation research studies will need to be carried out to provide the evidence needed for the development and implementation of efficient, effective, equitable and sustainable programs for the delivery of asthma care to most Kenyans, many of whom live in rural areas and access care at the primary care level. It is commendable that these national asthma guidelines have identified key research priorities in all areas of asthma care and treatment. The development of health care programs that achieve the best possible outcomes is heavily dependent on research and thus working

with stakeholders , the MoH will endeavor to push through with the research priorities that were identified during the development of these guidelines.

To plan appropriately for the delivery of asthma care and treatment, data is required. We need to have better estimates of the burden of asthma, health resource use by people with asthma and outcomes of people living with asthma who receive treatment for the disease. This allows, for example, for the quantification of pharmaceutical products , that are needed by people living with asthma and can help the country to ensure the most cost effective therapeutic and care interventions are selected where more than one option is available.

As rightly indicated by the Guidelines Development Group, these guidelines will be considered a living document and will be revised as new evidence on the care and treatment of asthma emerges. The guidelines will be of no use if they are not disseminated widely, and approaches adopted to ensure they are used by health care workers of all cadres. In the current digital era , I trust that dissemination of these guidelines will primarily follow the digital route. Additionally, mechanisms need to be identified and implemented to ensure that the standards of care stipulated in these guidelines have been taken up by most health care providers and that the outcomes of care and treatment for asthma are the best possible.



Dr. Patrick Amoth, EBS

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PREFACE

Numerous studies suggest that in low- and middle-income countries, such as Kenya, the burden of Asthma may be increasing. Even though there are no local studies, it has been observed that poorer populations have higher rates of asthma morbidity and mortality from asthma and consequently these people endure poor quality of life, and enormous social, family, and economic costs. As in other many low - and middle-income countries, Kenya does not currently have a robust publicly supported asthma-care program and therefore care for asthma for most people who are living with this disease in this country is likely not to be optimized.

The first national asthma guidelines were developed in 2006 through a partnership involving the MoH's National TB, Leprosy and Lung Disease Program, the Respiratory Society of Kenya (then the Kenya Association for the Prevention of Tuberculosis and Lung Disease (KAPTLTD) (ReSoK) and partners in the pharmaceutical industry. The first version of the national asthma guidelines was called a 'consensus statement' rather than 'guidelines' based on the recognition that local scientific data or data from settings similar to Kenya's, was lacking. The second version of the national asthma guidelines were developed in 2011. Although it may seem long since the 2011 asthma guidelines were developed, in essence there were no major shifts in the global practice recommendations for asthma until 2019 when the Global Initiative for Asthma (GINA) recommended the use of a fixed combination of formoterol, a fast acting and Long Acting Beta 2 Agonist (LABA) and an inhaled steroid as reliever medication (taken as needed) for all GINA steps and the mainstay of therapy for steps 1 and 2 of the GINA asthma recommendations.

The third edition of the national asthma guidelines incorporates these new recommendations. It is intended to provide clinicians, researchers, policy makers, health programme developers and managers with a road map to guide the care and treatment of individuals with asthma in Kenya. As in previous versions, these guidelines highlight major knowledge gaps in the care and treatment of asthma in Kenya and lists research priorities in the various areas of asthma care.

The development of these guidelines was based on the synthesis of international guidelines that are regularly updated such as the Global Initiative for Asthma (GINA) guidelines. These international guidelines were reviewed, and an attempt made to adopt and adapt them to the Kenyan context. The guidelines development group also made efforts to identify local studies and or studies carried out in Sub – Saharan Africa that had become available since 2011 and which were relevant for the provision of asthma care in the Kenyan setting.

As the main technical agency of the MoH for the development and implementation of lung health programs in Kenya, the National TB, Leprosy and Lung Disease program commits to work with partners to disseminate these programs as widely as possible. The monitoring, evaluation and learning framework that has been included in these guidelines will be used to ensure high quality data on health resource utilization, treatment provided to people living with asthma and asthma treatment outcomes becomes available and is used to refine strategies and interventions for asthma care in Kenya. Ultimately the program expects that these guidelines will contribute significantly to improving Health Related Quality of Life (HRQoL) of people living with asthma in Kenya.



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Head, National TB, Leprosy and Lung Disease Program, MoH

ACKNOWLEDGEMENTS

The development of these guidelines was based on a consultative process involving the national Tuberculosis, Leprosy and Lung Disease Program of the Ministry of Health, the Respiratory Society of Kenya, partners in the pharmaceutical industry and the National Asthma Association of Kenya, an organization of people living with asthma. The Respiratory Society of Kenya, Ms. Irene Mbithi, provided secretariat support to the guidelines development group. Members of the guidelines development group who wrote the different chapters of the guidelines which were then discussed in several consultative forums. Prof. Jumaa Bwika served as the overall team lead of the guidelines development group and consolidated and edited versions of the guidelines as they evolved. Prof. Jeremiah Chakaya also edited the document and guided its finalization and launch. The guideline development process was made possible through an unrestricted grants from Astra Zeneca, CIPLA and GlaxoSmithKline.

We wish to also acknowledge Dr. Anne Irungu, Dr. Andrew Owuor, Mr. Isaac Sunte, Dr. Justus Simba, Dr. Duncan Tumwa, Dr. George Nyale, Dr. Boru Okotu, Dr. Philip Owiti, Dr. Teresiah Njoroge, Ms. Joan Kagema and all National TB Program staff who participated in the development of this guideline.

ABBREVIATIONS

ABC	Airway, Breathing, Circulation
AGP	Aerosol Generating Procedure
AHR	Airway Hyper-Responsiveness
AVPU	Alert, Verbal, Pain, Unresponsive (scoring system)
CCU	Critical Care Unit
CMPA	Cow's Milk Protein Allergy
COPD	Chronic Obstructive pulmonary disease
COVID-19	Corona Virus Disease -19
CRF	Case Record Form
CXR	Chest X-ray
DALYs	Daily Adjusted Life Years
DLCO	Diffusion Capacity for Carbon Monoxide
DPIs	Dry Powder Inhalers
ED	Emergency Department
FECO	Fraction of Expired Carbon Monoxide
FENO	Fractional Exhaled Nitric Oxide
FEV1	Forced Expiratory Volume in 1 second
FIO₂	Fraction of Inspired Oxygen
FVC	Forced Vital Capacity
GERD	Gastro Esophageal Reflux Disease
GINA	Global Initiative for Asthma
GWAS	Genome Wide Association Studies
HIV	Human Immunodeficiency Virus
HRQoL	Health Related Quality of Life
ICS	Inhaled Corticosteroids
ICU	Intensive Care Unit
IgE	Immunoglobulin E
ISAAC	International Study of Asthma and Allergic Disease in Childhood
IV	Intravenous

KAPTLD	Kenya Association for the Prevention of TB and Lung Disease
KNH	Kenyatta National Hospital
LABA	Long Acting Beta (2) Agonists
LAMA	Long Acting Muscarinic Antagonist
LTRA	Leukotriene Receptor Antagonist
MART	Maintenance and Reliever Therapy
MoH	Ministry of Health
NSAIDs	Non-steroidal anti-inflammatory drugs
NTLD-P	National TB, Leprosy and Lung Disease Program
OA	Occupational Asthma
OCS	Oral corticosteroids
OLD	Occupational Lung Disease
PaCO₂	Arterial Carbon Dioxide tension (concentration)
PAL	Practical Approach to Lung Health
PaO₂	Arterial Oxygen tension (concentration)
PCR	Polymerase Chain Reaction
PEEP	Positive End Expiratory Pressure
PEF	Peak Expiratory Flow
pMDI	pressurized Meter Dose Inhaler
PPE	Personal Protective Equipment
ReSoK	Respiratory Society of Kenya
RSV	Respiratory Syncytial Virus
SABA	Short Acting Beta(2) Agonist
SAMA	Short Acting Muscarinic Antagonist
SARS-COV2	Severe Acute Respiratory Syndrome- Corona Virus 2
SMIs	Soft Mist Inhalers
SSA	Sub- Saharan Africa
TB	Tuberculosis
UHC	Universal Health Coverage (or Care)
WEA	Work Exacerbated Asthma
WHO	World Health Organization

EXECUTIVE SUMMARY

The previous Kenya national asthma management guidelines were published in 2011. Since then, there have been significant shifts in practice recommendations by international agencies such as GINA. The development of these guidelines was therefore driven by the need to align Kenya's national asthma guidelines with international recommendations. These new guidelines, borrowed heavily from international guidelines which developed using an evidence-based approach, combining the best research available with expert consensus to arrive at best practice recommendations. The guideline development process involved a wide range of stakeholders coordinated by the Respiratory Society of Kenya in close collaboration with the Ministry of Health's National Leprosy, Tuberculosis and Lung Disease Program (NLTLDLP), the governmental agency that is mandated with the prevention, care and treatment of lung diseases in Kenya.

Experts in asthma, including clinicians, nurses, public health practitioners and persons living with asthma were tasked to review relevant research work to identify new evidence and best practices for asthma management in Kenya in addition to the adoption and adaptation of international guidelines to the local setting. Among the key questions that the Kenya Asthma National Guidelines development group sought to answer include:

1. Should all people presenting to health care facilities with symptoms suggestive of bronchial asthma have a spirometric lung function test?
2. Kenya has a large burden of TB, and it may be that TB/Asthma co-morbidity is common, therefore, should all people presenting to health care facilities with symptoms suggestive of bronchial asthma be screened (using a chest -ray) and tested for TB?
3. Should all people presenting to health care facilities with symptoms suggestive of bronchial asthma have a blood eosinophil count determined?
4. Should all people presenting to health care facilities with symptoms suggestive of bronchial asthma be tested for HIV?
5. Should all people presenting to health care facilities with symptoms suggestive of bronchial asthma have a Fractional Exhaled Nitric Oxide (FENO) test?
6. Should all people presenting to health care facilities with symptoms suggestive of bronchial asthma have a stool microscopy test for geo-helminths?
7. Should all people presenting to health care facilities with symptoms suggestive of bronchial asthma have an allergy test and if so, using which test (skin allergy tests or specific IgE)?
8. Should all people diagnosed with bronchial asthma begin treatment with a short course of oral steroids?
9. Should all patients diagnosed with bronchial asthma begin treatment with an inhaled steroid and a long acting beta -agonist?

10. Should all patients with bronchial asthma be vaccinated annually with the influenza vaccine?
11. Should all patients with bronchial asthma experiencing an asthma exacerbation and who have not responded to repeated doses of nebulised beta agonist and an anticholinergic be treated with aminophylline?
12. Should all patients with bronchial asthma experiencing an asthma exacerbation and who have not responded to repeated doses of nebulised beta agonist and an anticholinergic be treated with magnesium sulphate?
13. In patients with bronchial asthma, does providing health education (interpersonal communication, written information including posters, audio-visuals) improve asthma outcomes?
14. Does developing, supporting and sustaining asthma patient clubs and networks improve asthma outcomes?
15. How should the national asthma care and prevention program be monitored and evaluated?

Outlined below are the key practice recommendations contained in these guidelines

Asthma diagnosis

A syndromic approach to the diagnosis of asthma is favored. A comprehensive clinical history should be obtained in all people presenting to health care facilities with symptoms compatible with asthma. Patients should then be placed into one of three categories: high probability of asthma, medium probability of asthma and low probability of asthma. Spirometric lung function testing, as a diagnostic test for asthma, should be carried out in those in the medium and low probability categories. Spirometric lung function is a useful tool to assess response to asthma treatment. In young children below the age of 9 years spirometry is not easy to carry out and may not provide reliable results.

Asthma treatment

The Kenya National asthma guidelines development group adopted fully the asthma treatment recommendation by GINA for Step 1 and 2 in older children and adults. In these persons a low dose Inhaled Corticosteroid (ICS) - Formoterol is used on an 'as needed' basis. Alternatively low dose ICS may be used at the same time an 'as needed' Short-acting Beta-2 Agonist (SABA) dose is taken. Those who are in step 2 should be encouraged to take regular low doses of ICS and take an ICS – SABA as needed for relief of symptoms. Treatment is escalated to medium dose, and high dose ICS with the addition of other controller medicines such as a Long-acting muscarinic antagonists (LAMA) and a Leukotriene receptor antagonists (LTRA) as asthma severity increases.

Management of asthma exacerbations

Every person with asthma who experiences worsening of asthma symptoms should be assessed for severity of the exacerbation and treated appropriately. The mainstay of treatment of asthma exacerbation is bronchodilation with an inhaled SABA with or without a Short-acting muscarinic antagonists (SAMA), oxygen for hypoxemic individuals and augmentation of anti-inflammatory therapy using a short course of systemic steroids. Intravenous bronchodilators such as salbutamol, magnesium sulphate and aminophylline should be reserved for persons with a severe asthma exacerbation not responsive to repeated doses of inhaled/nebulized SABA and SAMA.

Asthma research

Each chapter of this guidelines ends with a prioritized list of research questions

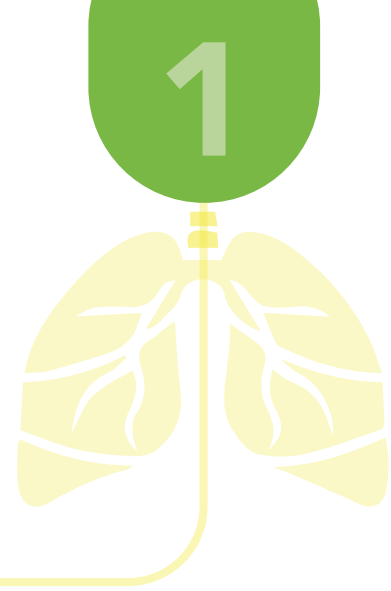
Asthma Monitoring, Evaluation and Learning Plan

It is anticipated that the nascent asthma care program will grow, and flourish and asthma data will become routinely available. Thus, a better understanding of the burden of asthma disease, asthma related health resource utilization and asthma health outcomes should become available during the period of implementation of these guidelines.

Asthma education

To enhance asthma outcomes, patient, family, and care giver education is critical. Education on asthma should enhance knowledge of the disease, address myths and misconceptions that are driving asthma stigma and discrimination and equip persons living with asthma and their families with information and skill to manage this chronic disease.

Asthma Definition, Disease Burden and Risk Factors



CHAPTER OBJECTIVES

This chapter is intended to highlight the burden of asthma in Kenya and the associated risk factors so that individuals, health program managers and policy makers can apply this knowledge to develop and implement interventions to prevent asthma and to provide appropriate care and treatment for the disease. Additionally, this chapter highlights gaps in knowledge about the burden of asthma in Kenya and the associated risk factors which is intended to stimulate a robust program of epidemiologic research on asthma in Kenya.

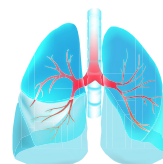
The primary audience for this chapter includes individuals with asthma and their families, policy makers, health care program financiers, health care program developers and managers and researchers.

Asthma: Definition

In 2020 the Global Initiative for Asthma (GINA) defined asthma as a heterogeneous disease usually characterized by chronic airway inflammation. Asthma is defined by a history of respiratory symptoms such as wheeze, shortness of breath, chest tightness and cough that vary over time and in intensity, together with variable expiratory airflow limitation.

The key components of this definition include the presence of:

- airway inflammation in all people with asthma.
- symptoms such as wheezing, breathlessness, chest tightness and cough that vary in time and intensity.
- Variable expiratory airflow limitation



43.7 Million

the 2017 estimate global incidence of asthma new cases per year.

272.68 Million

the 2017 estimate global prevalence of asthma



490,000

deaths caused by Asthma in 2017.

Text Box 1: Prevalence of Asthma in Kenya

It is estimated that about 7.5% of the Kenyan population, or nearly 4 million people, have asthma.

In epidemiologic studies conducted about two decades ago, the prevalence of asthma in children between the ages of 12-14 years, was documented to have increased over a 5-year period. It is unclear if this trend has continued.

Asthma has been observed to be more prevalent in urban as opposed to rural areas, however, it is currently unclear if this difference persists.

There are no population-based studies on asthma prevalence in children below 10 years or in adults over the age of 15 in Kenya.

While clinical experience indicates that asthma is a common reason for health resource utilization there is no data on the burden of asthma that is routinely managed in the health care system.

Asthma: Burden of disease

In 2017, the global incidence of asthma was estimated to be 43.7million new cases per year. In the same year, it was estimated that the global prevalence of asthma was 272.68 million people while deaths stood at 0.49 (490,000) million people. Global Disability Adjusted Life Years (DALYs) from asthma and deaths appear to be declining with asthma being responsible for less than 1% of global DALYs by 2017. Incidence of asthma is highest in the first five years of life while the prevalence and DALYs of asthma peak at 0-14 years. There is an observed second peak in the prevalence and DALYs for asthma between age 45-74. Mortality from asthma increases with age and peaks at age 80 (*Asher, Bissell et al. 2019, Mattiuzzi and Lippi 2020*).

The prevalence of asthma varies widely from place to place which may reflect measurement issues in view of the lack of a uniform definition of asthma used in epidemiologic studies, varying environmental exposures and possibly variations in genetic susceptibility. While attempts have been made to standardize the measurement of asthma in epidemiologic studies to enable comparisons of prevalence to be made among countries and various populations, variations in asthma definitions for prevalence measurement at the population level persist. This notwithstanding asthma is currently recognized to be the most common chronic respiratory disease in the world. In 2015 it was estimated that 1, 150 people in the world die of asthma daily, a figure that is close to the number of people who die from Malaria (1, 175) daily, yet asthma has received much less global attention (*Asher, Bissell et al. 2019*).

Epidemiologic studies on the burden of asthma in Kenya and for most of Africa is scanty. Notable efforts to measure the prevalence of asthma in sub-Saharan Africa have largely used the International Study of Asthma and Allergic Disease in Childhood (ISAAC) approach. Based on ISAAC and other studies the prevalence of asthma in Africa was found to be variable, ranging from 6-20%. A consistent rural urban difference in the prevalence of asthma has been found across Sub-Saharan Africa (SSA) with rural areas

having a lower prevalence of the disease. This observation has not been fully explained, however, adoption of a 'Western lifestyle' has been the most advanced theory for this epidemiologic phenomenon. As lifestyles and economic profiles evolve, the difference in asthma prevalence between rural and urban areas may have narrowed but there is no data yet that has confirmed this.

In Kenya, epidemiologic community level studies on the burden of asthma have not been repeated since the ISAAC studies carried that were out in 1995 and 2000. These studies were carried out in limited geographical areas (Nairobi, Thika and Eldoret) and thus the data may not be applicable to the entire country. In ISAAC phase 1, carried out in 1995 in Nairobi and Eldoret, the prevalence of wheeze in the past 12 months, elicited using a written questionnaire, among 13-14-year-old children in School, was 17.1% and 10.4 % in Nairobi and Eldoret respectively. In ISAAC phase 3, carried out in 2000, the prevalence of asthma in the same population of school children aged 13-14 years, had increased to 18% and 13.8 % in Nairobi and Eldoret respectively. An earlier study on the prevalence of asthma in children aged 10-14 years, revealed a higher prevalence of asthma in Nairobi compared with rural Murang'a. However, the prevalence of asthma in children around the pineapple farms of Thika was very close to that seen among similar age children in Nairobi. The key conclusion (summarized in text box number 1), from these few population based epidemiological studies is that asthma is a very common disease in Kenya and its prevalence may be rising, at least among older children. There are no population-based studies that have examined the prevalence of asthma among children below the age of 10 years and in adults above the age of 15 years in Kenya. In 2015, the Global Burden of Disease study estimated that the age standardized DALYs rate per 100,000 population in Kenya was 201-300 (*Lancet Respir Med* 2017; 5: 691-706). (Collaborators 2017)

Asthma has important individual health consequences. Uncontrolled asthma results in recurrent or persistent symptoms that impair quality of life, reduce self-esteem, reduce social interaction, increase psychosocial trauma, and occasionally lead to fatal outcomes. The economic costs of uncontrolled asthma may be enormous and include direct costs from health resource utilization (medical consultations, drugs and hospitalization costs), indirect costs from work absenteeism or premature deaths and intangible costs of persistent illness. In a study of the availability of medicines for chronic non-communicable diseases (diabetes, hypertension and asthma) in Kenya, the median household expenditure on asthma medicines was USD 4, however, in this study, asthma medicines were the least available at only 53.1% of households with a person with asthma compared with 83.1% for diabetes and 77.1% for hypertension (*Veronica J. Wirtz et al. Tropical Medicine and International Health* 2018; 23(8): 879-885). Studies of the costs of uncontrolled asthma are urgently needed in Kenya.

Asthma: Risk Factors

A distinction needs to be made between factors that increase the risk of developing asthma and those factors that increase the risk of an asthmatic attack or exacerbation in persons who have developed asthma.

Asthma: Risk factors for developing asthma

Asthma tends to run in families. Monozygotic twins have a higher concordance rate for asthma than dizygotic twins, suggesting that genetic factors are important in the development of asthma. However, asthma is not a simple single gene inherited disease. It is likely that multiple genes interact in complex ways to influence the expression of asthma. **Some of the genes that have been identified to be associated with an increased susceptibility to asthma** include ORMDL3, ADAM33 and cytokine and cytokine receptor genes such as IL18R1, IL33, IL2RB, IL10, TGFB1 and IL6R1, however, putative asthma genes are many and can only explain a small proportion (<10%) of the heritability of asthma. It may be that the genes associated with asthma susceptibility are different from those that mediate asthma progression and severity. Although there are multiple genes that have been identified to be associated with asthma, there are no asthma specific genes identified yet and thus no gene directed therapies are available (*Deborah Meyers et al. Lancet Respiratory Medicine 2014; May;2(5):405-15.doi: 10.1016/S2213-2600(14)70012-8*).

Individuals who are atopic, i.e., have positive skin prick tests to common allergens, have an increased risk of asthma just like individuals with demonstrable airway hyper responsiveness (need a small dose of a bronchoconstrictor agent to narrow the airways (FEV₁) by 20%). Both atopy and airway hyper-responsiveness (AHR) may be genetically determined. It is important to note however that not all individuals with atopy or AHR develop asthma. In a recent study carried out at three tertiary care centres in Kenya, Uganda and Ethiopia, a positive skin prick test was found in 90% of 1, 671 study participants with the commonest allergens being house dust mite (66%), *blomia tropicalis* (62%) and German cockroach (52%) (*Kwizera et al. World Allergy Organization 2020; 13:100130*).

Early on in life, asthma is more common in boys than girls, especially among first born boys. In adult life, asthma appears to be more common in females than males. Although there is some uncertainty it appears that children breastfed for longer than six months may be somewhat protected from developing asthma.

Dietary factors may also be important in the development of asthma. In general, it appears that a high salt diet and a diet that is low in antioxidant vitamins such as vitamin C or calorie intake from cereals may be associated with the development of asthma.

Obesity appears to be a risk factor for the development of asthma, an observation that has been seen in several studies including among South African children.

Exposure to tobacco smoke may also be associated with the development of asthma. Many substances encountered in the occupational settings may also increase the risk of development of asthma in susceptible individuals. Though controversial, it is likely that air pollution also has important effects on the development of asthma. Both ambient and household air pollution are recognized drivers of asthma. In a recent meta- analysis of studies that evaluated the health effects of household air pollution the relative risk of household air pollution for asthma was 1.23 (95% CI 1.11-1.36). In a systematic review of health effects of ambient air pollution, it was noted that cough and wheeze were the most common symptoms associated with exposure to ambient particulate matter with aerodynamic diameter of 2.5 (PM_{2.5})

Although the data remains inconclusive, many studies suggest that infestation with intestinal helminths is negatively correlated with asthma. In general, viral infections in early childhood may increase the risk of asthma.

There appears to be an inverse relationship between infection with *Mycobacterium tuberculosis* and allergic disease including asthma. On the other hand, HIV infection and disease appear not to be a risk factor for asthma, however, asthma- like symptoms may appear as HIV infected individuals (children in particular) are treated with anti- retroviral treatment and immune system recovery occurs.

A summary of some of the risk factors associated with the development of asthma is provided in text box 2.

Text Box 2: Risk Factors for Development of Asthma	
Non-Modifiable Factors <ul style="list-style-type: none"> • Gender: Early M>F; Later F>M • Atopy • AHR 	Modifiable Factors <ul style="list-style-type: none"> • Allergen Exposure • Infections and Infestations • Breastfeeding • Air pollution • HIV infection • Occupational Exposures • Tobacco smoking including environmental tobacco smoke (passive smoking)
<i>Note: Explanations in the text</i>	

Thus, the development of asthma appears to be influenced by the interaction of multiple factors with complex interactions between genetic and environmental factors. While further epidemiologic studies are needed to further elucidate risk factors for asthma it appears reasonable to recommend that Kenyans breastfeed longer, adopt diets with high antioxidant content, avoid obesity and smoking and reduce exposure to air pollution both at the household level and in ambient air.

Priority Research Areas:

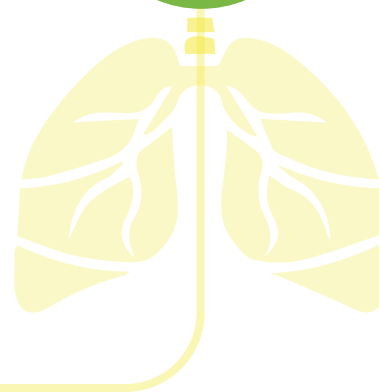
1. National asthma prevalence survey
2. Asthma risk factors analysis including role of infections and infestations
3. Asthma Health resource utilization patterns
4. Asthma deaths including time trends.

Suggested further reading

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Asthma Pathogenesis and Pathophysiology



CHAPTER OBJECTIVES

This chapter is intended to highlight the pathogenetic mechanisms in asthma so as to allow prescribers and users of asthma therapies to understand and appreciate the scientific rationale of the various therapies currently recommended for asthma. Expanding knowledge of the pathobiology of asthma is increasingly being used to provide personalized care and treatment of asthma based on observed characteristics (phenotypes) and the underlying molecular mechanisms (endotypes). The emphasis on airway inflammation is intended to promote the widespread and persistent use of anti-inflammatory therapies, especially inhaled corticosteroids for the control of asthma.

The primary audience for this chapter includes clinicians, health programme planners and managers, health programme financiers, asthma patients and their families.

Text Box 4: Summary of Airway Pathophysiologic Processes in Asthma

- Airways Inflammation with increased number of activated inflammatory cells
- Production of various chemical mediators (cytokine mediator soup)
- Airway structural changes resulting from the airway inflammatory process
- Airway functional changes (Airway Hyperresponsiveness) from the inflammatory process and structural changes
- Airway Narrowing from airway smooth muscle contraction, airway thickening from collagen deposition, airway edema and excessive airway mucus.

Asthma: Pathology

It is increasingly becoming clear that the constellation of symptoms and patterns of disease that characterize asthma is not due to a single disease and it has been suggested that the term “asthma” should be used to denote an umbrella term for a group of diseases (the asthmas) with commonalities but also wide differences. The concept of asthma phenotypes, which refers to observed characteristics that are determined by interactions between genes

and the environment and asthma endotypes, which relates to the underlying molecular mechanisms, offer the potential to personalize care. Traditionally asthma has been thought of as a disease driven by airway inflammation that leads to airway hyper-responsiveness (AHR), and later on to airway remodeling. However, this view is now thought to be over simplistic with studies showing inconsistent association between airway inflammation and AHR and airway remodeling. That said, airway inflammation is a consistent feature of “asthma”. This inflammation may be eosinophilic, neutrophilic, mixed cell type or pauci-granulocytic (minimal presence of inflammatory cells).

It is currently not known what drives airway inflammation in asthma and the lack of resolution of this inflammation. Genetic predisposition certainly plays a major role. While there are no asthma specific genes, genome wide association studies (GWAS) have helped to identify genes that are associated with an increased risk of asthma in addition to those that are associated with a reduced risk. These genes appear to be clustered around 17q21 alleles and include ORMDL3, PKN2 (Protein Kinase N2) and PTK2 (Protein Tyrosine Kinase 2), and AKPP (Alkaline Phosphatase, Placental), ADAM33 and cytokine and cytokine receptor genes such as IL18R1, IL33, IL2RB, IL10, TGFB1 and IL6R1. Knowledge of the complex interactions between environmental exposures (exposome), genes including inheritable genetic modifications (genomics and epigenetics), gene transcription (transcriptomics), proteins (proteomics) and metabolites of proteins (metabolomics) is rapidly expanding and is expected to lead to the development of specific diagnostic tests for the various asthmas, predict severity of disease and responses to treatment in addition to the development of specific therapies.

A wide array of inflammatory cells is involved in the asthmatic inflammation including, mast cells, eosinophils, T lymphocytes, dendritic cells, macrophages and neutrophils. Additionally, structural cells of the airways also appear to participate in the inflammatory process in the airways. These cells include airway epithelial cells, airway smooth muscle cells, endothelial cells, fibroblasts and myofibroblasts and airway nerves. It appears that everybody is invited to the asthma inflammatory party.

The current thinking is that asthmatic inflammation begins with an altered response of the airway epithelium to the external environment which leads to a disruption of the barrier function of the airway epithelium. The disruption of the barrier function of the airway epithelium allows the penetration of inhaled environmental substances into the airway sub-mucosa where they interact with antigen presenting cells such as dendritic cells. Once the dendritic cells carrying the relevant antigen migrate to regional lymph nodes an inflammatory cascade is initiated with cross talk among inflammatory cells through molecular inflammatory mediators, principally cytokines. The inflammatory response may be predominantly directed towards production of cytokines (such as IL-4, IL-5, IL-13,) that promote allergic and eosinophilic responses (TH-2) rather than those that promote responses designed to kill intra-cellular pathogens (interferon gamma). By measuring cytokine profiles, it is now possible to group persons with asthma into TH-2 and non-TH-2 driven groups with sub-grouping of the TH-2 group into TH-2 high and TH-2 low groups. This knowledge has been used to develop and target biological treatments such as mepolizumab, reslizumab, benralizumab and others.

The major pathologic changes observed in the airways of people with asthma include epithelial necrosis, basement membrane thickening, airway smooth muscle hyperplasia

and hypertrophy, and an increase in mucus producing elements such as goblet cells and sub mucosal glands. It is not completely clear how these structural changes are related to airway inflammation.

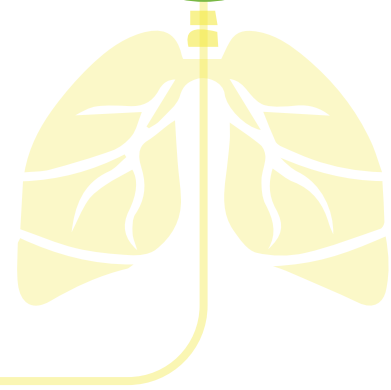
Research Priorities

1. What are the common asthma phenotypes in Kenya?
2. Genes and asthma in Kenya: analysis of genetic markers of asthma including gene expression and asthma phenotypes
3. Elucidation of patho-biological mechanisms that influence interactions between asthma, common infections and infestations and the environment in Kenya.

Suggested Further Reading

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The Diagnosis of Asthma



CHAPTER OBJECTIVES

This chapter highlights the key diagnostic steps in the evaluation of patients suspected to have asthma and how to assess the severity of disease for those diagnosed with asthma in order to optimize treatment and prognosis. If these steps are followed it should be possible to make an accurate diagnosis of asthma in most patients with this disease.

The primary audience for this chapter includes clinicians, patients and their families, health program developers, managers and financiers who need to put in place the basic health infrastructure necessary to facilitate the diagnosis of asthma.

Clinical researchers will also find this chapter useful in the development and evaluation of clinical algorithms for asthma.

KEY POINTS

1. Clinical diagnosis of Asthma is based on the presence of symptoms including persistent or recurrent cough, wheezing, shortness of breath and chest tightness/heaviness.
2. Lung function and bronchial provocation tests aid in diagnosis and severity classification but may be normal in between flare-ups especially with children. A normal lung function does not rule out Asthma.
3. Several biomarkers may be used as adjuncts in managing patients with asthma including aiding in the choice of therapy in some cases but have not yet been validated for asthma diagnosis.
4. Imaging is rarely indicated but may be needed in persons presenting with atypical symptoms or signs suggesting the presence of another disease or complications such as pneumonia or pneumothorax.
5. Referral to a specialist is indicated for patients with an uncertain diagnosis or possible mimic disorder, severe disease, poorly controlled asthma, comorbid conditions that complicate the disease or its treatment and the young below 2 years.

Asthma: General Diagnostic Principles

A diagnosis of asthma should be considered in all people who present with recurrent or persistent wheeze, shortness of breath, chest tightness or heaviness and cough. While the presence of wheeze on chest auscultation may enhance the clinical confidence with which the diagnosis of asthma is made, its absence should not be used to exclude asthma. Wheeze is very common in a child under 3 years especially with viral respiratory infections that on its own should not be used to diagnose asthma.

It is recommended that all adult patients suspected or known to have asthma have a **spirometric lung function test**. Efforts will be made to make spirometric lung function testing widely available in Kenya through procurement of equipment and expansion of the training of health care providers on spirometry that has been going on under the stewardship of the Respiratory Society of Kenya (ReSoK).

The measurement of lung function with spirometry or peak expiratory flow measurement may demonstrate airflow obstruction (Forced Expiratory Volume in the first one second of a forced expiratory maneuver (FEV1) divided by total volume of air expired (FVC) of less than 75%) and reversibility (an increase in the FEV1 and or Peak Expiratory Flow of at least 12% or 200 ml or 15%, respectively, 15 to 30 minutes after inhalation of a short and rapid acting bronchodilator), and thus enhance the diagnosis of asthma while also providing an indicator of disease severity and helping to distinguish this disease from chronic obstructive pulmonary disease (COPD). Lung function testing may also help to distinguish asthma from other diseases that may present with cough, wheeze and shortness of breath. If the clinical suspicion of asthma remains high but lung function testing is normal, it is recommended that airway hyper-responsiveness challenge tests be measured as described in this chapter, if the technical capacity to undertake these tests is available. Measurement of airway hyper-responsiveness should be done in a clinical setting where there is an experienced clinician and where emergency care can be given should a severe exacerbation occur during testing. It should be highlighted that asthma may be particularly difficult to diagnose in children below the age of 5 years, in those with mild and intermittent disease, in the elderly who often have a poor perception of asthma symptoms and in the occupational setting.

Text Box 5: Asthma Diagnosis: General Principles

► **Listen to the patient – the clinical history is the most important element in the diagnosis of asthma.**

- Is there recurrent or episodic wheeze, cough, chest tightness or shortness of breath?
- Are the symptoms particularly troublesome at night or early morning?
- Are the symptoms triggered by factors such as dust, cold exposure, respiratory infections, strong fragrances, emotions, laughter or exercise?
- Is there a consistent response to asthma specific treatment?

► **Obtain a lung or pulmonary function Test (measure FVC, FEV1 and PEF)**

- FEV1/FVC ratio of less than 0.75 in adults and less than 0.9 in children is an indicator of airflow limitation or obstruction. (Global Lung Initiative 2012 data for African ethnicity, Quanjer, Stanojevic et al. 2012).
- Is there a bronchodilator response (FEV1 improved by greater than 12% and greater than 200 milliliters, 30 minutes after inhalation of a short acting bronchodilator? Note clinical improvement may suffice where a spirometer or Peak Expiratory Flowmeter is not available.
- Measure PEF variability (wide swings in the PEF (change of 20% or greater) between morning and evening or when at work and off work.

► **Measure airway hyperresponsiveness.**

- Does the FEV1 drop by at least **20%** with only small doses of an inhaled bronchoconstrictor (called the provocative dose or concentration (PD20 or PC20) such as methacholine, mannitol and histamine or with exercise?

Diagnosis of Asthma in Children

The general principles for the diagnosis of asthma outlined at the beginning of this chapter apply to children. However, the diagnosis of asthma may be particularly difficult in children under 5 years. Since lung function testing is difficult in young children, the diagnosis has to rely on clinical suspicion, physical examination and a trial of asthma treatment. Asthma is highly suggested in the presence of frequent episodes (more than once a month or over 3 times in the past 12 months) of wheeze, activity induced cough or wheeze and paroxysmal or persistent cough with or without wheeze in the absence of a viral respiratory tract infection. A strong family history of asthma or allergic disease is also supportive of the diagnosis of asthma in very young children.

Text Box 6: Factors that Increase the Likelihood of Asthma in Children

- Frequent episodes of wheeze, cough, chest tightness or heaviness, breathlessness particularly experienced at night and/ or early morning, or triggered by exercise or during playtime, common irritants like dust and perfumes, emotions like laughter or symptoms that also occur in the absence of a 'common cold'.
- Personal history of atopy/allergy conditions like eczema, allergic rhinitis or conjunctivitis, history of reactions to animal proteins like milk, meat, or eggs.
- Family history of atopy and or Asthma: siblings, parents or close relatives.
- Reduced play and easily tires during activity and playtime.
- Widespread poly-phonic wheeze on chest auscultation during a flare-up.
- History of improvement in symptoms or lung function in response to asthma-specific therapy.

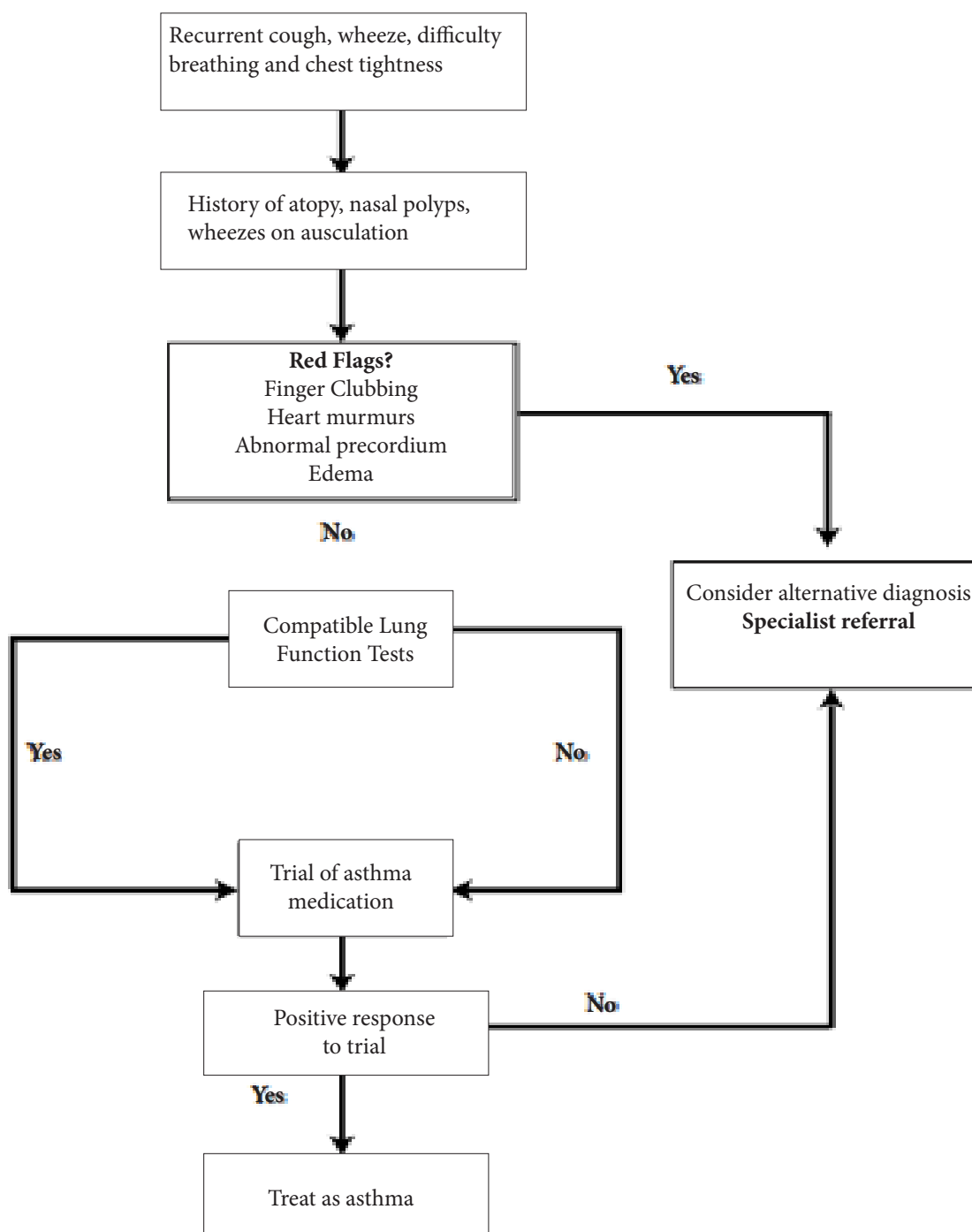
Factors that Decrease the Likelihood of Asthma

- Symptoms with 'colds' only with no other interval symptoms.
- Isolated cough especially when 'moist'.
- Repeatedly normal chest auscultatory findings when symptomatic.
- Normal peak expiratory flow especially when symptomatic.
- No response to trial of asthma therapy.
- Clinical features pointing to an alternative diagnosis e.g. failure to thrive, malnutrition, finger clubbing, sternal anomalies, edema, heart murmurs.

To diagnose children suspected to have Asthma based on signs and symptoms it is recommended that a trial of therapy with either a 1-month course of low dose ICS or a short course of oral steroid and short acting beta agonist inhaler when needed be provided, with the child reviewed to confirm symptom resolution or improvement with this treatment. If the child fails therapy, then refer to a pediatrician or chest specialist for further review and management.

Probability of asthma	Recommended Action	
High	<ul style="list-style-type: none">• Start trial of therapy.• Review and assess response.• Further testing for non-responders.	
	Compatible Spirometry	Therapeutic trial
Intermediate	Normal Spirometry (spirometry possible over age 5 years but interpretable results are best obtained with children over age 9 years)	Specialist referral for atopic testing, bronchodilator reversibility, bronchial hyper-responsiveness challenge.
	Spirometry not feasible	Therapeutic trial and assess for response in 1 month. Evaluate for alternative diagnosis if not responsive.
Low	Evaluate for other disease and or refer to a specialist.	

Diagnostic Flowchart for Children



Approaches to identifying asthma mimics in children

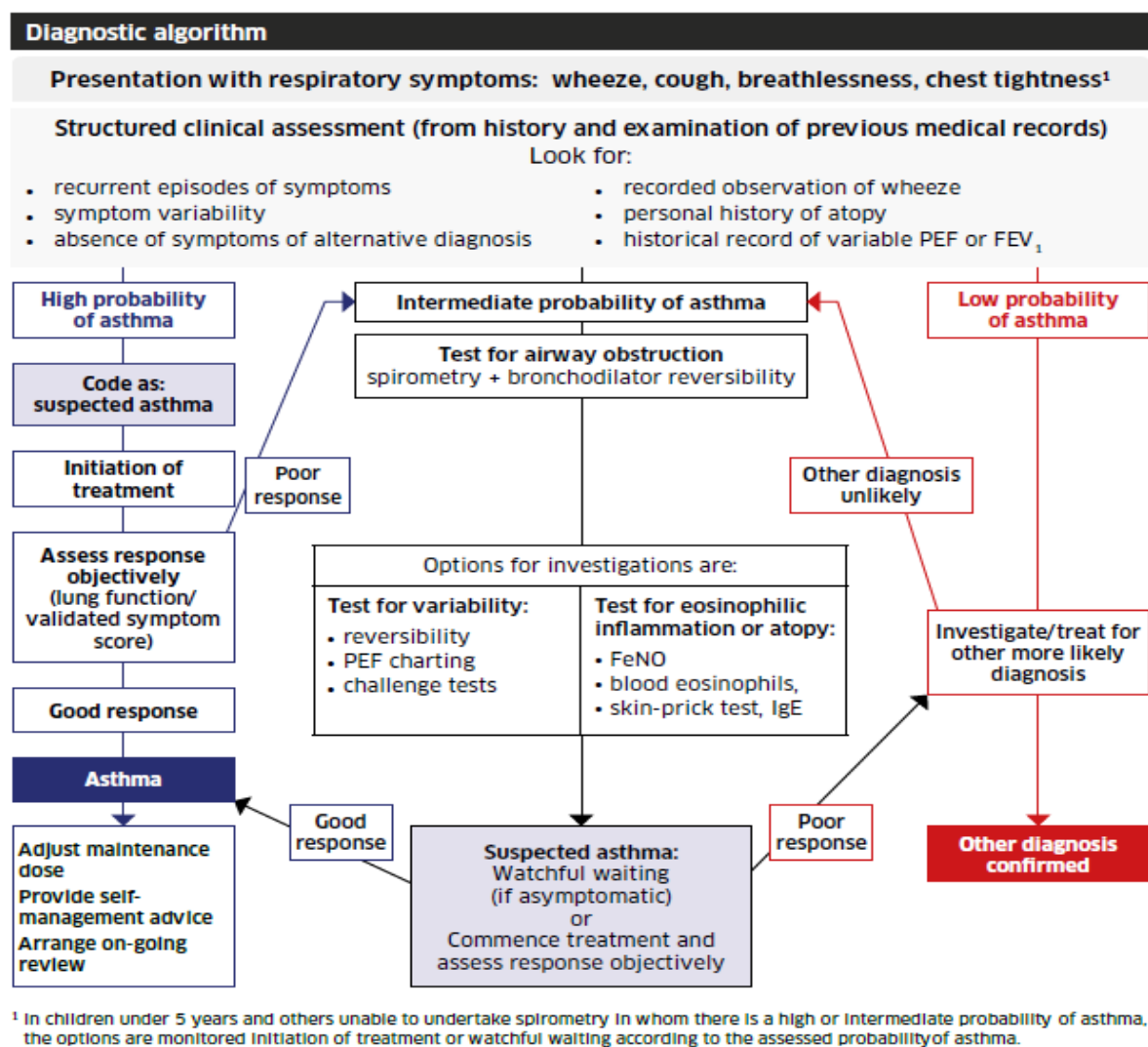
Diagnosis	Evaluation
Upper Airway Disease: <ul style="list-style-type: none"> • Adenotonsillar hypertrophy • Rhinosinusitis • Post Nasal Drip 	<ul style="list-style-type: none"> • Clinical Ear, Nose, Throat Examination. • Post nasal space (PNS) X-ray. • CT Paranasal Sinuses. • ENT Specialist Referral;

Diagnosis	Evaluation
Congenital Structural Bronchial Disease: <ul style="list-style-type: none"> • Tracheo-bronchomalacia • Cartilage Rings • Cysts • Webs 	<ul style="list-style-type: none"> • Bronchoscopy • CT Scan Chest
Bronchial/ Tracheal Obstruction: <ul style="list-style-type: none"> • Vascular Rings/ Slings • Enlarged Cardiac Chamber • Lymph Node Enlargement from TB or Lymphoma 	<ul style="list-style-type: none"> • Chest X-ray (CXR) • Computed tomography (CT) Scan Chest • Echocardiogram • Bronchoscopy and biopsy.
Endobronchial Disease: <ul style="list-style-type: none"> • Foreign Body /Tumor 	<ul style="list-style-type: none"> • CXR • Bronchoscopy
Esophageal / Swallowing Problems: <ul style="list-style-type: none"> • Severe Gastroesophageal Reflux Disease (GERD) • Uncoordinated Swallowing in neuromuscular disorders. • Laryngeal cleft • Tracheo-esophageal Fistula 	<ul style="list-style-type: none"> • Upper Gastrointestinal (GI) Studies/ Barium Swallow • PH (acidity)probe • Milk scan • Upper GI endoscopy
Pulmonary Suppuration: <ul style="list-style-type: none"> • Cystic Fibrosis • Primary Ciliary Dyskinesia • Severe Immunodeficiency Syndromes • Agammaglobulinemia 	<ul style="list-style-type: none"> • Sweat/Genetic testing • Lung/Sinus Biopsy/Molecular Genetic Testing • Complete Blood Count • Immunoglobulin Levels • Complement Levels
Miscellaneous: <ul style="list-style-type: none"> • Post Viral Wheeze • Acute Bronchiolitis • Laryngo-Tracheobronchitis. • Heart failure with pulmonary edema. • Cow's milk protein allergy (CMPA), food allergy. 	<ul style="list-style-type: none"> • Characteristic Viral Symptoms • Respiratory specimens for PCR of common causes such as RSV, Rhinovirus, Adenovirus. • CXR. cardiac Echocardiogram • Common in infants and may be a trigger in pre-school children.

*RSV – Respiratory syncytial virus, PCR 1

Asthma: Diagnosis in older children and adults

The general principles outlined at the beginning of this chapter should be applied when evaluating patients suspected to have asthma. The common differential diagnosis in patients presenting with asthma like symptoms among older children and adults and the approaches to evaluating these patients is summarized in table 3.



Source: BTS: SIGN 158 British Guideline on management of Asthma 2019.

Approaches to identifying asthma mimics in older children and adults.

Chronic obstructive pulmonary disease	<ul style="list-style-type: none"> Spirometry
Congestive heart failure	<ul style="list-style-type: none"> Echocardiogram
Pulmonary embolism	<ul style="list-style-type: none"> Chest X-ray Perfusion/ventilation scans CT pulmonary Angiogram

Tumors	<ul style="list-style-type: none"> • CT scan chest
Pulmonary eosinophilia	<ul style="list-style-type: none"> • Sputum eosinophilia
ACE Inhibitor induced cough	<ul style="list-style-type: none"> • Medication review and discontinuation of ACE-I
Vocal cord dysfunction	<ul style="list-style-type: none"> • Bronchoscopy
Laryngeal dysfunction	<ul style="list-style-type: none"> • Laryngoscopy

Asthma Diagnosis: Role of Lung Function Tests

- **Airflow Limitation:** Objective tests of lung function are recommended in persons 5 years of age and over. By demonstrating reversibility and variability of airflow limitation, these tests increase diagnostic confidence. They also estimate disease severity and help guide treatment decisions.
- **Airflow Variability:** This refers to improvement and/or deterioration in symptoms and lung function from airflow limitation or an obstructive airway. It can occur over the course of one day (diurnal variability), from day to day, from clinic visit to visit, seasonally, or from a reversibility test.
- **Reversibility** (also called responsiveness) refers to rapid improvements in FEV1 (or PEF) measured within minutes after inhalation of a rapid onset bronchodilator such as salbutamol or more sustained improvement over days or weeks after the introduction of effective controller treatment such as ICS.
- **Spirometry** and peak expiratory flow measurements are widely used to confirm the diagnosis and monitor response to therapy. Spirometry is the recommended method for measuring airflow limitation. FEV1 and FVC are the most used spirometric indices. Predicted values of FEV1 and FVC based on race, age, sex, and height have been obtained from population studies.
- **FEV1:** Forced expiratory volume in 1 second. Amount of air one can forcefully expel from the lung in 1 second. It is reduced in Asthma.
- **FVC:** Forced vital capacity: Forceful volume of air that one can expire without collapsing the alveoli. Usually measured up to 6 seconds for a full test. FEV1 is measured against this volume and if the ratio is reduced, this is diagnostic of Asthma.
- **FEV1/FVC ratio** of less than 0.75 in adults and less than 0.9 in children is an indicator of airflow limitation or obstruction.: **GLI2012 Global Lung Initiative 2012 data for African ethnicity.
- **Reversibility** shown by an increase in FEV1 of 12% or more (200mls or more) of the pre-bronchodilator value is diagnostic for asthma within an appropriate clinical context. It is important to note that up to 60% of COPD patients do exhibit spirometric reversibility on bronchodilation with increase of FEV1 by up to 60% and up to 700 ml. On the reverse, up to 15% of asthmatics who have uncontrolled inflammation or airway remodeling do not have significant spirometric reversibility with bronchodilation. However, reversibility may occur after a period of inhaled corticosteroid use.

- Variability of FEV1 >12 % or over 200mls in adults over subsequent clinic visits adds to the diagnosis.
- Peak Expiratory Flow measurements (PEF) is the maximal flow of expired air after a full inspiration. The best of 3 efforts is used.
- PEF is measured using the peak flow meter. Predicted values for PEF are also available but the range of normal values is very wide.
- PEF measurements should be compared to the individual's own previous best measurements when used for monitoring.
- Daily diurnal variation in PEF of more than 10 % in adults and over 13 % in children over a 2-week documented period suggests asthma. Variation above 15% between clinic visits also support the diagnosis of asthma.
- PEF variability can be measured as:
 1. Twice daily readings, Maximum minus minimum PEF value of the day expressed as a percentage of the mean daily PEF value and averaged over one to two weeks.
 2. Minimum morning pre-bronchodilator PEF over one week expressed as a percentage of the recent best (preferred method).



NOTE:

While community transmission of the COVID-19 virus is occurring in the country or in a specific region where the patient resides, it is recommended that spirometry **and peak expiratory flow measurement within health care facilities be postponed**. Follow aerosol, contact and droplet precautions to perform these lung function tests safely. Consider home PEF monitoring, if needed, instead of performing these tests in healthcare settings.

For adequate Asthma diagnosis the following tests/ techniques should be made available at the different facility levels

Level	Facility	Available Test
1	Community outreach units.	High index of suspicion and referral to higher level facilities
2	Dispensary	Peak Expiratory Flow Monitoring
3	Health Centre	
4	Sub-county hospitals	
5	County Hospitals	Spirometry, other pulmonary function tests including exercising testing, hyperresponsiveness challenge, FENO and allergy testing.
6	National Referral Hospitals	

Asthma Diagnosis: Measures of Airway Responsiveness

The airway responsiveness to bronchoconstrictor stimuli to determine the presence of airway hyperresponsiveness is a useful tool in patients with suggestive symptoms but who have normal spirometry, those who don't respond to asthma therapy trial and those with exercise limitation, poor symptom perception or with atypical symptoms.

The test involves the inhalation of increasing doses of a bronchoconstrictor such as histamine, mannitol, methacholine or adenosine, to the provocative dose (PD) that reduces the FEV₁ by more than a set value, usually 20%. Bronchial provocation can also be achieved by an exercise challenge.

A positive test has low specificity for asthma as airway hyper-responsiveness is present in other conditions such as COPD, cystic fibrosis, allergic rhinitis and bronchiectasis.

A negative test is however useful in excluding asthma in patients not on prolonged inhaled glucocorticoids.

Asthma Diagnosis: Role of Markers of Airway Inflammation

Asthmatic airways (patients not on corticosteroids) produce more Nitric Oxide (NO) and Carbon monoxide (CO) than non-asthmatic airways. Therefore, measuring the fraction of expired NO (FENO) and CO (FECO) has been suggested as non-invasive markers in evaluating airway inflammation in asthma. The measurement of FENO was previously hampered by the need for complex assay systems, however, recently smaller handheld devices have become available and measurement of FENO is increasingly being used.

- To determine the likely steroid responsive asthmatic,
- To monitor the adequacy of the controller ICS dose,
- To indicate poor adherence to therapy,
- To indicate poor inhaler technique.

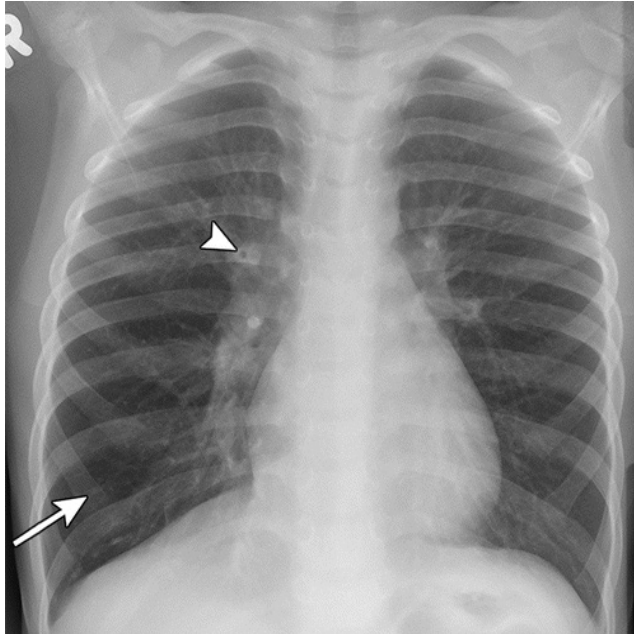
FENO is not for diagnosis of asthma as it's not specific, Low FENO levels should not exclude an Asthma diagnosis. Allergic Rhinitis amongst other conditions can also increase FENO levels.

Asthma Diagnosis: Role of Allergy Tests

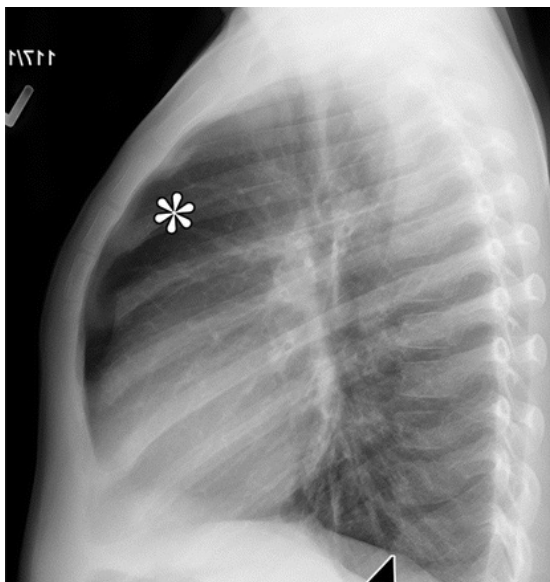
Testing for allergic status is usually accomplished by performing skin testing or measuring specific IgE in serum and is especially useful for children with multiple allergic conditions or highly atopic, severe and difficult to control asthma patients. Allergy tests are not widely available in the public healthcare centres and may be quite expensive in our set-up. A positive skin allergy test or specific serum IgE may suggest the specific allergenic trigger exacerbating asthma symptoms in individual patients but the false positive rate is high. Thus, a positive skin allergy test or specific serum IgE should be carefully correlated with the clinical symptoms. There is no role for measuring serum total IgE only in the diagnostic work up of asthma.

Asthma Diagnosis: Role of Imaging

Imaging should be restricted to those patients who have atypical symptoms or positive airway findings with severe or difficult to control symptoms or admission with a severe exacerbation. Chest imaging may reveal features of hyperinflation, bronchitis, chest infections, pneumothorax/mediastinum, cardiac disease, effusions, bronchiectasis and adenopathy. Further imaging may be useful to detect disorders mentioned in this chapter as differential diagnosis or mimics of Asthma.



Reactive airways disease in a 6-year-old girl who presented with wheeze. (a) Frontal chest radiograph shows that the seventh rib (arrow) does not overlap the hemi-diaphragm, a finding consistent with hyperinflation. In addition, evidence of bronchial wall thickening (arrowhead) is shown.



(b) Lateral chest radiograph shows further signs of hyperinflation, including an increased retrosternal airspace (*) and flattening of the hemidiaphragms (arrowheads).

Darras KE, Roston AT, Yewchuk LK. Imaging Acute Airway Obstruction in Infants and Children. *Radiographics*. 2015 Nov-Dec; 35(7):2064-79. doi: 10.1148/rg.2015150096. Epub 2015 Oct 23. PMID: 26495798.

Asthma Diagnosis: Eosinophil Counts

Sputum and blood eosinophil counts are not essential for diagnosis of asthma. In some cases, they may be useful together with other biomarkers to guide use of biological therapies.

Asthma Diagnosis: Human Immunodeficiency Virus Disease (HIV) and Tuberculosis (TB)

As per our national guidelines, all people seeking care in health facilities should be offered HIV testing. TB should be assessed as a differential diagnosis of asthma when features related to TB such as weight loss, night sweating and chronic respiratory symptoms are present.

Asthma Diagnosis: Stool Microscopy for Helminths

A common infection in our young and school going children in this region, where systemic helminths such as like *Ascaris* have been known to spread into the lung and trigger asthma like symptoms (Loeffler's syndrome). If a child has other non-respiratory symptoms to suggest the presence of helminthiasis, a stool test should be carried out, but the panel does not recommend routine testing of all children presenting with asthma symptoms for helminthiasis.

Asthma Severity Assessment

Asthma severity is assessed retrospectively, after at least 2–3 months of appropriate treatment, from the level of treatment required to control symptoms and exacerbations. At diagnosis assess: Frequency of symptoms, nocturnal symptoms, exercise limitation, acute exacerbations at presentation and FEV₁. It is important to distinguish between severe asthma and asthma that is untreated, undertreated, and uncontrolled, e.g., due to incorrect treatment, suboptimal inhaler technique and/or poor adherence. Frequency of symptoms does not correlate with severity of exacerbations. Patients with few and mild symptoms may have severe exacerbations.

In a recent study on Asthmatics in Eastern Africa, tobacco use, HIV, a history of TB, Gastro Esophageal Reflux Disease (GERD), rhinosinusitis, elevated FeNO above 35ppb, absolute eosinophil count above 300 cells/μL and allergic sensitization on skin prick tests to 1 or more allergens was associated with severe Asthma. Use of inhaled corticosteroids (ICS) was associated with a lower odd ratio of having severe asthma.

Assessing Severity of Asthma

MILD:

Have infrequent symptoms less than once a week or not more than twice a month, FEV1 predicted is below 80% but above 60%, maintains control with as-needed SABA +low dose ICS in children or low dose ICS-formoterol as needed in > 12 years, or with daily low dose ICS, leukotriene receptor antagonists.

MODERATE:

Have more frequent symptoms, more than once a week but not daily, maintains control with low to medium dose daily ICS with or without LABA and a leukotriene receptor antagonist.

SEVERE:

Have frequent symptoms almost daily, low lung function FEV1 below 60% of the predicted value and may have comorbid disease contributing to their poor control such as obesity, GERD and chronic rhinosinusitis. Have ever been admitted with a severe exacerbation needing oxygen therapy, prolonged hospital stay or intubation and intensive care unit (ICU) management. Maintains control with medium to high dose daily ICS with or without LABA and add on therapies such as leukotriene receptor antagonists, oral steroids, tiotropium and biologic agents where available.




Lung function tests, preferably spirometry, should be measured at the start of treatment, after 3–6 months of treatment (to identify the patient's personal best) and periodically thereafter for ongoing risk assessment.

'Untreated severe asthma' may be due to untreated uncontrolled frequent symptoms and exacerbations which resolve after correct diagnosis, appropriate therapy, adherence to treatment with correct use of inhaler devices, management of comorbid conditions and management of environmental, occupational and psychosocial triggers without necessarily the need for high dose ICS or add on treatments to maintain control.

Patients may perceive their symptoms as severe due to the frequency of symptoms and disruption of normal activities, but this is not an objective classification.

INTERMITTENT ASTHMA: These individuals have infrequent symptoms less than once a week or not more than twice a month with peaks during certain seasons such as the rainy/cold season, when maize plants are flowering or with respiratory infections. Between flare-ups they are asymptomatic or have minimal symptoms that don't interfere with their daily activities.

PERSISTENT ASTHMA: These individuals have frequent flare-ups and symptoms in between the exacerbations that interfere with daily activities like school, work, sleep or feeding with, mostly, no seasonal pattern.

Components of Severity		Classification of Asthma Severity (Youths ≥12 years of age and adults)			
		Intermittent	Persistent		
			Mild	Moderate	Severe
Impairment Normal FEV ₁ /FVC: 8–19 yr 85% 20–39 yr 80% 40–59 yr 75% 60–80 yr 70%	Symptoms	≤2 days/week	>2 days/week but not daily	Daily	Throughout the day
	Nighttime awakenings	≤2x/month	3–4x/month	>1x/week but not nightly	Often 7x/week
	Short-acting beta ₂ -agonist use for symptom control (not prevention of EIB)	≤2 days/week	>2 days/week but not >1x/day	Daily	Several times per day
	Interference with normal activity	None	Minor limitation	Some limitation	Extremely limited
	Lung function	<ul style="list-style-type: none">• Normal FEV₁ between exacerbations• FEV₁ >80% predicted• FEV₁/FVC normal	<ul style="list-style-type: none">• FEV₁ ≥80% predicted• FEV₁/FVC normal	<ul style="list-style-type: none">• FEV₁ >60% but <80% predicted• FEV₁/FVC reduced 5%	<ul style="list-style-type: none">• FEV₁ <60% predicted• FEV₁/FVC reduced >5%
Risk	Exacerbations requiring oral systemic corticosteroids	0–1/year (see note)	≥2/year (see note) 		
		 Consider severity and interval since last exacerbation. Frequency and severity may fluctuate over time for patients in any severity category. 			
		Relative annual risk of exacerbations may be related to FEV ₁			

* 2020 Focused Updates to the Asthma Management Guidelines: A Report from the National Asthma Education and Prevention Program Coordinating Committee Expert Panel Working Group. <https://www.nhlbi.nih.gov/health-topics/all-publications-and-resources/2020-focused-updates-asthma-management-guidelines>. accessed February 2021.

Referral to specialists: Pediatricians, Physicians and Pulmonologists where available

The panel recommends that individuals with asthma who display the following characteristics at lower levels of the health care system be referred to specialists. These specialists include pediatricians, physicians, and pulmonologists.

1. Persistent recurrent symptoms, over 3 episodes in a year while on therapy or repeated hospital/outpatient visits and or hospitalization.
 - All children below 2 years with asthma-like symptoms and an unclear diagnosis.
 - Patients with atypical symptoms who need assessment for a differential diagnosis.
 - Difficult to control and severe asthma patients. Patients needing step up to medium to high dose ICS with or without LABA addition and who remain uncontrolled or have difficulties stepping down therapy, those who need oral steroids to achieve and sustain control or those who need additional medications like tiotropium and leukotriene antagonists (LTRAs).

- Patients with low lung function who have an FEV1 below 60% of their predicted value on diagnosis and which remains persistently below 70% on follow-up and who do not achieve optimal control.
- Previous admission for a severe exacerbation needing oxygen therapy, prolonged hospital stay or intubation and ICU management.
- Uncontrolled Asthma in pregnancy.
- Asthma and a known comorbid condition like diabetes, hypertension, severe atopy, obesity, cardiac disease, HIV or TB.

Patients at risk of having an Asthma Exacerbation include

- Previous asthma admission within the last 1 year,
- Lack of clinic attendance or follow-up,
- Overuse of short acting beta agonist (SABA): > 3 canisters a year or > 1 canister a month or needing almost daily use
- Nebuliser use only, avoiding inhaler therapies like MDIs, DPIs.
- Lack of parental supervision and social stressors,
- Recent outpatient visit
- Comorbid factors like obesity, cardiac disease, and severe atopic disease.
- High ICS doses or frequent use of oral steroids,
- None use/poor adherence to ICS
- Poor lung function and exposure to environmental tobacco smoke (passive smoking), other forms of indoor air pollution such as the use of biomass fuels, paraffin stoves and outdoor pollution.

Risk Factors for Medication SideEffects

- Incorrect inhaler technique,
- Not shielding eyes and cleaning skin/oral cavity when using inhaler devices,
- Moderate/high dose ICS or potent ICS,
- Use of frequent oral steroids.

Prioritized Research Questions

- Development and testing of asthma diagnostic algorithms especially at lower levels of the health care systems , including at the community level. What asthma diagnostic algorithms work best to identify people with asthma?

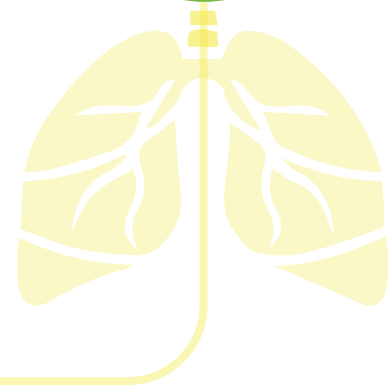
- Implementation research to test diagnostic algorithms for effectiveness including cost effectiveness. Which asthma diagnostic algorithms have the highest performance (sensitivity, specificity, receiver operating characteristics, cost and cost effectiveness, feasibility, equity)

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Occupational Asthma



Occupational lung diseases (OLD) are an important preventable but understated cause of morbidity and mortality and range from lung and pleural malignancies to acute hypersensitivity pneumonitis. The most common OLD is Work Related Asthma which accounts for up to 15% of asthma in people of working age and is categorized into Occupational Asthma (OA) which means asthma specifically caused by specific exposures at the workplace and Work Exacerbated Asthma (WEA), which is pre-existing asthma that is worsened by occupational exposures. However, OA can occur in people with a prior diagnosis of asthma. It can be sensitizer induced, meaning it is usually Ig E mediated and there is a latency between exposure to the agent at work and development or worsening of asthma symptoms. It may also be irritant induced, which means that symptoms occur within a few hours of exposure to a high concentration of the agent at work. Given the challenges of diagnosis and distinction between WEA and OA, it is universally accepted to define OA as that induced by exposure to workplace agents like airborne dusts, fumes or vapors, with or without prior asthma.

An excess of 250 agents that sensitize or trigger asthma in the workplace have been identified and are generally categorized by their molecular weight relative to 1 kilodalton: those above one kilodalton (high molecular weight) such as animal or plant proteins and those below this molecular weight (low molecular weight) such as chemicals, metal dusts and dyes. A list that shows common allergens and examples of local industries where there is potential exposure to these allergens is available from the ReSoK website. It is thought that a clear relationship exists between level of exposure and risk of development of symptoms. Presence of atopy too increases this risk, but there may be a variable latent period between exposure and onset of symptoms.

Diagnosis of Occupational Asthma

OA presents in the same manner as non-occupational asthma, and it is imperative to take a detailed occupational exposure history and document use of personal protective equipment if any, in all working age patients being assessed for asthma. Attempts should be made to find temporal relationships between severity or frequency of symptoms with

time at or away from work, and correlate symptoms to specific duties or exposures at work. Knowing patterns of work attendance for example shift work, rotational duties, and holiday times may be useful in this assessment. A detailed history should document suspected allergens at work, and clear exposure recorded.

A diagnosis of asthma needs to first be established, as detailed in Chapter 3. A daily symptom diary should be kept and serial peak expiratory flow charted with peak flows measured at least four times a day for a period of four weeks. Ideally, this would comprise 2 weeks attending work and two weeks off work. If not feasible, there should be clear documentation of periods away from work and of periods at work. A positive bronchial provocation test with histamine or methacholine done under specialists' guidance would augment these findings but is not imperative for diagnosis.

Further evaluation to specify the offending allergen can be made with the use of skin prick tests or specific IgE assays as guided by the exposure history. Bronchial provocation using the specific allergen is the ideal diagnostic test but requires specialist expertise, and the ability to prepare the allergen into a suitable solution with the appropriate concentrations for safe provocation testing.

Management of Occupational Asthma

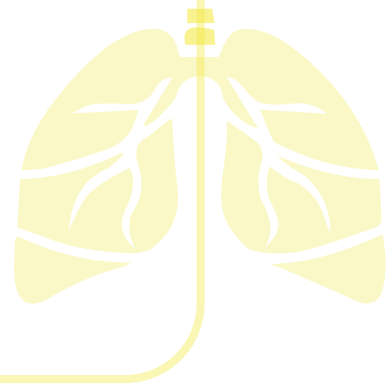
The primary approach is allergen avoidance, and this explains the role of specific allergen identification. Recovery from OA depends on extent and duration of exposure to the allergen, hence early diagnosis and management is crucial. In the event of asthma developing after work-based exposure, the disease may persist even after identification and complete avoidance of the specific allergen. Either way, the management of OA still requires the same approach and pharmacotherapy as that of non-occupational asthma.

It is important to note that OA has a socio-economic aspect, not just from reduced productivity due to the resultant morbidity and mortality, but also due to the need to retrain and replace workers where allergens are irreplaceable, and sadly, due to potential loss of livelihoods. There are important considerations to consider when diagnosing and managing OA, especially regarding compensation, human resource allocation, employment loss and sickness with time away from work. The role of labor and employment laws, and legislation for safety at work is very important and Healthcare Practitioners are advised to consult the necessary professionals when making recommendations and offering advice to patients.

Research Questions

- What is the prevalence of occupational asthma among the population of asthmatics in Kenya
- Which occupations are most commonly associated with OA in Kenya ?
- What are the asthma severity patterns in persons with OA in Kenya?
- Do people with OA respond differently to treatment compared with those who do not have OA?

Principles and Goals of Asthma Management



CHAPTER OBJECTIVES

The goal of this chapter is to guide health care providers on the long-term management of asthma.

This chapter includes the medications used in the treatment of asthma and description of the stepwise approach to achieving asthma control.

The goal of asthma control is to control symptoms, optimize exercise capacity and lung function, minimize future risks of exacerbations, and reduce adverse effects of asthma medications. For the persons with asthma, asthma control is likely to be achieved and sustained if the person understands the condition, the medications to use when in stable state and when asthma is going out of control .

The ultimate goal of managing asthma is to ensure the person living with asthma is enabled to live and enjoy a normal life (high level of health-related quality of life – HRQoL).

Medications used in paediatric asthma

KEY POINTS

- Inhaled corticosteroids are the cornerstone of managing asthma to achieve control.
- Oral short-acting bronchodilators, cough mixtures and mucolytics are not recommended for the management of asthma.
- A spacer device can be used in any age group including adults for those not able to use pressurized metered dose inhalers (pMDIs) directly. They should be prescribed in all children below 12 years, with a facemask for children under 5 years.

In management of asthma, the paediatric age group is divided into two groups: those aged 5 years and younger and those aged 6 to 11 years. Adolescents aged 12 years and above are considered together with adults.

Asthma is a chronic persistent disease, and the medicines need to be used on a long-term basis by most people with asthma. The preferred route of administration of most of these medicines is the inhaled route because it allows small doses (micrograms) to be used and delivers the drug directly to the airways thus achieving high local concentrations and limiting systemic adverse effects.

Various inhaler devices tabulated below have been developed

Types of inhaler devices:

- Pressurized Metered Dose Inhalers (pMDIs)
- Breath Actuated Metered Dose Inhalers (MDIs)
- Dry Powder Inhalers (DPIs)
- Soft Mist Inhalers (SMIs)
- Nebulizers or wet aerosols
- Spacer devices with or without face masks to be used with pMDIs

In general, medications used in asthma can be classified into 3 main groups

- 1. Controller medications:** These include inhaled steroid medications (ICS) which reduce airway inflammation and help control symptoms and reduce future exacerbation risks. They are taken daily to keep asthma under control. Examples include beclomethasone, budesonide, fluticasone and ciclesonide. Inhaled corticosteroids are often combined with long-acting beta 2 agonists (LABA), which are bronchodilators, to achieve and sustain asthma control. Available LABAs in Kenya include salmeterol, formoterol and vilanterol.
- 2. Reliever medications:** These medications are also called rescue medications. They work primarily as airway openers (bronchodilators) and are used as needed to relieve acute asthma symptoms. Inhaled bronchodilators commonly used and available in Kenya include the rapid onset but short acting beta 2 agonist (SABA) salbutamol and the rapid and short acting muscarinic antagonist (SAMA) ipratropium bromide.
- 3. Add-on medications:** These are medications which are used in addition to ICS, usually with a LABA, to control asthma in persons with persistent symptoms and/or exacerbations despite regular use of the ICS and LABA to achieve asthma control and reduce the need of using high dose ICS. They include the long-acting muscarinic antagonist (LAMA) tiotropium, leukotriene receptor antagonists (LTRA), oral steroids and biologic agents. Biologic agents include omalizumab, an anti-IgE, mepolizumab, an anti-interleukine 5 (IL-5), reslizumab, another anti-IL5 and benralizumab which binds to the receptor of IL-5 receptor (IL-5R). These medications are not currently available in Kenya.

Asthma medicines in Kenya's List of Essential medicines of 2019

Asthma medicines that are in Kenya's 2019 Essential medicine list	
Drug	Formulation
Budesonide	100 micrograms/dose (200 dose) 200 micrograms/dose (200 dose)
Budesonide + Formoterol	Dry powder inhaler 100 micrograms + 6mg/metered dose (120 dose) 200 micrograms + 6mg/metered dose (120 dose)
Ipratropium bromide	Inhalation (aerosol) 20 micrograms/metered dose (200 dose)
	Nebulised solution 500 micrograms/2mL unit dose vial (isotonic)
Montelukast	Tablet (chewable) 5mg Tablet 10mg
Salbutamol + Beclomethasone	Inhalation (aerosol) 100 micrograms + 50 micrograms
Salbutamol	Nebulizing solution 5mg/ml
Salbutamol + Ipratropium	Nebuliser solution 200 micrograms (as sulphate) + 1mg (as bromide) per 1mL (2.5mL amp)
Tiotropium	Powder for inhalation in a capsule 18 micrograms / capsule

1. The relievers medications (Bronchodilators)

A. The Beta-2 Agonists

The beta-2 agonists are the bronchodilators or relievers widely available for the treatment of asthma. They may be classified as:

1. Rapid and short acting
2. Rapid and long acting
3. Slow and long acting.

The rapid and short acting inhaled beta 2 agonists (SABAs) include salbutamol and its L-isomer levo-salbutamol. These medicines are used on 'as needed' basis to relieve asthma symptoms. **Monotherapy with SABAs is not recommended for the management of asthma.** When used with a controller, a high frequency of reliever use is an indicator of poor asthma control and should prompt a review of the asthma management plan and the need to adjust the controller medication. The effect of these medicines' peaks at about 2 hours and lasts about six hours.

Oral short-acting bronchodilators like salbutamol, fenoterol, and terbutaline, are not recommended in asthma treatment as they are associated with slow onset of action and higher rates of adverse effects as compared to inhaled bronchodilators.

Both Salmeterol and Formoterol are long-acting beta 2 agonists (LABAs) with prolonged bronchodilator action that lasts up to 12 hours. **Monotherapy with LABAs is not recommended for the management of asthma and these medications should be used in combination with ICS, mostly as fixed dose inhaler combinations.** Salmeterol has a slow onset of action while formoterol is fast acting and thus it may be used, in combination with an ICS, as both a reliever and a controller medication, commonly referred to as Maintenance and Reliever Therapy (MART).

Vilanterol is an ultra-long-acting β_2 adrenoceptor agonist (ultra-LABA). The duration of action of ultra-LABAs is 24 hours. This allows for them to be used in once-daily dosing regimens. Vilanterol should only be used in combination with an ICS.

Long-acting oral beta 2 agonists including slow-release oral formulations of salbutamol, terbutaline and bambuterol are generally not preferred because of the higher frequency of adverse events.

B. Anticholinergic agents

Ipratropium bromide is the anti-cholinergic most commonly used for the treatment of asthma especially in the acute care setting. When Ipratropium is used in the acute care setting, it is usually combined with a short acting inhaled beta 2 agonist (salbutamol). This combination may have additional benefits on lung function and reduce the risk of hospitalization in the acute care setting. Ipratropium bromide may also be used on a long-term basis as the 'as needed' bronchodilator in patients unable to tolerate beta 2 agonists.

Tiotropium is a long acting antimuscarinic antagonist (LAMA). It antagonizes M3 receptors in the airway smooth muscle leading to smooth muscle relaxation and thus bronchodilation. It also has anti-inflammatory effects. In Kenya tiotropium is available in encapsulated powder form to be used with a special device called the handihaler and also via mist inhalers for use in patients aged 6 years and above.

The anticholinergics are safe medicines associated with minor adverse events such as a bitter taste and dryness of the mouth.

Other reliever medicines

Oral theophyllines, both short acting (such as aminophylline) and slow-release formulations are not recommended for routine use in all persons with asthma and in particular children aged 11 years and below outside of specialist centres due to their limited safety data. Intravenous aminophylline may be used for acute severe or life-threatening asthma within critical care units where patients can be monitored adequately.

2. Controller medications

A. Long-Acting beta 2 agonists (LABAs)

These drugs are classified as controllers and are used in combination with ICS for the long-term control of asthma. In addition to bronchodilator properties, they also inhibit mast cell mediator release, plasma exudation and reduce sensory nerve activation. The LABAs may potentiate the molecular mechanism of corticosteroid actions, with increased nuclear localization of glucocorticoid receptors and thus have additive or sometimes synergistic suppression of inflammatory mediator release. Concurrent use of LABA with Inhaled corticosteroids also reduces the total steroid requirement thus mitigating ICS adverse effects.

Formoterol is a rapid onset long-acting beta 2 agonist. This drug, combined with an inhaled corticosteroid (ICS) is currently recommended for use both as maintenance or controller and reliever (MART) Therapy in persons over the age of 12 years.

Salmeterol is a slow onset, long-acting beta 2 agonist used in combination with an inhaled corticosteroid for asthma control but not as a MART therapy. Previous research on salmeterol monotherapy was associated with a higher mortality risk among a subset of subjects. This may have been due to lack of concurrent anti-inflammatory therapy and thus worsening of the underlying disease.

It is also recommended that the above LABA containing inhalers should only be used in children aged 4 years and above in whom research has been done to prove safety.

Vilanterol based ICS regimens can be used in adults or adolescents with uncontrolled asthma. The once daily dosing improves medication adherence. As with LABAs, ultra-LABAs are not recommended for children aged less than 5 years. On the other hand, in children aged 5-11 years, a randomized control study in children with uncontrolled asthma and on an ICS, the addition of vilanterol did not improve lung function when compared to a placebo. Thus, it is currently recommended vilanterol only be used in adolescents and adults where a clinical benefit has been demonstrated.

It must be emphasized that anti-inflammatory therapy (ICS) forms the backbone of asthma control. Hence LABAs should only be used in combination with ICS.

B. Inhaled Corticosteroids (ICS)

The pillar of asthma treatment is the use of anti-inflammatory inhaled corticosteroids (ICS). Although at equipotent doses the various inhaled steroids should have the same efficacy, differences in formulation and delivery systems can create variations in therapeutic efficacy. Also, chemical properties of the various inhaled steroids may also affect safety profiles. For example, both ciclesonide and beclomethasone dipropionate are pro-drugs which greatly lowers their potential to cause local oropharyngeal side effects. Recently small particle inhaled steroids have been introduced. These new formulations carry the advantage of improved total lung deposition including ability to reach small airways which may confer better asthma control at lower doses. It has been observed that higher doses of any of the inhaled steroids may result in adverse effects without additional benefit.

Inhaled corticosteroids are generally safe. Local side effects such as oropharyngeal candidiasis, and dysphonia can be minimized through good inhaler technique, mouth rinsing after drug inhalation or even better brushing teeth after use and use of spacer devices with a pMDI for the younger children .

Small amounts of Inhaled corticosteroids absorbed from the lung and possibly the gut may cause systemic adverse events. The risk of such adverse effects is dependent on the dose and potency of the inhaled corticosteroid, the delivery system used, systemic bioavailability, first pass metabolism and the half-life of the systemically absorbed drug.

In general, there are no significant systemic side effects when these drugs are used in low to medium doses. There is no evidence that inhaled corticosteroids increase the risk of lung infections including tuberculosis and these drugs can be used in the presence of active tuberculosis.

The anti-retroviral drug, ritonavir, significantly increases plasma fluticasone propionate concentration, resulting in significantly decreased serum cortisol concentrations. Systemic corticosteroid effects including Cushing's syndrome and adrenal suppression have been reported during post-marketing surveillance in patients receiving ritonavir and inhaled or intra-nasally administered fluticasone propionate. Therefore, co-administration of fluticasone propionate and ritonavir is not recommended unless the potential benefit to the patient outweighs the risk of systemic corticosteroid adverse effects. It appears that low dose beclomethasone or budesonide are safer options when concurrent administration with ritonavir is indicated.

Inhaled Corticosteroids commonly available in Kenya and their potency (children)			
Drug	Low Dose	Medium Dose	High Dose
	(mcg)	(mcg)	(mcg)
Beclomethasone dipropionate	100-500	>200-400	>400
Budesonide	100-200	>200-400	>400
Ciclesonide	80	>80-160	>160
Fluticasone propionate	50		Not applicable

Inhaled Corticosteroids commonly available in Kenya and their potency (Adults)			
Drug	Low Dose	Medium Dose	High Dose
	(mcg)	(mcg)	(mcg)
Beclomethasone dipropionate	200-500	>500-1000	>1000
Budesonide	200-400	>400-800	>800
Ciclesonide	80-160	>160 -320	>320
Fluticasone propionate	100-250	>250-500	>500
Fluticasone Furoate	100		200

C. Add-on medications

i. Leukotriene Modifiers

The leukotriene modifiers include the 5-lipo-oxygenase inhibitors, zileuton and the cysteinyl-leukotriene receptor 1 antagonists: montelukast, pranlukast and zafirlukast. Leukotriene modifiers may be used as add-on therapy in patients who fail to achieve control with low dose inhaled corticosteroids or have concurrent persistent allergic rhinitis. However, leukotriene modifiers are inferior in potency to doubling the inhaled corticosteroid dose or adding a LABA in children over 4 years old and in adults.

In some settings leukotriene modifiers can be used as controller medication. This includes situations where inhaled corticosteroids are not available. However, studies have shown that they are inferior to inhaled corticosteroids when used as controller medication.

This group of medicines is generally well tolerated. However, neuropsychiatric events have been reported in paediatric patients on leukotriene modifiers. These include anxiety, sleep disturbances, agitation, mood changes, irritability and suicidal ideation in adolescents. Patients must be informed at the beginning of the treatment of these effects.

ii. The Chromones

The chromones which include nedocromil sodium and sodium cromoglycate are currently no longer recommended in the long-term treatment of asthma. They have been used for intermittent asthma and exercise-induced bronchospasm but are less effective than low dose inhaled corticosteroids when used on their own. They augment the anti-inflammatory response to glucocorticoids mainly by acting on mast cells and potentially can reduce the dose of the ICS required to achieve a therapeutic effect. Cromones may in future play a role as an add-on therapy.

iii. Biologics

Omalizumab may benefit asthma patients aged ≥ 6 years with high IgE levels and who have severe allergic asthma that is poorly controlled on optimized usual treatment which includes oral steroids. Anti-IgE is given subcutaneously every 2-4 weekly and is expensive. This treatment is currently not available in Kenya. Newer biologicals such as mepolizumab, reslizumab and benralizumab are also unavailable in Kenya.

iv. Systemic Corticosteroids

Short pulses of systemic corticosteroids are recommended for patients with moderate to severe acute exacerbations of asthma. The preferred route of administration is oral. In a small subset of patients, asthma may remain uncontrolled unless systemic corticosteroids are used. In these patients with steroid dependent asthma the lowest possible dose of corticosteroid should be used. Dosing strategies such as alternate day therapy help mitigate systemic adverse effects.

In high doses systemic steroids can cause adverse effects such as easy bruising, adrenal suppression, reduced bone mineral density, increased risk of fractures, peptic ulceration,

cataracts, hyperglycemia, growth retardation, hypertension, and glaucoma. This therapeutic option should be done under the guidance of a specialist.

v. Allergen specific Immunotherapy

Because most asthmatics react adversely to a wide range of allergens, allergen specific immunotherapy has a limited role in asthma. However, in the rare instance when an atopic individual happens to be sensitive to one or two allergens and when optimized asthma treatment still results in inadequate control there may be a role for this therapy.

Complementary and alternative medicine

Alternative and complementary approaches, including yoga, acupuncture, dietary supplements, herbal preparations, and breathing techniques have not been subjected to rigorous scientific research and hence their use cannot be recommended at present.

Stepwise management of Paediatric Asthma

KEY POINTS

Stepwise approach aims to:

- Achieve good control.
- Minimize future risks of exacerbations.
- Minimize adverse effects of asthma medication.

Asthma control assessment should be done before adjusting medication up or down

Symptom control	Level of asthma symptom control		
In the past 4 weeks, has the child had:	Well controlled	Partly controlled	Uncontrolled
Daytime asthma symptoms for more than a few minutes, More than once a week?	None of these	1–2 of these	3–4 of these
Any activity limitation due to asthma? (Runs/plays less than other children, tires easily during walks/playing?)			
Reliever medication needed more than once a week.			
Any night waking or night coughing due to asthma?			

Risk factors for asthma exacerbations within the next few months

- Uncontrolled asthma symptoms.
- One or more severe exacerbations (Emergency Department (ED) attendance, hospitalization, or having received a course of Oral Corticosteroids (OCS) in the previous year.
- The start of the child's usual 'flare-up' season such as cold and rainy seasons, pollination seasons for example for maize or when resuming school.
- Exposures: tobacco smoke; indoor or outdoor air pollution; indoor allergens (e.g., house dust mite, cockroach, pets, mold).
- Major psychological or socio-economic problems for the child or in the family.
- Poor adherence with controller medication or incorrect inhaler technique.

Risk factors for persistent airflow limitation

- Severe asthma with several hospitalizations
- History of bronchiolitis.

Risk factors for medication side-effects

- **Systemic:** Frequent courses of OCS, high-dose and/or potent ICS
- **Local:** moderate/high-dose or potent ICS; incorrect inhaler technique; failure to protect skin or eyes when using ICS by nebulizer or spacer with face mask.

Stepwise approach in asthma management

Before stepping up asthma medication, the following should be checked:

- i. Presence of symptoms and/or persistent exacerbations despite being on optimal treatment for their asthma severity classification for at least 3 months.
- ii. Inhaler device technique, including spacer chamber use and care.
- iii. Adherence to prescribed dose.
- iv. Assessment for an alternative diagnosis.
- v. Presence of modifiable causes of asthma symptoms.

Stepping down asthma medication aims at finding the minimum effective dose of medication that can control the asthma symptoms while maintaining good lung function. It should be done once good asthma control has been achieved and maintained for at least 3 months. Things to consider before stepping down treatment include:

- i. Modifiable risk factors for asthma exacerbations have been managed.
- ii. Patients have written asthma action plans to be able to recognize and respond to symptom flare-ups.

- iii. Have adequate medication to resume their previous doses should symptoms recur.
- iv. An appropriate time is chosen e.g., patient does not have a viral infection or cold season or is travelling.
- v. There are no risk factors for exacerbations.

After stepping down treatment, asthma control assessment should be carried out within 1 month. If daily controller medication has ceased completely, follow up should be done for at least 12 months at 4-6 weeks interval initially then at 3-4-month intervals. Asthma control assessment tests should be done at each follow up visit. Lung function tests such as spirometry can be done 2-3 times a year.

Stepwise treatment for presumed asthma in children aged 5 years and younger

Step 1

At this age group, the preferred medication for patients with wheezing episodes is as-needed SABA every 4-6 hours until symptoms disappear, usually within 1 to 7 days. Stepping up treatment is required if the use of SABA is required for more than twice a week over a period of one month.

Step 2

The preferred controller option for patients with three or more wheezing episodes per year or presence of other asthma symptoms interfering with their playtime, feeding or sleep or severe intermittent symptoms with viral infections or season is the use of daily low dose ICS for at least 3 months to assess effectiveness of control. The reliever option is inhaled SABA as needed for acute symptoms.

Step 3

If after three months of therapy with low dose ICS, symptoms control is not achieved despite good adherence, good inhaler technique and non-pharmacologic strategies, step up should be done. The preferred controller option is doubling the low dose ICS. Alternatively, addition of an LTRA to the low dose ICS can be used as a controller option. The reliever option is inhaled SABA as needed for acute symptoms.

Step 4

Refer the patient to a specialist if they have asthma symptoms for most days of the month or wake up due to asthma more than once a week while on medium dose ICS. While the best treatment options for this stage have not been determined, if the diagnosis of asthma is confirmed, the treatment options that can be considered by the specialist include:

- i. Further increasing the ICS dose while monitoring adverse effects until asthma control is achieved.
- ii. Addition of a LABA.

- iii. Addition of a LTRA to the medium dose ICS.
- iv. Addition of low dose oral corticosteroids for a few weeks only until symptoms are controlled while monitoring adverse effects.
- v. Addition of intermittent high dose inhaled ICS at the onset of respiratory illnesses if the main problem is asthma exacerbations caused by frequent respiratory tract infections.

Stepwise Asthma treatment for children aged 5 years and younger

Symptoms	Management
STEP 1 Infrequent wheeze	As needed inhaled SABA
STEP 2 ≥3 wheezing episodes per year or presence of other asthma	Controller: Daily low dose ICS. Reliever: inhaled SABA when needed.
STEP 3 Most days or waking with asthma once a week or more	Controller options: Preferred: Double low dose ICS Alternative: Low dose ICS+LTRA Reliever: SABA taken together with the ICS current ICS controller option
STEP 4 Most days or waking with asthma once a week or more while on double low dose ICS	Controller options: Continue controller and refer to specialist Reliever: SABA taken as needed together with the current ICS controller option
For all assess: Diagnosis, modifiable risk factors, comorbidities and inhaler technique and adherence	

Step up or
Step down
Based on
assessment

Stepwise Asthma Treatment for Children Aged 6-11 Years

Step 1

For children with infrequent asthma symptoms the controller option is use of Low dose ICS whenever SABA is taken to reduce progression to a severe exacerbation and use of non-pharmacological techniques such as trigger avoidance. The reliever option is as needed inhaled SABA.

As-needed SABA only treatment is no longer recommended as it has been associated with increased risk of severe exacerbations as compared to addition of ICS.

Step 2

The preferred controller option for children at step 2 is daily low dose ICS. The reliever option is as needed inhaled SABA.

Step 3

The preferred controller option for step 3 is low dose ICS plus LABA. Other controller options include addition of LTRA to low dose ICS and use of medium dose ICS. The reliever option for this step is as needed inhaled SABA.

Children at this step onwards should be referred to specialists

Step 4

Children who have asthma symptoms for most days of the month or wake up due to asthma more than once a week or have low lung function while on medium dose ICS should be referred to a specialist. **The preferred controller medication is medium dose ICS plus LABA. Other options include high dose ICS, high dose ICS plus LABA, add-on tiotropium or add-on LTRA.** A course of low dose oral corticosteroids (OCS) may be given as the last option if inhaled high dose steroids and other therapies, and interventions targeted at modifiable factors such as comorbid conditions and environmental triggers do not achieve control. Children provided with low dose oral corticosteroids should be monitored carefully for adverse effects. The reliever option for this stage is as needed inhaled SABA. Biologics as an option for step up therapy are currently unavailable in Kenya.

Management of Asthma in children: Summary

- Achieving control of asthma requires the use of both pharmacologic and non-pharmacologic interventions.
- Most patients with asthma will achieve control with low dose ICS.
- The use of SABAs as monotherapy (alone) in children over 5 years old with intermittent asthma is not recommended anymore. These children should be treated with ICS anytime SABA is used.
- Every child diagnosed with asthma should be regularly assessed to ensure the correct diagnosis was made, the child is adherent to treatment, modifiable risk factors have been addressed and correct inhaler technique is in use before adjusting medications.
- Adjust medications after achieving and maintaining control for at least 3 months.
- Written asthma action plans that include how to recognize a flare-up of symptoms, how to use the reliever and controller medications and where and how (e.g., use of an emergency contact telephone number) to seek medical help when an exacerbation is impending or established.
- Refer to the specialist children below 2 years with recurrent wheeze and those who need medium to high dose ICS to achieve control.

Stepwise Asthma treatment for children aged 6-11 years

Symptoms	Management
STEP 1 Infrequent	Controller: Non pharmacological e.g., trigger avoidance Low dose ICS whenever SABA is taken Reliever: as needed inhaled SABA.
STEP 2 Twice a month or more but not on most days	Controller: Daily low dose ICS or Low dose ICS whenever SABA is taken. Reliever: as needed inhaled SABA.
STEP 3 Most days or waking with asthma once a week or more	Controller options: 1. Low dose ICS+LABA 2. Medium dose ICS 3. Low dose ICS+LTRA Reliever: as needed inhaled SABA. Refer to specialist.
STEP 4 Most days or waking with asthma once a week or more and low lung function	Controller options: 1. Medium dose ICS+LABA 2. High dose ICS + LABA 3. Add on-tiotropium or LRTA 4. High dose ICS . Reliever: as needed inhaled SABA. Short course OCS as per the criteria in the above section. Refer to specialist.

Step up or
Step down

Based on
assessment

Assess: Diagnosis, modifiable risk factors, lung function test, comorbidities and inhaler technique and adherence

Asthma Management in Adults

Effective management of asthma is a balance of prevention of asthma triggers and judicious use of effective pharmacotherapeutic agents.

All treatment strategies of chronic asthma in adults and children aged 12 years and above, must include an anti-inflammatory agent, preferably an inhaled corticosteroid to target airway inflammation, the primary airway abnormality. **Use of SABAs as the sole therapeutic strategy has been shown to be ineffective, dangerous and may lead to a worsening of asthma and an increase in both asthma and cardiovascular adverse outcomes including critical care unit admissions and death.**

Assessing Asthma Severity in Adults and Children Older than 11 Years of Age

Initiating Treatment

Classically, pharmacological management includes a maintenance and reliever pharmacotherapeutic agent(s) with the reliever used on as needed basis to avert or pre-empt acute symptoms and the maintenance pharmacotherapeutic agent used to prevent symptoms. As in the case of younger children, the number and amount of maintenance therapies escalates from step one through five depending on the severity of symptoms. The choice of a preferred reliever agent is crucial in determining what maintenance therapies should be employed.

SABA-Only Strategy

Regular use of a SABA as the sole therapeutic agent for asthma even for a week increases the risk of adverse effects and more prolonged use has been shown to increase asthma exacerbations including life threatening events and is associated with an increased risk of asthma death. Conversely, *regular use of ICS reduces the risk of requiring oral corticosteroids, inpatient asthma care and asthma deaths*. These inform the radical departure from earlier management guidelines for mild asthma. It is important to note that poor adherence to maintenance asthma treatments is a common feature in studies on Asthma populations and the risk of inadvertent default SABA-only strategy is high.

Step 1 and 2

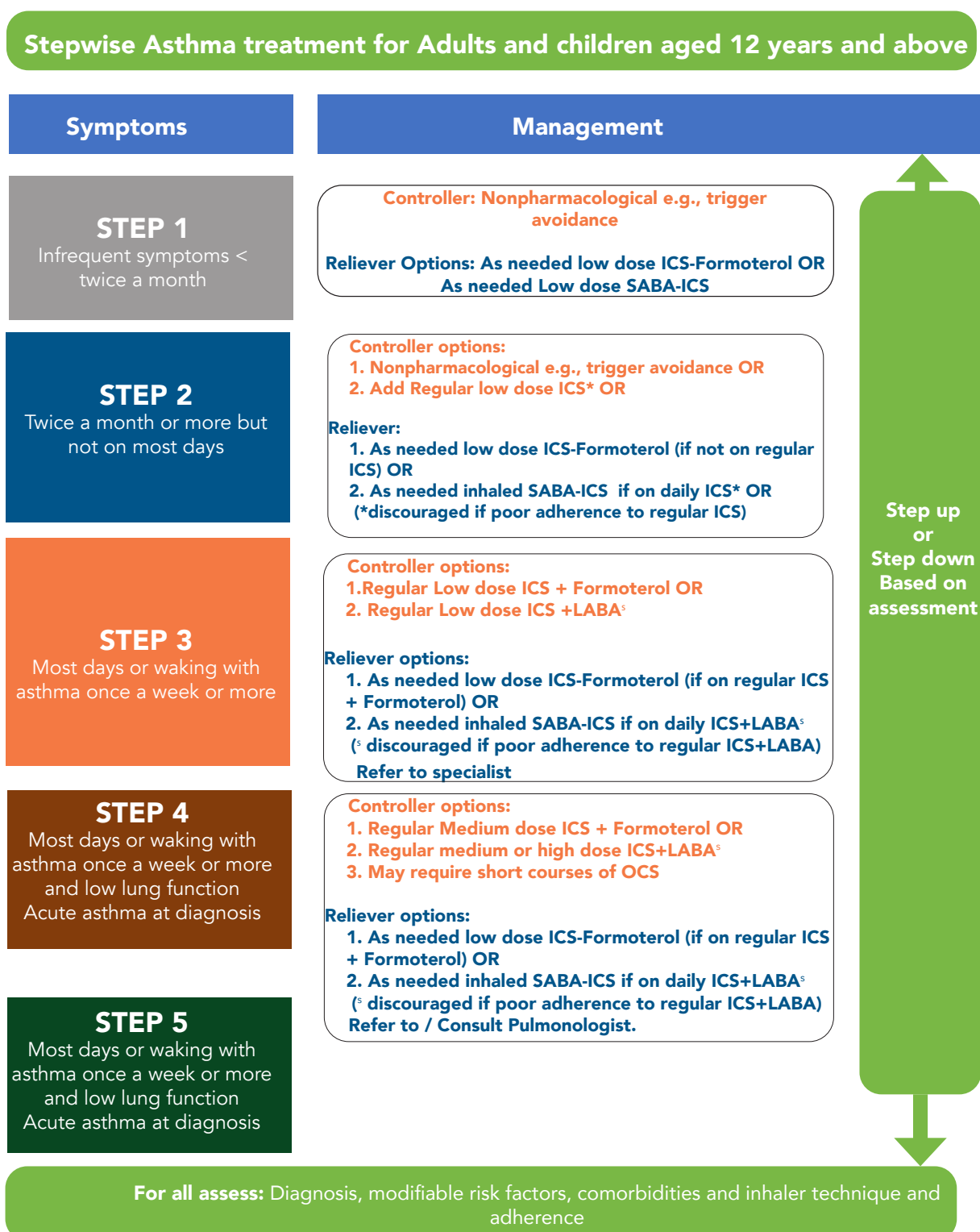
When compared to 'as needed' SABA-only strategy, treatment of mild asthma with ICS-Formoterol used when needed is superior and reduces severe exacerbations by two thirds. It has similar efficacy to use of daily ICS in controlling symptoms and preventing severe exacerbations. A strategy employing daily ICS and as needed SABA for mild asthma is effective in reducing adverse outcomes, preventing exacerbations, and controlling symptoms.

We propose two options for mild asthma. In the first option, a low dose ICS-Formoterol is used on an 'as needed' basis. This addresses both the acute requirement for rapid bronchodilation (and offers a longer lasting beta agonist effect), but also addresses the underlying inflammation with the low dose ICS. The maximum dose for this strategy is 72 micrograms of formoterol in a 24-hour period but is expected to average at 4 doses per week or less for mild asthma as evidenced in trial data.

The alternative option depends on severity. For step 1, we recommend using a low dose ICS at the same time an 'as needed' SABA dose is taken. This may be in sequence, or in a contemporaneous combination which is preferred and hence our as-needed recommendation for this option. Step 2 is based on optimal adherence to daily low dose ICS with as needed SABA used for rescue. This alternative relies on good adherence to daily ICS (and to sequential or concurrent ICS use for Step 1) as failure will result in an 'as needed' SABA-only strategy, which is dangerous and ineffective.

Step 3 and 4

This requires regular use of an ICS-LABA as maintenance treatment. In the same vein as above, there are two alternatives, the first involving regular use of low dose-ICS Formoterol as maintenance treatment and using the same combination whenever needed for rescue strategy for Step 3. This is the same for Step 4 except that the maintenance option is medium dose ICS-formoterol used regularly, with low dose ICS-formoterol used as needed for rescue. This strategy is referred to as maintenance and reliever therapy or 'MART'.



The alternative option uses a non-formoterol-based ICS-LABA as the maintenance treatment, at a low dose ICS-LABA used regularly for Step 3 and medium dose ICS-LABA used regularly for Step 4. This strategy employs the use of SABA-ICS as the rescue medication, used whenever needed. This alternative crucially relies on good adherence to daily ICS-LABA as failure will inadvertently result in a SABA-ICS only strategy, for which we lack sufficient data on safety and efficacy.

We do not recommend the use of non-formoterol-based ICS-LABA and ICS-Formoterol as MART concurrently in the same strategy. These patients may require short courses of oral corticosteroids to achieve control. We recommend referral to or consultation with a Consultant Physician or Pulmonologist for Step 3, and referral to or Consultation with a Pulmonologist for Step 4 and a regularly updated directory of Pulmonologists in the Republic of Kenya is available on the Respiratory Society of Kenya website and from their offices.

Step 5

Patients who are not controlled despite optimal Step 4 therapy which is adhered to should be referred to Pulmonologists. A LAMA should be added on to Step 4 therapy and substitution of the maintenance treatment from medium dose ICS to a high dose ICS be considered (no matter the LABA being used). A pulmonologist should assess adherence with non-pharmacological control strategies including the avoidance of known or hitherto undetected allergens; review and ensure rational pharmacotherapy and adherence and conduct a phenotype assessment.

Suggested Further Reading

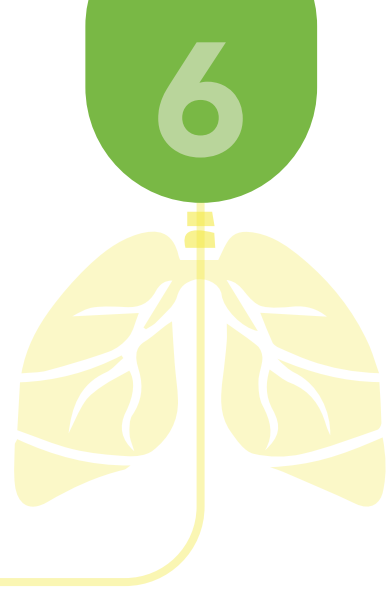
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Research Questions

1. What is the level of adherence and what influences adherence to maintenance treatment for mild asthma in Kenya ?
2. Is ICS/LABA with PRN SABA more effective than SMART for moderate asthma?
3. Is prn ICS-SABA as effective as prn ICS-Formoterol for mild asthma?



Management of acute asthma exacerbations

Management of Acute Asthma Exacerbations in Children at the Health Facilities

KEY MESSAGE

- Acute exacerbation of asthma can occur as the first presentation of asthma in children.
- A focused clinical assessment to determine severity of acute exacerbation should quickly be done prior to treatment initiation.
- All patients including children presenting with acute exacerbation of asthma should have their vital signs taken and recorded.
- Mainstay of treatment for an acute exacerbation include: assess need for oxygen, use inhaled or nebulized bronchodilators and systemic corticosteroids.
- Those who do not respond to these initial treatment options, require second line therapy that includes one or more of the following medications: parenteral Magnesium sulphate, Salbutamol or Aminophylline. These, medications, however, should be administered in an Intensive Care Unit (ICU) set up.
- Follow-up patients within 48-72 hours of discharge from the acute care or inpatient setting.
- Discharge patients with a written asthma action plan and assess for risk factors of recurrence.
- Ensure proper inhaler technique and that the patient understands or recognizes which medication should be used as a reliever versus the controller.

Definition

Acute asthma exacerbation (Flare-ups) refers to a change in the patient's usual status characterized by an increase in symptoms of shortness of breath, cough, wheezing or chest tightness which is unresponsive to usual effective therapy, and which may necessitate care in an emergency room or hospital ward. It is important to note that some cases may occur as the initial presentation of asthma in childhood(1).

Assessment of a Child Presenting with Acute Exacerbations (1,2)

History: This should focus on:

- How the episode started and progressed including the severity (any danger signs including inability to talk/feed?).
- Whether there is possibility of an allergic reaction that has caused the exacerbations
- What drugs have been used including whether the patient is on inhalers and how these are normally used.

Physical Examination: This should focus on:

- General appearance: how distressed is the patient including ability to talk, use of accessory muscles.
- Vital signs including the respiratory rate, heart rate, temperature, SPo2 and BP.
- Whether there is likelihood of complications evidence for example by the presence of asymmetry of breath sounds.
- Documenting presence or absence of added sounds including whether wheezing is only expiratory or biphasic.
- A silent chest is a worrying sign in a patient suspected to have acute asthma.
- Look for signs of comorbid conditions including obesity, eczema, and allergic rhinitis
- Examine the patient for signs such as cardiac murmurs, finger clubbing or severe wasting.

Diagnostics

- The guidelines development group recommends that spirometric lung function testing should not be carried out in asthma patients experiencing an acute exacerbation, especially when severe.
- The guidelines development group recommends that an arterial blood gas should be obtained in asthma patients experiencing a severe asthma exacerbation that requires or may need care in a critical care unit.
- The guidelines development panel recommends that radiological imaging of the chest be reserved for asthma patients experiencing a severe exacerbation, those with an atypical presentation who need to be assessed for a possible differential diagnosis and in those presenting with clinical symptoms and signs suggestive of a lung infection (pneumonia).

Classification of Acute Exacerbations of Asthma in Children

Acute exacerbation of asthma in children is classified into mild, moderate, severe and life threatening. This is shown in table below.

Assessment of acute asthma exacerbation in children

Classification	Clinical Signs	Measurements
Life -threatening asthma	<ul style="list-style-type: none"> • Silent chest • Cyanosis • Poor respiratory effort • Hypotension* • Responds to pain stimulus only or unresponsive • Bradycardia – Poor sign 	SpO2 below 92%
Severe asthma exacerbation	<ul style="list-style-type: none"> • Unable to complete sentences in one breath • Too breathless to talk/feed • Responds to voice, agitation, or irritability • Has lower chest wall in-drawing • Tachycardia+ • Tachypnoea 	SpO2 below 92%
Moderate asthma exacerbation	<ul style="list-style-type: none"> • Not responding to initial treatment of a mild exacerbation within 2 hours • Has expiratory wheezing • Tachypnoea • Has no lower chest wall in-drawing • Able to talk but may have episodes of breathlessness • No altered mental state • May or may not be able to feed 	SpO2 above 92%
Mild asthma exacerbation	<ul style="list-style-type: none"> • Has expiratory wheezing • Has no tachypnoea • Has no lower chest wall in-drawing • Able to talk and feed with no breathlessness 	SpO2 above 92%

Hypoxemia: Oxygen saturation below 92%

Tachycardia+: See appendix for normal values for different age groups

Tachypnoea: RR \geq 40/Min (Age 1-5 years); RR \geq 30/ Min (Age 5-12 years)

Hypotension*: See appendix for normal values for different age groups

Altered mental status: See appendix for AVPU scale

Treatment of Children Presenting to Health Facilities with Acute Exacerbation of Asthma-

COVID-19 Pandemic Precautions

1. During the COVID-19 Pandemic, **nebulization is regarded as an aerosol generating procedure (AGP). Use of Personal Protective Equipment (PPE) and aerosol precautions must be followed when used.** A spacer and pMDI is considered a safer option.
2. If patients present to hospital with their spacer and mask, the ideal is to use the patient's own gadgets. Use of shared spacers and masks is strongly discouraged but if there are no alternatives to using shared spacers and masks, they should be duly disinfected prior to their use in every patient to prevent infection transmission.
3. Nebulize if a pMDI and a spacer is unavailable, there is poor response to a MDI/ spacer, the child is either uncooperative or unable to follow directions required for MDI use, or there are shortages of inhaled medications.

Mild Exacerbation

Use a pMDI and a spacer starting with 2 puffs of salbutamol (200 micrograms) as soon as symptoms begin, even at home. Give 1 puff at a time with each puff inhaled separately in 5-10 tidal breaths at 15 - 30-second intervals. Inhaled salbutamol doses can be repeated at 2 puffs every 20-30 minutes according to response. If the child remains unresponsive within 2 hours, escalate the treatment to that recommended for a moderate exacerbation.

Continue delivering a controller medication and salbutamol every 6 hours for up to 48 hours. Schedule a review within 48-72 hours either by phone or at the nearest health centre if feasible.

A spacer and a mask must be used for children under 5 years preferably with a mouthpiece for those over 5-year-old. If salbutamol is nebulized, the recommended dose is 0.15mg/kg for children below 4 years, 2.5mg for children 5-11 years and 2.5-5mg for those above 12 years 5mg. Levosalbutamol, the L-isomer of salbutamol or ipratropium bromide can be used in those known to have significant adverse effects to salbutamol and for patient with cardiac disease for whom tachycardia should be avoided. The recommended dose of nebulized levosalbutamol is 1.25mg for children below 4 years, 1.25 mg - 2.5mg for those

5-11 years and 2.5mg for those above 12 years. The recommended doses of levosalbutamol delivered via a pMDI is 2puffs, equivalent to 100mcg.

Moderate exacerbation

Continue inhaled salbutamol via a pMDI every 20-30 minutes. If available, add Ipratropium bromide delivered via a pMDI at a dose of 20mcg per actuation. Use 160mcg every 20 minutes up to 3 times in 1 hour then every 4-6 hourly when the patient's condition improves. Alternatively, add nebulized ipratropium bromide to the nebulized salbutamol in saline to make a total volume of 4 ml in the same nebulizer and administer every 20 - 30 minutes initially for 1 hour then 4 - 6-hourly as improvement occurs. The recommended dose of nebulized Ipratropium is 250mcg for children below 11 years and 500mcg for those above 12 years. Avoid mixed formulation of ipratropium and salbutamol in children below 12 years as they may overdose either drug.

Start oral steroids early. Oral Prednisolone should be given at 1mg/kg/dose, once daily for 3-5days. The shorter duration is preferred. If the patient was started on the lower dose of prednisolone and is not improving within 72 hours or has been on maintenance daily oral steroids for asthma control, consider increasing the dose of prednisone to 2mg/kg/ dose. The recommended maximum dosages of prednisolone per age category are 10 mg per dose (daily) for children under 2 years of age, 20 mg for children aged 2–5 years and 30–40 mg for children older than 5 years. As an alternative to prednisolone oral dexamethasone at 0.6mg/kg/day can be given for up to 2 days with a maximum of 20mg in a day.

Intravenous steroids are **ONLY** recommended for children with severe or life-threatening acute exacerbations who are unable to retain oral medications. They do not offer advantages over oral steroids.

Observe patients in the acute care setting for at least 6 hours. If after this period, vital signs remain stable and the patient's condition has improved with no requirement for oxygen therapy, the patient should be discharged home and be followed-up in 48-72 hours. Follow-up can be by a telephone consult or a visit to the nearest health center.

Admit those patients who require oxygen therapy, do not improve after 6 hours of observation in the acute care setting, cannot use their inhaler medications well at home, are known to be poorly adherent to treatment or have poor social factors and may not be able to come for short-term follow-up after discharge.

Severe and Life-threatening Acute Exacerbation (7,11)

In the acute care setting start oxygen therapy and target an SPO₂ of 94-98%. Nebulize salbutamol and ipratropium bromide as indicated above using oxygen as the driving gas. For patients with a severe exacerbation which is non-responsive to treatment or those with features of a life-threatening acute exacerbations, inform the critical care unit (CCU) and refer or transfer the patient to the ICU as rapidly as possible.

A single dose of intravenous (IV) Magnesium Sulphate can be given in the acute care setting. If Magnesium Sulphate is given the patient's blood pressure must be monitored closely for hypotension and the patient transferred to the critical care unit as soon as

possible. The recommended dose of Magnesium Sulphate is 50 mg/kg, with a maximum dose of 2 grams given over 20 minutes.

IV salbutamol should be used **ONLY** in the CCU in severe and life-threatening asthma where cardiac monitoring can be done. There are anecdotal reports of benefits from IV aminophylline in life-threatening acute asthma, however, a systematic review of the literature did not support these observations and the occurrence of cardiovascular and gastrointestinal adverse effects from its use were deemed to be significant in this setting. The Guidelines Development Group does not recommend the use of aminophylline in adult patients with acute severe asthma, a recommendation that is at variance with the use of this medication in children as mentioned above.

IV loading dose of salbutamol: 5 - 10 µg/kg/min of 1 mg/ml solution infused at 0.3 - 0.6 ml/kg/h for 1 hour, followed by continuous infusion of 1 - 5 µg/kg/min at 0.06 - 0.3 ml/kg/h.

IV aminophylline: Give IV aminophylline at an initial loading dose of 5–6 mg/kg (up to a maximum of 300 mg) over at least 20 minutes but preferably over 1 hour, followed by a maintenance dose of 5 mg/kg every 6 hours. The safety profile of IV aminophylline in children is not well established.

While oral corticosteroids can be prescribed in severe cases, if this is not tolerated or in life-threatening situations, IV corticosteroids should be prescribed as described below.

IV Dexamethasone: 0.1 -0.3mg/kg/daily in 2-3 divided doses with a maximum of 20mg a day given as a slow IV injection or infusion. Alternatively, IV Hydrocortisone may be given at a dose of 4 mg/kg with a maximum of 100mg repeated 6-hourly for those aged 1 year and below, 25 mg for those aged 2-4 years and 50mg for those 5-17 years.

Steroids should be continued for about 5 days or until about 2 days after the exacerbation appears to have resolved. Tapering of systemic corticosteroids is unnecessary unless the treatment course has exceeded 14 days.

Adrenaline is indicated if the exacerbation is due to an anaphylactic reaction. An intramuscular or subcutaneous dose of 0.01ml/kg of 1:1000(1mg/ml) solution is given every 20 min up to 3 doses.

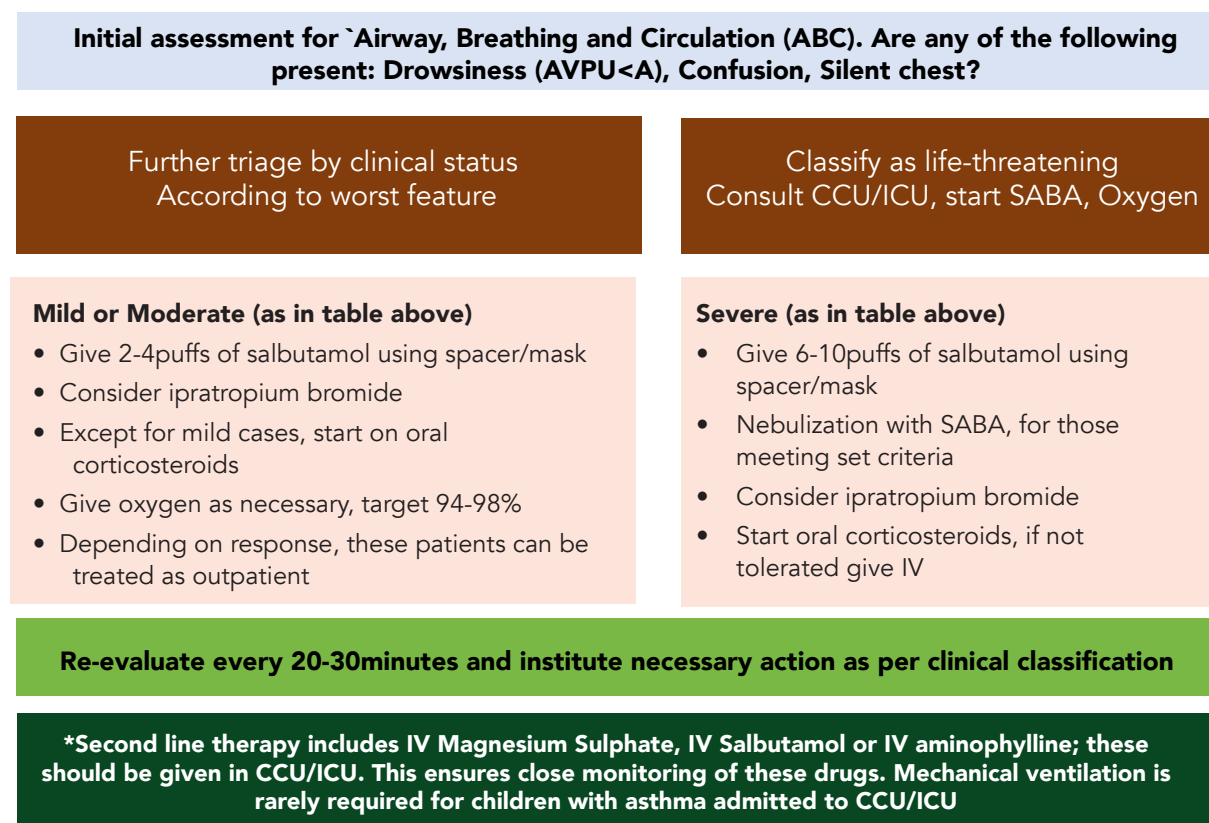
For children 5 years and below the dose works out to 150micrograms (0.15ml), while children 6-11 years it is 300micrograms (0.3ml) and for those 12-17 years it is 500micrograms (0.5ml).

Imaging and assessment for co-current bacterial infections should be done in all patients with a severe asthma exacerbation. If there is evidence of a co-current bacterial infection or a strong suspicion of the presence of bacterial infection, appropriate antimicrobial therapy should be started but it must be noted that often viral infections are the cause of most flare-ups of Asthma.

In patients with life threatening asthma and acute respiratory failure, non-invasive ventilation (NIV) can be used and should be tried to manage the respiratory failure. This mode of respiratory support has been used in acute asthma with good outcomes.

Mechanical Ventilation is rarely indicated in acute severe asthma with less than 6% of patients experiencing an acute exacerbation of asthma ending up on a ventilator. When a patient requires mechanical ventilation, the recommended initial ventilator settings are a fraction of inspired oxygen (FIO₂) of 1, a low tidal volume of between of 5-7 ml/Kg, a low positive end expiratory pressure (PEEP) of below 5 cm H₂O, a long expiratory time with an inspiratory to expiratory ratio (I:E ratio) of more than in 1:2 and a low breathing frequency of 8-10 per minute. The peak inspiratory pressure should be limited to below 40 cmH₂O.

Summary flow chart for treatment of children presenting to health facilities with acute exacerbation of asthma.



Special Considerations

- Leukotriene Receptor Antagonists: Drugs like Montelukast do not have a role in acute exacerbations.
- Nebulized magnesium sulphate is not yet recommended for use in acute asthma, studies are ongoing.
- Mucolytics, mucokinetic agents and cough mixtures are not useful in acute asthma and may be harmful.
- Steroid nasal sprays and non-sedating antihistamines can be used for comorbid acute exacerbation of allergic rhinitis.
- Chest physiotherapy may worsen wheezing in the early stages of acute Asthma. Cautious use of airway clearance exercises for those with excess mucus, atelectasis may be necessary.

- Spacer devices can be used in all age groups including adults who may not be able to use inhalers correctly.

Discharge and Follow up

- Children admitted for acute exacerbation of asthma should be discharged from the wards if their vital signs have been stable and they have been off oxygen for at least 24 hours.
- On discharge, health education on asthma should be re-emphasized and any myths demystified. As part of this, inhaler technique should be revisited.
- Discharge medications should be discussed with the parent. Have a written asthma action plan and educate parent and patient, if the child is old enough, to know their reliever and controller medications and the difference between these two types of medications.
- Treat comorbid conditions too and arrange for multidisciplinary consults as needed.
- Advice on avoidance of trigger factors such as indoor allergens and irritants.
- A follow up should be arranged within 48-72 hours of discharge and this can be by phone or in the clinic if feasible. Thereafter the patient should be seen within two weeks to plan for long term management.

Appendix: VITAL SIGNS:

Temperature

Normal Ranges from 35.5 - 37.9 °C using the ear or axillary route. On average 36.0 to 37.3°C.

Age Group	Heart Rate	Respirations	Systolic BP
Preterm	120 - 180	50 - 70	40 - 60
Newborn (0 to 1 Month)	100 - 160	35 - 55	50 - 70
Infant (1 to 12 Months)	80 - 140	30 - 40	70 - 100
Toddler (1 to 3 Years)	80 - 130	20 - 30	70 - 110
Preschool (3 to 6 Years)	80 - 110	20 - 30	80 - 110
School Age (6 to 12 Years)	70 - 100	18 - 24	80 - 120
Adolescents (12+ Years)	60 - 90	14 - 22	100 - 120

Conscious Level

- Alert (A): appropriately responsive and aware of surroundings.
- Verbal (V): responds only to voice.
- Pain (P): responds only to a pain stimulus.
- Unresponsive (U): does not respond to any stimuli. Unconscious, convulsing or coma level.

Further Research

There is no local data to support any of the recommendations made by the guideline development panel for the management of acute exacerbation of asthma. There is also very limited data from settings that are similar to the Kenyan setting. Researchers are strongly urged to set up relevant clinical trials to unravel the appropriateness of the treatment approaches outlined in this guidelines and which have largely been adopted from international guidelines. The key question is whether these treatments actually work in the Kenyan setting.

In particular:

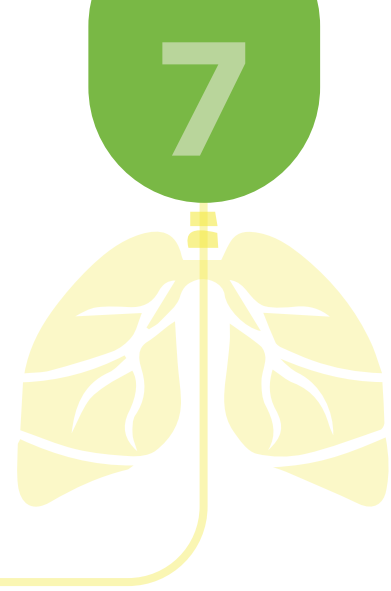
1. What is the optimum dose of oral steroids that should be use in Kenya for children with an acute asthma exacerbation? Which of the steroids should be preferred including among the IV formulations?
2. Should Kenyan children with an acute exacerbation of asthma be treated with additional antibiotics considering that pneumonia is so common and kills so many children in Kenya?
3. Does montelukast have any significant role in care of children with an acute exacerbation of asthma?
4. For Kenyan children with an acute exacerbation of asthma who are refractory to first line asthma management, which of the three IV formulations (Magnesium Sulphate, Salbutamol or aminophylline) should be preferred?

Suggested Reading:

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8. Jafarnejad S, Ebrahimi HK. Clinical guidelines on pediatric asthma exacerbation in emergency department, a narrative review. *European Journal of Translational Myology*. 2020 Apr 1;30(1):179–86.
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Management of asthma exacerbations (acute asthma) in adults



Definition

Asthma exacerbations are abrupt or progressive worsening of asthma symptoms beyond usual daily symptoms. They are also known as asthmatic attacks or acute severe asthma. In most patients the worsening is a slow gradual process but in some a rapid deterioration may occur.

Presentation

The worsening of asthma may be noticed as an increased use of bronchodilators (rescue medication), lack or reduced response to usual reliever compared to before, an increase in symptoms such as cough, breathlessness, wheezing or chest tightness. If a patient has been on a lung function monitoring device such as a peak flow rate meter, they will see a progressive decrease in pulmonary function.

Which asthma patients are at risk of asthmatic attacks?

Asthmatic attacks can occur in any asthma patient. The occurrence of an attack causes anguish not only to patients but also to family and friends and increases cost of medical care, thus all efforts should be made to avoid such attacks.

In order to do this, one has to learn what causes such worsening. These are called asthma trigger factors and they may include but not limited to:

- Dust
- Smoke
- Chemicals
- Perfumes
- Upper respiratory tract infections
- Pollen etc.

So, any asthmatic who gets exposed to triggers and is not on adequate medication to control the resulting airway inflammation will end up in an attack.

Are all the attacks the same?

Not all attacks are the same. The severity and duration of the attacks varies from person to person and even in the same person they can vary from time to time. Generally, an attack / exacerbation must be assessed to determine its severity. Simple assessment of breathing disturbance, speech, breathing rate, PEF, mental status, and oxygenation status should be able to provide an indication of the severity of the exacerbation (text box below), which are generally classified as:

- Mild
- Moderate
- Severe

Classification of the Severity of Acute Asthma Attacks (Adapted from GINA guidelines)

The patients in severe attacks may present with severe respiratory distress and imminent respiratory failure that is life threatening hence need to be identified early and treated aggressively. All asthma patients should be provided with a written action plan outlining actions to be taken when an asthma exacerbation occurs

Who is at Risk for Severe Attacks?

It is important to identify patients who are at risk of severe life-threatening exacerbations. These include patients with:

- Previous episode of near fatal asthma
- Emergency visit or hospitalization in the last year
- Current or recent use of systemic glucocorticoids
- Non-use of controller/anti-inflammatory medicine
- Psychiatric or psychosocial illness
- Nonadherence to controller treatment

In patients known or suspected to be at risk of severe life-threatening exacerbations, some of whom are known to have a poor perception of asthma symptoms, home PEF monitoring should be encouraged. The level of PEF at which specific actions need to be taken should clearly be spelled out in a written action plan.

What are the goals of treating an asthmatic attack?

The aims of treating acute asthma are:

1. Rapid alleviation of hypoxia
2. Relieve airway obstruction
3. Prevent worsening
4. Prevent relapse
5. Restore lung function to normal or previous best

How is Hypoxia diagnosed?

Hypoxia is low levels of oxygen in the body's tissues. Hypoxemia is low levels of oxygen in the blood. While both hypoxia and hypoxemia can occur separately, they often occur together because if there is low blood oxygen, the blood does not deliver enough oxygen to the body's tissues. The term hypoxia is often used to describe both low oxygen in the body's tissues as well as low blood oxygen.

Signs and symptoms of hypoxia include:

- | | |
|---|--|
| <ul style="list-style-type: none">• Changes in skin color, ranging from blue to cherry red• Blue skin, lips, and fingernails• Confusion• Disorientation• Coughing• Fast heart rate | <ul style="list-style-type: none">• Rapid breathing• Shortness of breath• Slow heart rate• Sweating• Wheezing• Headache |
|---|--|

Hypoxia is a Medical Emergency

Hypoxemia is diagnosed with a physical examination, where the clinician will listen to the heart and lungs, and also check to see if the skin, lips, or fingernails have a bluish color.

Tests used to check oxygen levels include:

- Pulse oximetry
 - A small device with a sensor that clips to the finger and measures the amount of oxygen in the blood.
 - Normal readings are about 94% to 99% oxygen saturation levels
- Arterial blood gas test
 - A blood sample is taken from an artery to measure levels of oxygen in the blood
- Pulmonary function tests

What are the complications of hypoxia?

Hypoxia can cause serious complications, such as:

- Brain damage
- Paralysis
- Heart damage
- Tissue death (necrosis)
- Brain death (vegetative state)
- Can lead to cerebral palsy

What is the Treatment for Hypoxia?

Hypoxia is a medical emergency and treatment for acute hypoxia involves administration of oxygen in a hospital. Oxygen is typically supplied via a nasal cannula or a mask that covers the nose and mouth. Severely ill patients should be placed on oxygen to keep the SpO_2 close to 95%.

Patients who have signs suggestive of a potentially fatal outcome should be transferred to or admitted to a critical care unit and continued on bronchodilators. Those judged to require mechanical ventilation should initially be placed on a fraction of inspired oxygen (FiO_2) of 1, with low tidal volumes of between of 5-7 ml/Kg, a low positive end expiratory pressure (PEEP) of below 5 cm H₂O, a long expiratory time with an Inspiratory to Expiratory Ratio (I: E ratio) of more than 1:2 and a low breathing frequency of 8-10 per minute. The peak inspiratory pressure should be limited to below 40 cmH₂O.

In severe cases, patients may need oxygen in a hyperbaric chamber, and others will require mechanical ventilation (intubation). It is important to note that administration of oxygen will not treat the primary cause that led to the hypoxia hence other asthma medication will be required.

How do we Diagnose Airway Obstruction?

Airway obstruction is diagnosed by performing lung function tests such as:

1. Measuring forced expiratory volumes using spirometry
2. Measuring Peak Expiratory Airflow (PEF) using a Peak Expiratory Flow Meter

These tests may be difficult to carry out during an asthma attack where treatment should be prioritized and not delayed unnecessarily to carry out a test.

Relieving Airway Obstruction

Attempts should be made to rapidly relieve airway obstruction that is causing decreased air intake by giving rapid acting bronchodilator medications as listed below:

1. **Beta adrenoceptor agonists:** These can be those with rapid onset but short duration of action such as salbutamol, Fenoterol and Terbutaline or those with a rapid onset and a long duration of action such as Formoterol
2. **Anti-cholinergics:** ipratropium, Oxitropium
3. **Theophyllines:** aminophylline (used in severe asthma attacks in children)
4. Magnesium sulphate

The first two are the most commonly used agents because they are very effective and can be administered as aerosol / inhalers to the lungs directly via either pMDI or nebulization. We advise that drugs be used in a step wise manner depending on the severity of the attack and response to treatment.

In most patients with mild to moderately severe exacerbations bronchodilation can be achieved by administration of 5-10 puffs of a short acting beta agonist through the pMDI and a volume spacer. **The administration of bronchodilators via a nebulizer should be reserved for patients with severe exacerbations especially those who appear exhausted, drowsy, confused or have a silent chest.** When nebulized bronchodilators are deemed to be necessary oxygen should, as far as feasible, be used as the driving gas.

The response to the bronchodilator should be assessed in about 15 to 30 minutes depending on the severity of the exacerbation and drug administration repeated at intervals of 15 - 30 minutes until a response is obtained. The anticholinergic, Ipratropium bromide may be added if the response to inhaled salbutamol is not satisfactory.

Although widely used in Kenya, intravenous aminophylline should probably be reserved for patients who do not respond to repeated administration of a beta 2 agonist plus anticholinergics. Similarly, the use of adrenaline should probably be reserved for patients who do not respond to inhaled bronchodilators and intravenous aminophylline.

Intravenous magnesium sulphate therapy should be considered adjuvant in situations where usual treatment appears not to be working.

All patients with exacerbations of asthma should be prescribed oral systemic steroids at a dose of 0.5 -1 mg/Kg prednisolone or equivalent up to 40mg maximum which should preferably be given by the oral route. The systemic steroids should be continued for about 5 days or until about 2 days after the attack appears to have resolved.

In most situations, chest x-rays are not useful in the evaluation of patients with asthma attacks. Chest physiotherapy, mucolytics and mucokinetic agents, cough mixtures and antihistamines are also not needed in the management of patients with asthma attacks and may in fact be dangerous.

Only a minority of patients have a bacterial infection associated causally with the asthma exacerbation, hence the use of antibiotics to treat an asthma exacerbation is often not indicated unless there is a strong evidence of bacterial infection.

An attempt should be made to identify modifiable factors that led to the exacerbation with a view to preventing future exacerbations. The text box below outlines some of the issues that need to be examined in every patient who experiences a severe exacerbation of asthma.

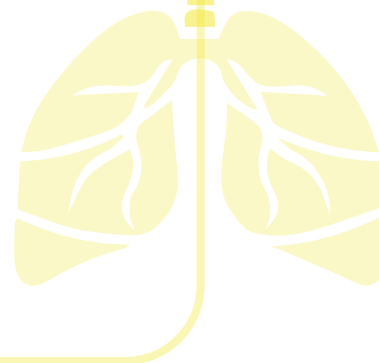
Issues to be examined to prevent future asthma exacerbations

- What was the usual level of control?
- Was the patient on appropriate therapy?
- Was the patient adherent to therapy?
- Was the inhaler technique correct?
- Are there trigger factors that the patient may be going back to?
- Was the patient being monitored adequately?

The text box below outlines how the severity of an asthma exacerbation should be assessed.

ASSESSING THE SEVERITY OF AN ASTHMA EXACERBATION

- How breathless is the patient? Respiratory rate, use of accessory muscles, pulsus paradoxus
- Is the patient able to talk?
 - Full sentences
 - Danger sign: speaking in phrases or words only
- Is the patient alert?
 - Danger sign: drowsy or confused
- Is the wheeze audible?
 - Danger sign: silent chest
- What is the PEF or FEV1?
 - Danger sign: PEF <30% of predicted
- What is the patient's oxygenation status?
 - Expect a low PaO₂, low PaCO₂
 - Danger sign: Normal or high PaCO₂ or oxygenation saturation of below 90%



Organization and Delivery of Asthma Care Services

CHAPTER OBJECTIVES

- To highlight the steps that will need to be taken to improve access to and quality of asthma care in Kenya.
- To outline the desired organization of asthma care services at all levels of the health care system in Kenya, in order to achieve universal access and the highest possible quality of care for asthma.

The target audience for this chapter includes health care planners and managers, health financiers, asthma advocates and those involved in training health care providers. The chapter is also useful to frontline clinicians especially as relates to roles of the various cadres in improving access to quality asthma care.

KEY CHAPTER HIGHLIGHTS

- The Practical Approach to Lung Health (PAL) approach provides a framework for providing quality care for patients presenting with respiratory illness at the primary care setting.
- Each health care worker has a critical role in the identification and cascade of care for patients with asthma.
- Each level of health care in Kenya plays a role in the identification and care of patients with asthma.
- Referral to higher-level (or at times lower level) facilities and specialists may be necessary for optimal care of patients with asthma. When done, it is important to ensure that linkage is complete.

Organization and delivery of asthma care services

The role of the Practical Approach to Lung Health (PAL)

Asthma patients are found in the community, and in health care settings such as dispensaries, health centres and hospitals. At all these levels it is desirable that patients with asthma are rapidly identified and placed on appropriate treatment to achieve control at the minimum cost possible. The Practical Approach to Lung Health offers the opportunity to achieve this.

Rationale for the PAL approach

Cough and other respiratory symptoms are common reasons for seeking care in primary health care settings. It is estimated that 25-35% of patients seeking care in primary health care settings have a respiratory illness. While most patients presenting at these settings will have a minor acute respiratory illness, a proportion of them will have chronic lung disease such as asthma or chronic obstructive airways disease, while others have serious and potentially life-threatening conditions such as pneumonia and tuberculosis. At the primary health care setting many patients presenting with respiratory symptoms are managed using a syndromic approach with minimal use of laboratory or other tests. It is essential that all patients presenting at the primary health care setting are managed properly to reduce morbidity and to prevent deaths from respiratory diseases. It is therefore important to rapidly identify patients who may have more serious or chronic lung disease in order to offer appropriate on-site care and reduce suffering. It is also imperative to quickly identify which patients will benefit from higher-level care, thus in need of referral and linkage. A systematic approach to the care of patients presenting with respiratory illness would be expected to improve case finding and quality of care for the four respiratory diseases that pose the greatest public health threat in Kenya: pneumonia, TB, asthma and COPD.

The Practical Approach to Lung Health (PAL)

PAL strategy is a syndromic management of patients with respiratory symptoms presenting to primary health care facilities. The approach focuses on persons over the age of 5 years (younger children are managed according to the algorithms of the integrated management of childhood illness (IMCI) and is designed to optimize care for patients with TB, acute respiratory infections (principally pneumonia) and chronic respiratory diseases especially asthma and COPD.

The primary objective of the PAL approach is to provide the best possible quality of care for patients presenting with respiratory symptoms at the primary health care setting and to enhance the efficiency of health care delivery for respiratory disease.

The PAL approach or strategy has two main components:

- i) Standardization of health care procedures through the development and implementation of clinical care guidelines.
- ii) Enhanced coordination at various levels of health system and within components of the health system at the sub-national levels.

The PAL strategy is therefore a patient-centered approach for diagnosis and treatment of respiratory illnesses at the primary health care setting which attempts to promote a symptom-based, standardized, and integrated approach to the management of respiratory disease with enhanced linkages and coordination within the healthcare delivery service.

While laboratory and diagnostic tests may not be possible at many primary care settings, at the higher-level settings these should be attempted in order to accurately diagnose, grade, and manage patients with asthma well. Health care workers at the primary level settings need to recognize when to refer and link ill-controlled or difficult patients to higher-level settings and specialists for further care. The guidance presented here in the various chapters should suffice for this purpose.

Roles of health care workers in asthma care in Kenya

The table below suggest some of the roles of the various cadres of health care workers in asthma care and prevention in Kenya.

Cadre of Health Care Workers	Role
Community Health Workers	Identification of people with asthma, linking people with asthma to care and treatment, providing asthma education at the community level, providing community level support to people with asthma
Nurses	Identification of people with asthma, carrying out assessment of asthma severity, providing asthma education, training patients on inhaler technique providing treatment support of patients with asthma, collecting, archiving and transmission of data
Clinical officers	Identification of people with asthma, carrying out assessment of asthma severity, providing asthma education, prescribing asthma medication, collecting, archiving and transmission of data
Medical Doctors (Generalists)	Identification of people with asthma, carrying out assessment of asthma severity, providing asthma education, prescribing asthma medication, training patients on inhaler technique collecting, archiving and transmission of data
Medical Doctors (Specialists)	Identification of people with asthma, carrying out assessment of asthma severity, providing asthma education, prescribing asthma medication, training patients on inhaler technique collecting, archiving and transmission of data
Medical Doctors (Pulmonologists)	Identification of people with asthma, carrying out assessment of asthma severity, identifying reasons for poor asthma control, managing patients with asthma that is difficult to control providing asthma education, prescribing asthma medication, collecting, archiving and transmission of data
Pharmacists	Dispensing asthma medicines, training of people with asthma to correctly use dispensed inhaled asthma medicines
Public Health Specialists	Design and implementation of asthma care programs, monitoring and evaluation of asthma care programs with adoption of lessons learnt

Roles of the various tiers of health system in asthma care in Kenya

Each tier of the health care system has a role in the cascade of asthma care in Kenya as presented in the table below

Level of the Health Care System	Role
Level 1 (Community)	Awareness creation, community screening and identification of people with asthma, community support , community monitoring
Level 2-3	Identification of people with asthma among those seeking care, basic assessment of lung function (PEF as the bare minimum), provision of basic treatment for asthma (Step 1-2 of the treatment guidelines), data generation and use
Level 4 and 5	Identification of people with asthma among those seeking care, managing people with asthma referred by lower levels of the health care system, lung function assessment (both spirometry and PEF as the bare minimum), provision of treatment for asthma (Step 1-to 4 of the treatment guidelines), data generation and use
Level 6	Identification of people with asthma among those seeking care, managing people with asthma referred by lower levels of the health care system, lung function assessment (including lung volumes and capacities), provision of treatment for asthma (Step 3-to 5 of the treatment guidelines), data generation and use

Referrals for Asthma Care

Some patients may need referral to higher-level facilities or specialists for further care. These could be for purposes of managing difficult-to-treat, severe or complicated asthma or for appropriate diagnosis and testing or to access some medications. Likewise, after appropriate care, some patients may need to be referred back to nearer home lower-level facilities for continuity of care.

Below are simplified criteria for referring patients with asthma:

When to refer:

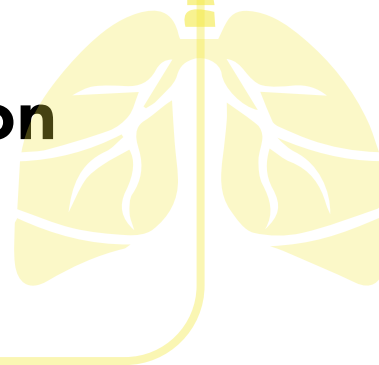
- For patient identification e.g., a patient with respiratory illness not responding to available care in the health facility
- For diagnosis and testing e.g., a patient in need of spirometry, PEF measurement, X-ray and or other relevant tests not available in the facility
- For appropriate management e.g., a difficult-to-treat, severe or complicated asthma
- For appropriate asthma education and intervention e.g., adherence enhancement, social intervention and appropriate use of asthma inhalers

- For continuity of care at a lower-level facility – for stabilized patients in higher-level facilities who need to continue care in the appropriate nearer home health facilities

Who and how to carry out the referral

- Referrals should be done by the primary clinician managing the patient after appropriate consultation with the patient (guardian if a minor).
- Explain to the patient the reasons and need for the upward or downward referral.
- Obtain his/her (or guardian's) concurrence.
- Allay any fears related to the process.
- Outline a referral and linkage plan with the patient (or guardian), agreeing on which facilities or specialist to be referred to, time-to-arrival and any feedback mechanism.
- Fill in the appropriate referral tools outlining the patient's clinical status, medications, investigations and other relevant management aspects if any, and the reason(s) for the referral. Provide a contact by which clarifications could be sought.
- If possible, alert the receiving clinician or facility of the referred patient. Ask for feedback of arrival or continuity of care if need be.

Monitoring and Evaluation of Asthma Care Programmes in Kenya



CHAPTER OBJECTIVES

- To highlight the importance of monitoring and evaluation of the national asthma care programme in order to obtain critical information on the health care resource utilization by asthma patients, the treatment provided to asthma patients and the treatment outcomes of patients managed within the programmes. This information is critical for advocacy purposes, resource mobilization and refinement of the programme to promote access to quality asthma care services.
- The primary audience for this chapter includes health programme developers and managers, health programme financiers, asthma activists, patients, and their families.

KEY CHAPTER HIGHLIGHTS

- Quality recording and reporting of key asthma indicators is vital for quality care, information sharing and provides a basis for programmatic and policy improvements.
- Every patient should be managed using a record card/ file and the information transferred to appropriate registers.
- Regularly, the appropriate data should be reported in the health databases by the relevant officers.

Monitoring and evaluation of asthma programmes

Monitoring and evaluation of the national asthma care programme is based on the usual monitoring and evaluation framework. This framework includes the tracking of inputs such as finances; outputs such as persons trained, equipment and drugs procured and distributed and outcomes such as patients identified and treated and their treatment outcomes. The tracking of inputs, outputs and outcomes is a continuous process and can be conducted at various levels of health care in the country.

The programme evaluation which should be conducted periodically determines a number of programme related measures that cannot be routinely monitored such as:

- The efficiency with which programme resources are utilized, the efficiency of asthma service delivery and adherence to asthma management guidelines.
- The reach of the programme especially in relation to gender and socio-economic status (equity)
- Most importantly to determine the impact of the programme on asthma morbidity, in hospital mortality and quality of life of asthma patients including asthma hospitalizations and emergency room utilization.

It should also be possible to measure the impact of the programme on in-hospital asthma mortality but the overall impact of the programme on asthma mortality may be difficult to discern if a significant proportion of asthma patients remain undiagnosed, complicate or die at home. It will also be difficult to evaluate the impact of the asthma care programme on asthma incidence and prevalence since the determinants of the incidence and prevalence of asthma are currently poorly understood and the interventions of the asthma care programmes are not primarily intended to influence the epidemiology of the disease.

Recording and reporting of asthma care activities

Recording and reporting of asthma-related data is vital for monitoring and evaluation of asthma care activities in the country. Collection and aggregation of asthma-related data forms part of the general health information system, which aims to:

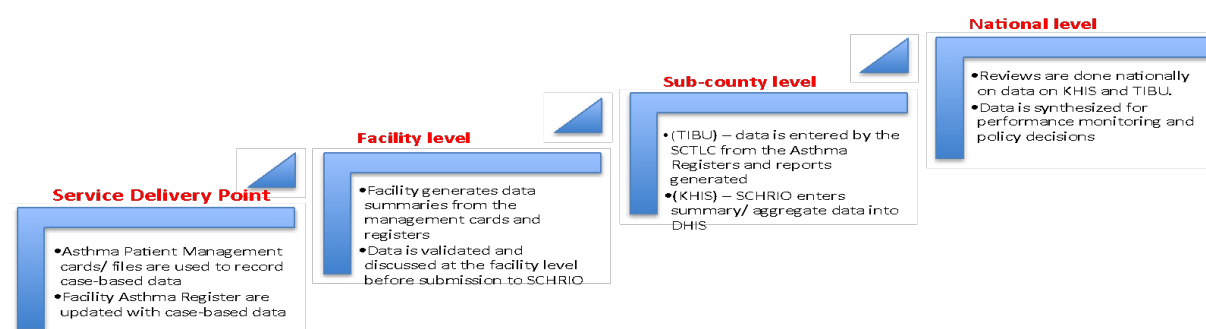
- Ensure a continuum of care, information-sharing with patients and transfer of information between health facilities.
- Enable managers at different levels in the health system to monitor the asthma care programme's performance in a standardized and comparable way, and
- Provide the basis for programmatic and policy development.

Recording and reporting for asthma in Kenya, though essential, still suffers from inadequate tools, uptake and reporting of the data. Accurate, complete and quality documentation of the clinical details of a patient with asthma are a minimum requirement for every clinician managing asthma. Reporting of this information to the county and national tuberculosis, leprosy and lung disease programme provides a basis for programmatic and policy enhancement. Integration of asthma reporting to the routine Kenya Health Information System (KHIS) reporting ensures sustenance and uniformity.

Every patient with asthma should be managed using a patient record card/ file (which can be either paper- or electronic-based), and information transferred in asthma registers for onward transmission to the national electronic systems, KHIS, for aggregation and TIBU for case-based data. Data for KHIS, obtained from several reporting tools at the facility e.g., MOH 705 A/B is aggregated at the facility and channeled to the sub-county health records officer for keying into KHIS while data on asthma registers in facilities is entered into the TIBU system by the sub-county TB and Lung coordinator. Facilities implementing

wholly (or near wholly) electronic systems should adapt or find ways to ensure their data is integrated into the national systems.

Below is the envisioned asthma data flow system



Every health care provider who manages patients with asthma has a professional responsibility to record and report all cases s/he manages.

Every health facility has a responsibility to report on cases of asthma under their care.

Recording and reporting tools for asthma care

Appropriate recording and reporting of asthma care include the use of the following tools:

- Asthma Patient Appointment Card
- Asthma Patient Management Card
- Facility Asthma Register
- MoH 705A/B
- Asthma Register in TIBU

Description of the Asthma-related recording and reporting tools

Tool	Purpose	Where/ who fills
Asthma Patient Appointment Card	<p>Provides education material to the patient covering basics of asthma, how to diagnose, treat and manage asthma, how to monitor response to asthma treatment, and how to recognize and respond to asthma emergencies.</p> <p>It also has the patient's clinic appointment details.</p>	This is given to the patient (or guardian) at treatment initiation. It should be carried to the clinic at every visit.

Tool	Purpose	Where/ who fills
Asthma Patient Management Card	Acts as the patient file where all clinical details of the patient are recorded. This is the primary recording tool for asthma patient care. It can also be in the form of an Electronic Medical Record (EMR).	Filled by the primary clinician managing the patient with asthma. Filled at each patient's clinical visit
Facility Asthma Register	Summarizes socio-demographic and clinical data for individual patients on management for asthma in the facility	Filled at the service delivery point where patients with asthma are managed e.g., chest clinic. Filled by the HCW at the service delivery point.
MoH 705A/B	Summarizes the diagnoses and relevant details of all outpatient visits in a facility	Filled by designated individual(s) in the health facility
Asthma Register in TIBU	National surveillance tool providing web case-based data mirroring the facility asthma register	Transcription of the facility asthma register into TIBU is done by the SCTLC at routine visits to the facilities

Reporting units

The basic reporting and management units are the sub-counties, under which are facilities, and above which are counties and national level.

Asthma Indicators

Below are examples of patient-level indicators which could be tracked to monitor the performance of an asthma care programme.

Asthma Case Notification:

- New asthma case notification rate – defined as the number of new asthma cases identified and recorded over a specific time period. Figures are provided as cases per 100,000 population.
- All asthma case notification rate – defined as the new plus previously notified asthma cases recorded over a specific time period. The figures are provided as cases per 100,000 population.

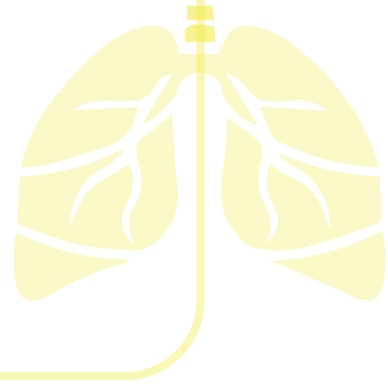
The cases notified will be categorized by gender, age, HIV status and initial severity status (mild, moderate and severe) at the time of identification.

Asthma treatment outcomes:

The asthma care programme will also monitor the outcomes of treatment for all registered patients. This will follow a system akin to what is used in the HIV care programme. Thus, at the end of every reporting period the following outcomes will be recorded:

- a) Number (and proportion) of patients in the register who are controlled, partly controlled or uncontrolled based on the most recent clinical assessment.
- b) Number (and proportion) of patients registered in the preceding quarter who are lost to follow up, transferred out or dead

These can be disaggregated by treatment provided, recorded level of adherence, age, gender and HIV status.



Asthma Education

KEY MESSAGE

Patient education is an integral part of asthma management.

Patients, family members (where appropriate), caregivers and health care workers should jointly develop an individualized asthma care plan.

All patients with difficult to control or severe asthma should be evaluated for adherence to asthma medications and for the presence of treatment-influencing co-morbidities. If adherence to treatment is driving the sub-optimal control, the reasons for non-adherence should be identified and addressed.

All patients with asthma should know that currently there is no role of oral bronchodilator medications in asthma and monotherapy with inhaled SABA should be avoided.

All patient with asthma should be educated/trained on the management of an asthmatic flare up/ exacerbation. The management of an asthma flare up/attack should begin at the household level and every patient with asthma should have a plan that outlines what should be done in the event that an asthma flare up occurs.

Correct use of inhaled medicines including good inhaler technique is critical for achieving asthma control and therefore every patient with asthma should be adequately trained on the inhaler device that has been selected for him or her and only allowed to take the device home after it is ascertained that inhaler technique has been learnt. At every clinic visit, inhaler technique should be checked, and errors corrected.

Every health facility managing patients with asthma should make efforts to set up asthma services that conform to “basic quality standards.”

Asthma education is essential to address asthma stigma and discrimination and to empower patients and communities to respond appropriately to this disease including advocating for accessible, equitable and affordable high quality asthma services. An educated asthma population may organize into peer groups, to advance common interests and to support each other for the common good.

This chapter focuses on patient education as an integral part of asthma management. Patients, family members, caregivers and the health care providers should jointly develop individualized asthma care plans to enhance autonomy in care (guided self-management). Patient advocacy groups and peer groups play a key role in asthma management.

Patient Education

Asthma is a chronic illness and therefore the clinical team and patients, their families and care givers need to develop a long-term plan for the management of each patient. Guided self-management, which empowers people with asthma, reduces emergency healthcare utilization, and improves health-related quality of life.

- Patient education should be integrated into every aspect of asthma care.
- All members of the healthcare team, including nurses, pharmacists, and respiratory therapists, should provide asthma education.

Clinicians should teach patients asthma self-management based on basic asthma facts, self-monitoring techniques, the role of medications, inhaler use, and environmental control measures.

A local study among children with asthma and their parents highlighted the importance of involving parents and patients in decision-making about management of their condition to improve adherence and control of symptoms. In this study asthma was also found to be highly stigmatized with only 32% of caregivers accepting an asthma diagnosis in their child.

Other factors affecting adherence were low educational attainment, low income, cigarette smoking, the comorbid conditions obesity and depression, pet ownership, other allergic comorbid diseases especially rhinitis, weather seasonality (including pollination), occupation and food allergies.

The Goals of Asthma Care/Management

The goals of asthma care and management include:

- To achieve good control of symptoms and maintain normal activity levels
- To minimize future risk of exacerbations and complications: reduce frequency and severity of flare-ups, maintain normal lung function and in children ensure normal growth and development.
- Minimize medication adverse effects.

Strategies to achieve these goals include: developing long term and strong partnerships between the patient (and the family), care givers and the health care provider; identification and avoidance of symptom trigger factors and incorporating a cycle of assess, adjust treatment and review response to patient care. Incorporating patients' own goals is also important in achieving good outcomes in asthma care.

1. The Partnership between Patient (and family) and the Health Care Provider

Asthma is largely a lifelong disease and as with other chronic health problems a close partnership needs to be built between the patient and his or her family and the health care provider for the best possible outcomes.

This partnership needs to begin with a clear communication of the diagnosis. When asthma is diagnosed it should be called asthma and not any other name.

The patient and his or her family should be given as much information as possible about the disease, the goals of treatment, the identification and avoidance of symptom triggers, the drug treatment including the distinction between relievers and controllers, the potential adverse effects and how they may be prevented, and the steps to be taken when an asthma exacerbation occurs.

Additionally, the patient who has been placed on a specific inhaler device should be trained on the appropriate use of that device and only allowed to take the device home after it is certified that the appropriate inhaler technique has been learnt.

A written action plan that includes the medicines, number of puffs, frequency of inhalation and the steps to be taken when an exacerbation occurs, allows patients some autonomy in the management of their disease. This is called guided self-management and it has been shown to reduce asthma morbidity in both adults and children.

The Patient-Health provider partnership

- Joint goal setting
- Personalized education about the disease, medications including relievers and controllers, potential adverse effects of medicines and inhaler technique
- Recognition of worsening asthma and actions to be taken
- Self-monitoring of asthma control
- Regular review to assess control and adjust treatment as may be necessary
- A written asthma management plan

Key pillars of patient-health provider partnership are good communication and health literacy. Good communication by health care providers has been associated with improved asthma outcomes and has also been associated with increased patient satisfaction and appropriate use of health care resources without increasing consultation times.

Health literacy is concerned with the degree to which individuals have the capacity to obtain, process and understand basic health information and services to make appropriate health decisions. Improving health literacy has been associated with better asthma control.

Strategies to Facilitate Good Communication include:

- Friendly demeanor
- Allowing patients/ guardians to express their views
- Empathy
- Giving encouragement
- Giving appropriate personalized information
- Providing feedback and review

Strategies to Improve Health Literacy

- Order information from most to least important
- Speak slowly
- Avoid medical jargon
- Confirming understanding by asking patient to repeat instructions
- Use simple illustrative stories, drawings or pictures to explain concepts

2. Identification and Avoidance of Symptom Trigger Factors

Asthma Triggers

Tobacco / cigarette smoking	Dust Mites	Allergies	Emotions- laughing, grief
Outdoor Pollution – smog, car exhaust fumes.	Pets	Mold	Cleaning and Disinfectant agents
Pests (e.g., cockroaches, mice)	Exercise / Overweight or obesity	Heartburn/ Gastroesophageal reflux disease	Cold and rainy seasons
Foods and food additives such as sulfite, benzoate and monosodium glutamate used for food preservation and food coloring agents such as tartrazine and flavoring like strawberry and vanilla	Respiratory infections	Medication- NSAIDs including aspirin, Beta blockers	Indoor air pollution - biomass fuels, exposure to secondhand tobacco smoke at home

There are no interventions that have been scientifically proven to prevent the development of asthma in individuals at high risk of the disease. Development of asthma, and subsequent asthma control, are strongly linked to many prenatal and postnatal environmental determinants including antenatal maternal stress and smoking, postnatal secondhand smoke exposure, poor quality housing, obesity, foods, poverty, and air pollution.

Breastfed infants appear to have lower rates of childhood wheeze and thus breastfeeding should be widely promoted.

Individual patients with asthma should be advised and supported to identify and whenever possible avoid factors that are associated with the development of asthma symptoms.

A provisional recommendation to vaccinate asthma patients with severe and difficult to control asthma may be appropriate as local clinical experience accumulates and local studies to examine the role of the influenza viruses in asthma exacerbations are undertaken. Children should continue with their well-baby vaccination schedule: **asthma is not a contraindication to receiving routine vaccines.**

Being overweight or obese has been identified as a risk factor for childhood asthma and wheeze, especially in girls. Asthma control has been shown to improve with weight reduction in obese and overweight patients. Thus, patients with asthma should be advised to maintain ideal weight and to lose weight if obese or overweight.

It is important to note that the tolerance levels for asthma symptom triggers are usually improved with the use of effective controller medications.

Use of biomass fuels is still widely practiced in Kenya and is an important cause of indoor house pollution. Air pollution has been associated with asthma exacerbations and patients with asthma should be advised to avoid being in polluted and dusty environments.

3. Assess, Adjust Treatment, and Review Response Cycle

With appropriate treatment, most patients with asthma can gain and maintain asthma control and thus lead normal productive lives. For children, this relates to the ability to participate in school and sporting activities as much as possible. The cycle of assess, adjust treatment, and review response is important in achieving the goals of asthma management.

At each visit:

1. Assess - diagnosis, symptom control, adherence, risk factors, inhaler technique and patient preference.
2. Adjust treatment- medication, non-pharmacological strategies, and treatment of modifiable risk factors.
3. Review response- medication effectiveness and adverse effects and improvement in quality of life as per patient's perception.

The key points of health education include the following:

1. Personalized Education: Ensure the following is included in the patient education

- Basic information about the disease- define it and call it by its name.
- Triggers.
- Medication including relievers and controllers.
- Potential side effects of medicines.

- Training on the medicine inhaler technique.
- Recognition of worsening asthma and actions to be taken.

2. Self-monitoring of asthma control

- Regular review to assess control and adjust treatment as may be necessary.
- Identification and avoidance of symptom trigger factors (indoor and outdoor pollutants).
- Treatment goals should be developed for the patient and family.

3. A written individualized, daily self-management plan should be developed

Make sure that all patients have a written asthma action plan with instructions about:

- How to recognize the symptoms of a flare-up of their Asthma.
- Differentiating their controller and reliever medication and how to use it when asthma worsens.
- When to seek medical help.

4. Regular assessment of patients for their symptom control

Asthma symptom control should be assessed at every opportunity, including during routine prescribing or dispensing. In children, as in adults, assessment of asthma symptom control is based on symptoms, limitation of activities and use of rescue medication.

Teach patients and guardians skills to self-monitor and manage asthma and to use a written asthma management plan. Include both the parent's and child's information when the level of symptom control is being assessed, as parents have a longer recall period than children.

Management of an asthmatic flare up at home:

Steps to take:

1. Give 5-10 puffs of SABA inhaler, wait for 20 minutes after every 2 puffs
2. Wait for 1 minute in between inhalations
3. Call the number provided by the health care provider (emergency number) for this purpose in case the patient is not improving or immediately take the patient to the emergency department of the nearest health facility, or the facility agreed with the health care provider.

Nebulizer use at home

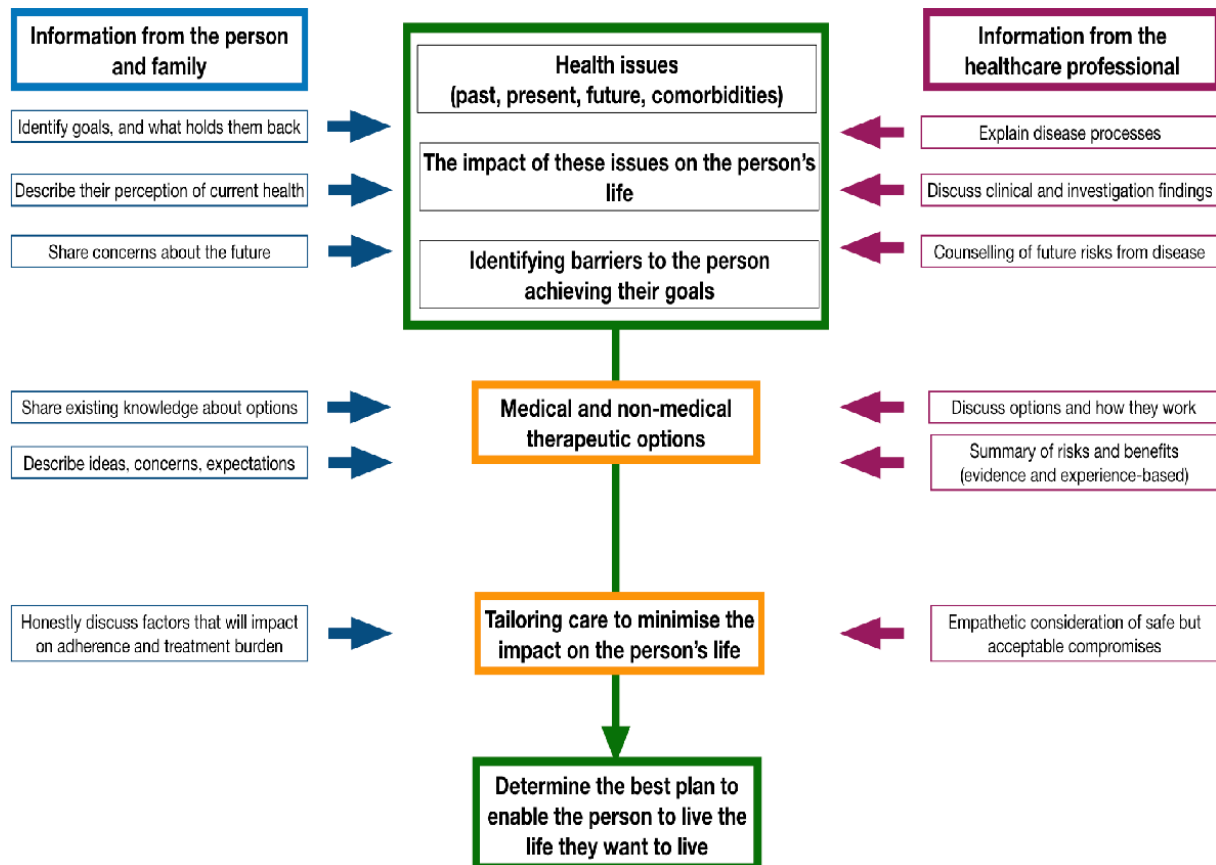
Follow manufacturer's instructions.

In case two attempts have failed, seek immediate emergency care at the nearest facility.

Follow-up and Review of Patients

After initial diagnosis a review should be scheduled within 4-6 weeks to assess efficacy of the medication, confirm the diagnosis, check inhaler technique (including use of spacer if needed) and correct errors, discuss any concerns the patient or parent may have of their diagnosis and the treatment and to plan for further follow-up. Spirometry can be done or repeated then. Non-pharmacologic measures should also be discussed and emphasized.

An approach to making shared healthcare decisions with young people.



Source: Sinha IP, et al. Arch Dis Child 2020;0:1–5. doi:10.1136/archdischild-2020-318788

Uncontrolled, Difficult-To-Treat And Severe Asthma

1. Assess adherence to medication, inhaler and spacer technique, check if medication is expired or the canister is empty, confirm that the patient can differentiate his or her reliever medication from the controller medication.
2. Use multiple approaches to limit exposure to allergens and other substances that can worsen asthma as single steps are rarely sufficient.
3. Identify the pattern of inflammation and response to treatment.
4. Check and confirm that the patient is not using complementary medicines that may be contributing to the poor asthma control.
5. Assess for psychosocial stressors.
6. Assess and manage comorbidities.

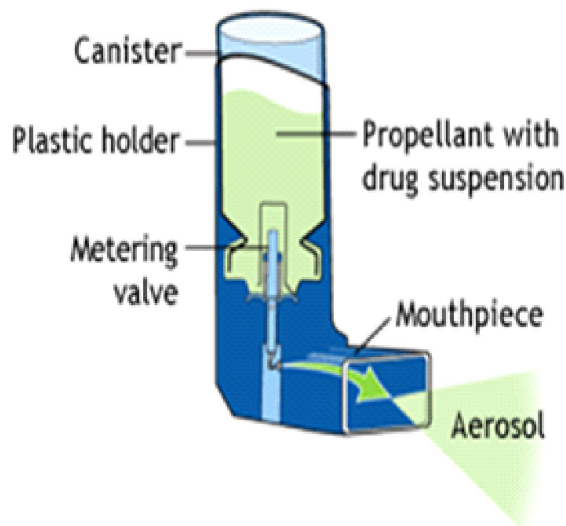
1. Inhalers

The delivery of a medication directly to the site of inflammation by way of an inhalation device is preferable because it reduces the potential of systemic adverse effects, especially compared with the oral route, and it permits more medication to be delivered to the site of action, the airways.

Types of inhaler devices:

- Pressurized Metered Dose Inhalers (pMDIs) - A pMDI delivers asthma medicine through a small, handheld aerosol canister.
- Breath Actuated MDIs.
- Dry Powder Inhalers- require respiratory effort in order to use them.
- Soft Mist Inhalers.
- Nebulizers or wet aerosols

Parts of an Inhaler Device



Volume Spacers with or without face masks to be used with pMDIs

Choice of device: factors to consider

- Does the medication come in the device type the patient likes and can obtain?
- Is the device age appropriate - child/adult?
- Does the device deliver a consistent/ reliable dose?
- Is it easy and quick to teach correct use?
- Is it easy to use correctly?

General Guidance for use of Inhalers

- Without spacer (for most children >12 years and adults)
- With spacer (for most children <12 years and some adult patients, especially the elderly)

The choice of device can be just as important as the drug being delivered. Wrong choice of device or the right device used incorrectly can be the reason a patient with asthma is not controlled.

2b. Inhaler technique

Patient and Caregiver Education on Inhaler and Spacer Techniques:

Spacer devices

Patients of any age who are unable to use inhalers correctly after adequate training may benefit from the use of a spacer.

Select correct size for the spacer device and mask for infant, children, or adolescent/adult.

Inhalation therapy without a spacer in adults and children above 12 years

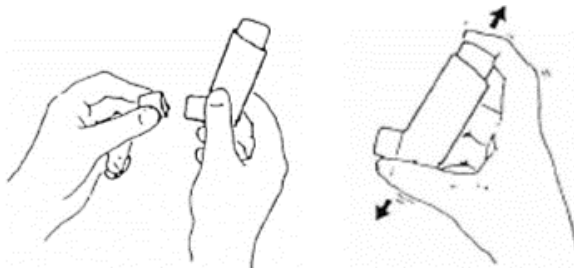
1. Shake the inhaler well.
2. Remove the cap from the mouthpiece
3. Before using the inhaler for the first time, shake well and release 2 puffs in the air (priming the device). **This is only done for a new canister and not every time the inhaler is being used**
4. While standing or sitting upright, breathe out as much air as possible
5. Place the mouthpiece of the inhaler between the lips and gently close the lips around it
6. While beginning to inhale, press down the canister of the metered dose inhaler once to release one puff while breathing in as deeply/slowly as possible.
7. Hold the breath for 5–10 seconds while the inhaler is still in the mouth. The guardian or client will non-verbally count one to ten. Avoid counting loudly as the medicine will escape from the mouth
8. Breathe out slowly through the nose, keep mouth closed and rest for a few breaths (30–60 seconds).
9. In case a second puff is needed, shake the inhaler device again
10. Repeat steps 4–7 for each puff prescribed
11. Rinse mouth with water after inhalation of corticosteroids, and wipe/ wash the face with a wet cloth

Inhalation therapy with a spacer in adults and children

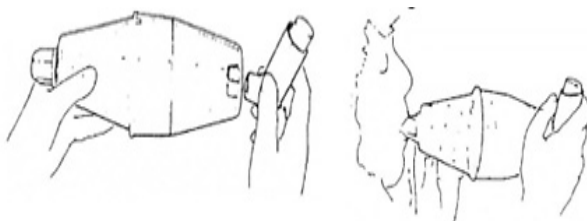
1. Shake the inhaler well
2. Remove the cap from the mouthpiece
3. Before using the inhaler for the first time, shake well and release 2 puffs in the air (priming the device)
4. While standing or sitting upright, breathe out as much air as possible
5. Insert inhaler into the inhalation chamber
6. Insert the mouthpiece of the spacer into the mouth and close the lips around the mouthpiece. Avoid leakage of the inhaler medicines through the sides of the mouth.
7. Press down the canister of the metered dose inhaler once to release one puff into the spacer.
8. Immediately take 5–10 slow deep breaths. The guardian or client will non-verbally count one to ten. Avoid counting loudly as the medicine will escape from the mouth
9. In case a second puff is needed, shake the inhaler device again
10. Repeat steps 4–8 for each puff prescribed, waiting at least 30 seconds between puffs
11. Rinse mouth with water after inhalation of corticosteroids and wipe/ wash the face with a wet cloth
12. For infants, ask the mother to breastfeed or feed the child

How to use the pMDI with a spacer

1. Remove cap of inhaler
2. Shake inhaler



3. Insert inhaler into flat end of the spacer device



4. Place mouthpiece in mouth and press inhaler canister to release a dose of medication. Ask the patient to breathe (using a suction like action) in slowly, deeply and strongly
5. Hold breaths for at least ten seconds or as long as comfortable

For children or elderly patients who need to be assisted

Step 1-3 remain the same

Step 4. Place mouthpiece in child's/patient's mouth or face mask onto child and press inhaler canister to release a dose of medication. Ask the patient to breathe in and out (deeply if possible) for 7 – 10 breaths.



NOTE:

- Older children > 7 years should try to hold their breath after inhaling for up to 6 -10 seconds. Ask them to non-verbally count one to ten.
- If a face mask is used it must be fitted firmly around the child's mouth and nose
- Shake inhaler between every puff and NEVER spray two or more puffs at the same time. Give one puff, breath 7-10 times then shake the inhaler and give the second puff
- If you spray straight into the mouth without using a spacer then you only deliver < 1% of the dose ALWAYS USE THE SPACER.
- Different spacers are cleaned differently as per manufactures instructions.

Skin care

- Always clean the face of the child or the clients using the face mask with a wet clean cloth to prevent the absorption of the steroids on the skin.

2c. Cleaning of the inhaler device and spacer

Disassemble the inhaler from the spacer.

Cleaning the inhaler: remove the canister from the inhaler, keep in a dry place. Take the plastic holder and soak in warm water, let it air-dry before returning the inhaler canister.

Static electricity accumulates on spacers with time, attracting drug particles and thus delivers less drug to the lung, to reduce static, wash spacer in mildly soapy water and drip dry without rinsing out the soap. Wash once every 2 weeks or monthly.

NOTE: Always clean or wipe the mouthpiece with a clean, soft cloth. For the mask, always clean it with soap and water or wipe with a clean wet cloth and air dry it.

Maintain infection prevention standards.

INHALERS DO NOT FINISH WHEN THE LAST SPRAY COMES OUT:

Get to know how many doses are in the inhaler device

- Note how many doses you are taking every day
- Indicate in your diary the date when your inhaler is expected to become empty
- Do not use it after this date even if "something" seems to come out
- What comes out after the inhaler is finished contains no medicine, and may result in loss of asthma control
- For the inhaler devices that are not color coded, one can know if they are empty by the low weight. For the coded inhaler there is a change of color to red and the meter reading to zero.

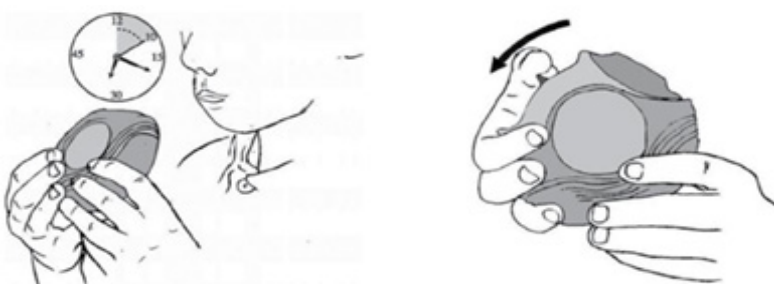
How to use commonly available dry powder inhaler (DPI) devices

A: The diskus

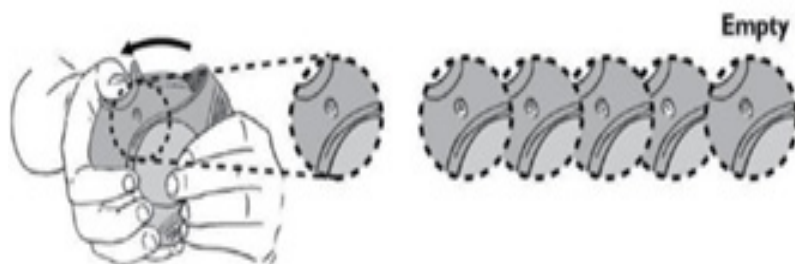
1. Place finger in the space provided and push anti- clockwise
2. This will reveal a lever, which you should also push anti-clockwise until the end to load a dose
3. Keep the mouthpiece upright after loading. Place device in mouth sealing lips around the mouthpiece
4. Inhale deeply, strongly and slowly
5. Hold breath for at least 10 seconds or as long as is comfortable. Breath out through the nose with the mouth closed.



6. Place finger back in the space and push clockwise to "close" the device. Do not touch the lever when "closing" the device.
7. Examine the counter to know how many doses are remaining



8. Do not use the device when the number 0 appears on the counter.



9. Always clean the mouth piece with clean soft cloth

B: The Ellipta



Only open the cover once you are ready to take a dose. If you open and close the cover without inhaling the medicine, the dose will be lost.

Click



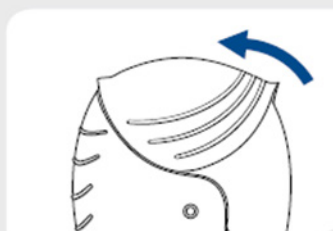
- Slide the cover down until you hear a 'click'
- While holding the inhaler away from your mouth, breathe out as far as is comfortable

Inhale



- Put the mouthpiece between your lips, and close your lips firmly around it
- Take one long, steady, deep breath in and hold this breath for at least 3-4 seconds

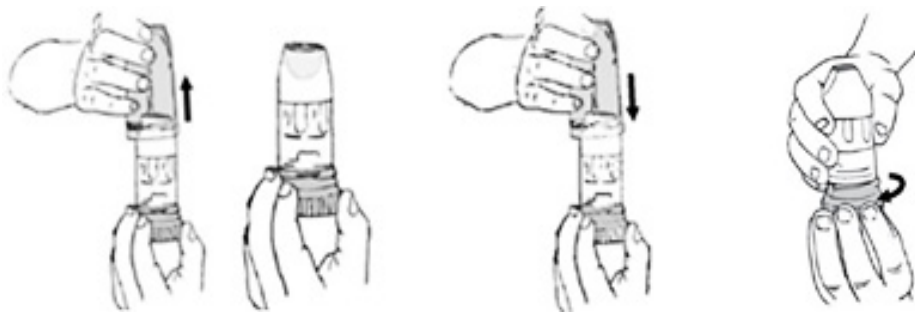
Close



- Remove the inhaler from your mouth and breathe out slowly and gently
- Slide the cover upwards as far as it will go to cover the mouthpiece

C: The Turbuhaler

1. Remove the protective cover of the device.



2. Hold device upright.
3. Twist the base anti-clockwise until it reaches the end, then turn it back until it makes a clicking sound. When this happens, a dose has been loaded ready to be inhaled
4. Turn the device to a horizontal position, place mouth into the space provided, ensuring that the lips do not go beyond this area, inhale deeply, slowly and strongly
5. Hold breath for at least 10 seconds or for as long as is comfortable
6. Do not move the base after inhaling the medicine unless you wish to load and inhale another dose.

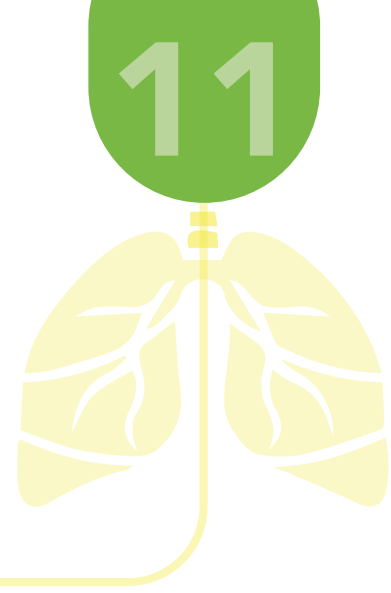


7. Examine the counter to obtain an estimate of the doses remaining in the device
8. Return the device to its protective housing
9. Wipe the mouthpiece with a clean, soft cloth then cover

Remember

- To note the number of doses in your device the first time you use it
- Depending on the average number of doses you inhale daily, record in your diary the expected date when the doses in your device will finish
- The sound that the device makes when you shake it should not be used to indicate that there are doses remaining in the device
- If a red mark appears on the counter only a few doses remain in the device and this is a warning that you should seek to replace your device

Role of Advocacy Groups in Management of Asthma



Asthma advocacy groups are important in the development of effective, efficient, equitable and sustainable responses to the burden of asthma. Activities of these groups range from raising awareness of the challenges that persons with asthma face to lobbying with government and other players in the health sector to improve access to asthma services, provide essential infrastructure for asthma care and to ensure essential medications for asthma are available to people with the disease either no cost (free) or at affordable prices.

Goal of asthma advocacy

To influence social, economic, and political determinants of health to secure health of people with asthma, build resilience amongst families and improve health care.

Aims of advocacy

- Improve patient access to care and treatment of asthma by qualified health practitioners
- Raise levels of awareness of the value of prevention and management of asthma
- Ensure integration of affected persons in all processes of policy formulation and decision making.
- Empower patients to take charge of their own health and improve it, reducing the burden of the disease
- Increase family resilience to decrease vulnerability and improve lung health and consequently reduce frequency and severity of asthma exacerbations, health facility visits and hospitalization, costs of medical care, time for health facility visits and deaths from asthma.
- Strengthen patient-health care provider relationships and partnerships to break barriers, facilitate better communication, achieve better management of asthma, and improve asthma outcomes.

- Strengthen health care system and patient-community relationship and partnership to achieve better understanding of asthma by the community, demand for and use of high-quality asthma services by the community including spirometric lung function tests and overcome asthma associated stigma and discrimination.
- Mitigate against the social, economic, and political determinants of health to reduce disparities. Such determinants include food security, quality housing, household fuel sources, education, employment policies and programs among others.
- Lobby for free or affordable national allergy and asthma testing to help in early and appropriately diagnosed disease leading to the provision of proper care and treatment.
- Lobby for government supported asthma research and epidemiological studies to provide critical data on the prevalence of asthma and its determinants to allow for appropriate planning and resource allocation for the prevention, care and treatment of asthma in Kenya

Peer Groups

Asthma peer groups are unit(s) formed by people affected by asthma either directly or indirectly.

The role of peer support groups in asthma

Peer support group can buffer the impact of stressors such as adjusting to chronic illness or coping with medical treatment and increase the likelihood of adherence to self-managed behaviors. Particularly, positive peer interactions can positively impact on asthma self-management in teenagers and adolescents. It is important to note however, several studies done to determine whether peer groups helped to reduce the risks of asthma flare ups and led to better asthma control in adolescents, it was inconclusive as to whether this groups led to better quality of life.

In Kenya the role of peer support groups include:

- Information sharing to gain knowledge on asthma.
- Moral and psychological support from peers.
- Interact and gain from experience sharing.
- Help to fight and overcome stigma.
- Able enlisting professional medical and counselling services. It is easier to pull resources together and seek professional services as a group.
- Influence and make decisions to improve the group's lung health in areas within their sphere of influence.
- Engage in meaningful ways for social and economic gains.

Asthma Associated Stigma

Lack of awareness is the greatest driver of asthma stigma. People suffering from asthma associated stigma experience challenges that subject them to psychological and emotional stress that always worsens their condition.

People with asthma suffer from stigma that can either be:

- Individual / personal asthma associated stigma: where those suffering from asthma, due to fear of onset of an asthmatic attack at any time or anywhere, find themselves withdrawn from active social life or engagement in some forms of meaningful economic activities. This is worsened by fear of lack of medicine or inability to seek emergency treatment in case of an asthmatic attack.
- Communal asthma associated stigma: Living with people who lack awareness of asthma, has led to asthma being misconstrued to be an infectious disease, making those suffering from it to be shunned and isolated. This coupled with cultural myths has made those suffering from asthma to live in denial, making diagnosis and treatment difficult. This can also lead patients to refuse to take medicines in public even when in dire need.

Misconceptions (myths) surrounding asthma thus propagating stigma

1. **Asthma is an infectious disease:** The truth is that asthma is a non-communicable condition and cannot be spread by coming in contact, sharing water or food with a known asthmatic.
2. **Asthma is a childhood disease that will be outgrown when one develops strong/ complete immunity:** wheezing is a common symptom in childhood due to small airways and frequent viral infections. Most children by 6-8 years of age will stop wheezing with respiratory infections but those diagnosed with Asthma need to understand it's a chronic condition with recurrence and remissions
3. **Asthma is a disease of witchcraft or a curse that runs in the family:** Asthma has a genetic/hereditary trait and commonly other close family members will have a similar history.
4. **People suffering from asthma are "weak" and thus unable to engage in some activities at homes or workplaces:** Undiagnosed or uncontrolled asthma contributes to restricted social and economic activities. Once correctly diagnosed and managed, a patient can live a full life.
5. **People suffering from asthma have a short life to live and are of less importance to family and community:** High mortality of asthma was common before effective and safe inhaled medications were introduced. Increased awareness among health workers has also led to improved diagnosis and institution of appropriate treatment. These improvements in care and treatment of asthma have been documented to reduce asthma mortality when applied to a large proportion of the population with asthma (the Finnish model⁶²). Currently well controlled asthmatics live full lives like the normal population.

6. Asthma has no medicine and those with it shall suffer as long as they live: knowledge of asthma and its management shall help change this perception

Is there a need for an asthma stigma discussion?

Asthma stigma discussion at home

Parents need to openly discuss the stigma that their children are going through either at home or in school. Failure to discuss asthma stigma can lead to negative effects on the child's performance of duties or in academic excellence.

It is also paramount that married couples or those in courtship openly discuss the ripple effects of asthma stigma to save their relationships.

Asthma stigma discussion at workplaces

It is important to openly discuss, and fight work related asthma stigma to empower people and ensure people understand the importance of supporting those with asthma to avoid workplace triggers of asthma, get time off work to attend asthma clinics and to allow work modifications as needed for those with occupational Asthma.

Work related stigma can lead not only to poor performance but also to psychological trauma and emotional stress that can worsen the condition of those suffering from asthma leading to jobs losses or even loss of lives.

National/ Community discussion on asthma associated stigma

Leaders at all levels need to talk and sensitize people on the importance of fighting asthma stigma in every sphere of life. Community leaders can be involved in training, awareness, and advocacy campaigns, while national leaders can lobby for policies and funding towards enhancing public programs on asthma management.

Tips on how to manage asthma associated stigma

1. Patient Empowerment:

An empowered patient with adequate knowledge of their condition can fight and overcome either communal or personal stigma to better self-manage their asthma, improving their lung health and ably engaging in social and economic life.

2. Family and Community support

An empowered family/ community shall be able to freely interact with those with asthma, recognizing their roles in the society and supporting their contributions to community and national development.

3. Peer groups

Peer groups play an important role in discussing stigma matters surrounding asthma and members of the group can guide and mentor others, through experience sharing, on how to fight stigma.

The power of social media and the internet is critical in supporting peer groups to thrive and connecting people together, no matter the time and distance, which can positively influence those living in isolation with no one around to support them.

4. Asthma counseling clinics

Stigma associated with asthma has adverse effects on the psychological and emotional wellbeing of those living with it and can lead to worsening or deteriorating health.

The establishment of asthma counseling clinics may help to provide much needed psychological support to overcome stigma and to promote psychological and emotional wellbeing.

5. Proper intake of medicines and adherence to proper management plans

The regular use of controller medicines helps the person with asthma to control their disease and consequently be able to engage in social events including gatherings without fear of asthma symptom flare up/attacks at public places. However, it is paramount to overcome the stigma associated with taking medicines in public which sometimes appears as an embarrassment.

Research Questions

In patients with bronchial asthma, does providing health education (interpersonal communication, written information including audio-visuals) improve asthma outcomes?

Does developing asthma care teams (clinicians, nurses, pharmacy technologists) at the PHC intermediate and higher levels improve asthma outcomes?

Does developing, supporting and sustaining asthma patient clubs and network improve asthma outcomes?

Suggested further reading

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Annex 1: Working instructions for spirometry in asthma clinics during the COVID-19 pandemic

Aim of spirometry

To aid physicians diagnose respiratory disease and assess the general respiratory health by measuring the effect of a disease on lung function.

Scope

Spirometry is useful for assessing airway responsiveness, monitoring disease course, assessing the results of therapeutic interventions, assessing preoperative risk, and determining a prognosis for many pulmonary conditions.

Responsibilities

- Only staff trained in spirometry should perform this procedure.

Procedure

- **Maintain infection control measures at all times.**
- The machine should be calibrated as per the manufacturer's instructions.
- The patient or client should be taken into a specific spirometry designated room where the spirometry is done (the lung function laboratory).
- The participant's height and weight should be measured and other vital signs including blood pressure and oxygen saturation measured.
- The procedure should be explained to the participant including what the test will be measuring, for example, how much air can be pushed out of the lung and how quickly that air can be breathed out.
- The participant should be asked to stand up straight and tall.
- The participant is then asked to take a deep breath in and fill their lungs as much as they can.
- The participant is then asked to make a tight seal around the mouthpiece of the spirometer and breath out as hard, as fast and as long as possible, until they feel their lungs have emptied.
- The operator will give encouragement and for some spirometers an incentive will appear on the screen to help the participant do their best.
- The participant will be asked to do this 3-5 times and the result showing the best of FEV1 and FVC will be recorded and visible on the computer screen as a spirogram.
- The flow-volume curve should have a smooth rise and descent.
- The recording of the results in the case record form (CRF) should be accurate.

- If a post bronchodilator response is to be recorded, salbutamol 200 micrograms should then be administered to the participant.
- After 15mins steps of the procedure should be repeated and the best FEV1 result should be recorded in the computer.
- The patient is then given the results to take to the clinician and a other copy of the results filed
- The participant should be thanked for their involvement.

Appropriate PPE should be used during the COVID 19 pandemic when carrying out spirometry. If feasible and appropriate, infection with SARS-COV2 should be ruled out before the spirometric lung function test is carried out.

N95 PPE Donning Checklist (If Using Face Shield)

1. Hand Hygiene
2. Isolation Gown (tie both ties into bows)
3. N95 mask, seal check.
4. Face Shield
5. Hand Hygiene
6. Gloves (completely cover white cuff)
7. Safety Check

N95 PPE Donning Checklist (If Using Goggles)

1. Hand Hygiene
2. Isolation Gown (tie both ties into bows)
3. N95 mask, seal check
4. Goggles
5. Hand Hygiene
6. Gloves (completely cover white cuff)
7. Safety Check

N95 PPE Doffing Checklist (If Using Face Shield)

- Clean door handle and gloves with disinfectant wipe
- Doff gown
- Doff gloves
- Exit patient room

- Hand hygiene
- Don clean gloves
- Use disinfectant wipe to clean surface for face shield
- Remove face shield
- Disinfect face shield
- Doff gloves
- Perform hand hygiene
- Remove N95
- Place cleaned face shield in designated area

N95 PPE Doffing Checklist (If Using Goggles and procedure mask over N95)

- Clean door handle and gloves with disinfectant wipe
- Doff gown
- Doff gloves
- Exit patient room
- Hand hygiene
- Don clean gloves
- Hand hygiene
- Use disinfectant wipe to clean surface for goggles
- Remove goggles
- Disinfect goggles
- Doff gloves
- Perform hand hygiene
- Remove N95
- Place cleaned goggles in designed area

Guidelines for spirometry room cleaning

Spirometry is an Aerosol Generating Procedure (AGP). Whenever this procedure is carried out the following should be done: .

- Room should remain vacant for 45 minutes for regular room. The time starts when the AGP is completed.
- Established cleaning processes should be followed. It is critical that all horizontal surfaces are thoroughly wiped (e.g., examination bed, countertop, chair, equipment, etc.) with the approved low-level disinfectant. The manufacturer's instructions must be followed (wet times) for disinfection to occur.
- After cleaning, room is ready for next patient

Annex 2: Examples of Asthma management plans

Example 1

Client Name: Contact number: Hospital record number: Parent's Name (if a minor): Date:			
	MEDICINE	HOW MUCH TO TAKE	WHEN TO TAKE
<ul style="list-style-type: none"> Breathing is good No cough or wheeze Sleep through the night Can work, go to school or play. 	Take these medicines EVERY DAY for Control and Use controller medication as prescribed.		
<ul style="list-style-type: none"> Coughing at night or while playing or feeding. Wheeze Tight or heavy chest 	Start reliever medication and continue controller as prescribed.		
<ul style="list-style-type: none"> Coughing and wheezing is persistent. Not responding to reliever medication within 1 hour of use. Breathing is hard or fast. Getting tired or agitated. 	Start reliever medication <ul style="list-style-type: none"> 1 puff every minute up to 10 puffs, continue controller medication Call the emergency contact and come to hospital immediately!		
Doctor's name:		Emergency contact:	

Example 2

Client Name: Baby SK Contact number: 07**123456 Hospital record number: 0000 Parent's Name (if a minor): SK Date: 12/02/2021			
	MEDICINE	HOW MUCH TO TAKE	WHEN TO TAKE
<ul style="list-style-type: none"> Breathing is good No cough or wheeze Sleep through the night Can work, go to school or play. 	Use controller medication as prescribed. (Inhaled corticosteroid)	1 puff	Twice a day (12 hourly)
<ul style="list-style-type: none"> Coughing at night or while playing or feeding Wheeze Tight or heavy chest 	Start reliever medication and continue controller as prescribed.	2 puffs SABA 1 puff Inhaled corticosteroid	SABA - Three to four times a day (6-8 hourly) ICS-Twice a day (12 hourly)
<ul style="list-style-type: none"> Coughing and wheezing is persistent. <p>Not responding to reliever medication within 1 hour of use.</p> <p>Breathing is hard or fast.</p> <p>Getting tired or agitated.</p>	<p>Start reliever medication, continue controller medication,</p> <p>Call the emergency contact and come to hospital immediately!</p>	1 puff every minute up to 10 puffs in 1 hour, as you prepare to come to the hospital.	
Doctor's name:	Dr FL	Emergency contact:	07**987654

Example 3

Client Name:

Contact number:

Hospital record number:

Parent's Name (if a minor):

Date:

For Relief of asthma symptoms (cough, wheeze, chest tightness, shortness of breath)

Inhale ____SABA__ inhaler __2____puff_s_____as needed

If you need more than 4 puffs in a day your asthma may getting out of control and take the following action

For prevention of asthma symptoms:

Inhale __ inhaler _____puffs ____times a day, every day.

Others : LTRA, tiotropium , theophylline etc

For treatment of your nasal allergy:

Take __tablet__ times a day for control of nasal symptoms.

Spray__ nasal sprays into each nostril__ times a day to control nasal symptoms.

In an emergency situation:

Call __DR FL_____ on this number: 07**123456

Go to the nearest Clinic or Hospital outpatient centre for a review!

Annex 3: Nebulization technique- Standard Operating Procedures

How to prepare medicine for nebulization.

- Measure out the dose of nebulized bronchodilator for use. Dilute with normal saline to a minimum of 3 mls to be able to nebulize.
- Ipratropium bromide and salbutamol can be mixed together for nebulization.
- **NOTE:** Nebulization only take 5-10minutes. Don't nebulize till the cup is completely empty
- Always make sure that the equipment is cleaned
- Ensure infection prevention is observed
- In children below 12 years avoid using pre-mixed combination formulations of these bronchodilators to avoid wrong dosing.
- Nebulized budesonide should never be mixed with other nebulization solutions. It should be used separately
- NOTE: Always dilute with normal saline
- Always monitor the patient's vital signs e.g., heart rate. Tachycardia from salbutamol is transient and tolerable for most patients but for those who are intolerant or develop other symptoms like tremors or dizziness STOP nebulization and consider alternatives like Ipratropium or levosalbutamol.
- Always monitor oxygen saturation and other vitals too.

Annex 4: Setting up an asthma clinic

Space

An ideal space should contain:

- Consultation room with an examination couch, stool/ chair for patient and clinician and a desk.
- Nebulization space
- Spirometry room

Human resource

- Clinician/ Medical officer
- Nurse
- Record officer

Stationery

- ASM 03- Asthma patient management unit register (MOH)
- Out-patient register book for the institution (e.g KNH)
- Patient cards
- Patient files
- Diaries
- Patient IEC-Information, education, communication material

Basic Equipment

Vital signs and clinical equipment:

- Thermometer, pulse oximeter, BP machine, timer or watch for respiratory and heart rate. If possible, a machine that is able to take all vital signs at once.
- Weighing machine/scale and height-board for younger children or meter for older children and adults.
- Stethoscope.

Emergency use:

- Bag and mask both adult and paediatric sizes.
- Oxygen cylinder or wall point, blender, mask, nasal prong and basic resuscitation drugs like adrenaline, SABA and ipratropium for an acute onset exacerbation
- Nebulization device and spacer device

Lung function equipment:

- Peak flow meter
- Spirometer
- Bacterial/Viral filters
- Spacer or nebulization device and SABA inhaler or respules for nebulization
- DLCO, body plethysmography equipment
- FENO machine
- Allergens for skin prick tests
- Bronchoconstrictor agents

Emergency use, vital sign and clinical equipment are basic for all clinics. Lung function testing equipment is as shown in the table below to be availed in higher level institutions.

Equipment that should be available (✓) vs type of facility				
Equipment	Facility level			
	Level 2	Level 3	Level 4	Level 5 & 6
Diffusion capacity for carbon monoxide (DLCO)				✓
Fractional of exhaled nitric oxide (FENO)				✓
Spirometry			✓	✓
Bacterial viral filters		✓	✓	✓
Peak flow meter		✓	✓	✓
Weighing machine/ Height meter	✓	✓	✓	✓
Spacer	✓	✓	✓	✓
Short acting Beta agonists	✓	✓	✓	✓
Pulse oximeter	✓	✓	✓	✓
BP machine	✓	✓	✓	✓
Thermometer	✓	✓	✓	✓
Stethoscope		✓	✓	✓
Nebulization machine		✓	✓	✓
Mouthpiece with filter		✓	✓	✓
Oxygen cylinder	✓	✓	✓	✓
Skin prick test				✓
6-minute walk test			✓	✓

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