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"A Review on Asthma: Epidemiology, Causes, Prevention and Its Medication"

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ABSTRACT
When the lungs are unable to breathe correctly, they become inflamed and enlarged. The inflammation made it difficult to breathe in air into the lungs, and if air is not correctly inhaled, it might cause mortality. Asthma can be caused by a variety of factors such as tobacco smoke, stress, dust, anxiety, pollen grains, heredity, pollen grains, obesity and low weight, workplace chemicals, and old buildings and paintings. If these factors are not adequately addressed, it may result in an asthma attack. An asthma attack occurs when any of the contributing factors of asthma stimulates the lungs, causing the airways to become swollen and irritated. The muscles around the airways shrink, causing the airways to generate additional mucus, narrowing the lungs or breathing tubes. With the appropriate medical gadgets, asthma can be managed and treated effectively. These medical devices are known as inhalers, and they are specifically designed to deliver medications or medication into the lungs by inhalation, allowing the lungs to relax or expand and allow adequate airflow. Inhalers are small, portable devices used to give medications to asthmatic patients. The medications are bronchodilators and anti-inflammatory, and when inhaled, they relax the lungs, allowing air to circulate. Despite breakthroughs in therapy, asthma remains a major public health concern, impacting millions throughout the world. Ongoing research is focused on personalized treatment approaches and innovative treatments to improve disease control and patient outcomes.

Key words: Asthma, inflammation, inhailor, treatment, medication, prevention.

I. INTRODUCTION

Asthma is a respiratory disorder that affects the lungs, specifically the small airways (bronchi and bronchioles). These airways are lined with mucosa and internally bounded by smooth muscles. Narrowed, bloated, and inflammatory airways produce sticky mucus when they are constricted or limit airflow. Tobacco smoke, pollen dust, perfumes, exercise, cold weather, stress, and even the common cold can all promote persistent inflammation and hypersensitivity of the airways[1]. The smooth rings of muscle that surrounds the small airways contract and narrow when a human lung is exposed to certain objects or environments that may cause asthma. This results in inflammation, which causes the mucosa lining to swell and secrete sticky mucus, which decreases the amount of air that enters the lungs. The body normally uses mucus to capture and eliminate foreign objects, but during an asthma attack, the mucus obstructs the airways, making breathing more difficult[2]. During an attack, inflammation can make it harder to exhale than to inhale, which means the body will need to use more oxygen. This can reduce the body's oxygen delivery and even cause death[3].

Asthma is an inflammatory lung condition that causes uncomfortable breathing, which results in dyspnea, wheezing, chest tightness, and p ersistent coughing. When someone has an asthma attack, it makes breathing difficult for them. If left untreated, it may result in complications or even death[4]. Asthma primarily affects children, but it can also affect adults if left untreated. Most often, asthma is linked to allergies, which cause a person to be more susceptible or react to environmental factors. It can be considered as a structural remodelling and chronic inflammation of the airways that results in a permanent decline in lung function in adulthood. Although the exact etiology of asthma is unknown but a combination of environmental and genetic factors have been implicated [5]. It is crucial for people with asthma to understand what causes their attacks and how to avoid them. They should receive adequate education about asthma, including what causes an attack, places to avoid, and how to prevent it. In

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order to prevent lung failure or even death, asthmatic patients should receive proper instruction on their condition and how to safely use the devices [6]. There are two types of asthma: Atopic (extrinsic) asthma is dependent on whether symptoms are triggered by allergens. Non-atopic asthma is defined as asthma in which the symptoms are not induced by allergens.

Asthma medications are divided into two categories: quick relief medication, which is used for treating acute symptoms, and long-term therapy, which is used to prevent future asthma attacks[7].Asthma prevalence has been increasing worldwide and across many countries. The incidence is typically higher in westernized or developed countries than in undeveloped countries. This is because industrialized countries have more industries that generate chemical pollutants and gases. These gases and chemical discharges are extremely poisonous to the environment, resulting in air pollution that is affecting the body. As a country grows more Westernized or developed, the number of cases of asthma is expected to rise [8]. This study will focus on asthma and related medical devices, including cell biology/etiology, population, causes, symptoms, prevention, and treatment. Asthma affects approximately 300 million people globally, and while it cannot be completely cured but it can be treated by using medications such as beta-2-agonists and steroids, leading to a healthier life.

Asthma has afflicted a large number of people, and in some cases, it has resulted in their deaths [9]. Medical professionals can diagnose asthma early, and it should be monitored often to prevent severe difficulties. Research has shown that the majority of deaths in countries are caused by asthma attacks or triggers, thus people should receive appropriate information on asthma management and prevention [10].

1. Epidemiology

Approximately 262 million individuals worldwide suffered from asthma in 2019. Forecasts indicate that by 2025, this disorder will impact more than 100 million people due to its rising prevalence[11].Epidemiological data show that the number of cases has almost increased throughout the decades. Approximately 24% of children suffer from asthma, making it the most common chronic illness in this age group. Also, almost 19% of young people have been affected [12]. The financial burden of asthma is more worldwide than the combined costs of HIV/AIDS and tuberculosis [13]. Despite the concerning numbers, asthma is still under diagnosed.

According to the World Health Survey (WHS), only 4.3% of people with asthma were identified worldwide, and there were notable differences between nations of up to 21 times [14]. According to recent data, asthma is a significant public health concern in India, with a high prevalence, especially among children, and an especially high mortality rate compared to the global burden, indicating a gap in diagnosis and treatment. India is thought to be responsible for over 46% of all asthma deaths worldwide, according to studies. The country's high air pollution levels, household allergens, and restricted access to appropriate medication are the main contributing causes.

2. Causes ofAsthma

2.1 Tobacco smoke/smoking: It becomes difficult for a person to breathe when they are exposed to smoke because the irritation of their airways causes them to swell and become inflamed. One of the main causes of asthma is smoke, both smoking and ambient tobacco smoke. Environmental tobacco smoke (ETS) in homes continues to be a significant problem as smoke is present in our surroundings on a daily basis and we are unable to completely escape them, thus it is essential for us to figure out how to effectively control them. According to a European study, the prevalence of ambient tobacco smoke was higher at home (13%-40%) than at work (3-32%). Compared to central or southern Europe, northern Europe had lower rates of ETS exposure at home. This study shows that global smoking bans fail to reduce ETS exposure in homes and tobacco smoke is associated with asthma [15].

2.2 Air pollution: A combination of gases and solid particles in the air is known as air pollution. These highly toxic gases and solid particles are released into the environment by chemical and industrial sectors. These industries, together with the chemical production sector, generate environmentally harmful pollutants. When these compounds are discharged into the environment, they pollute the air, which causes asthmatic people to have an attack when they breathe in the polluted air [16].

2.3 Dust: There is a correlation between mortality and Asian dust. Asian dust is a phenomenon where soil particles from arid regions of China and Mongolia are blown by powerful winds to

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a height of several meters, where they are then carried by westerly winds to the surface of East Asia, including Japan. Dust storms have been observed to originate from nearby deserts in West Asia. Asthma patients have been hospitalized and readmitted to hospitals due to Asian dust, which has significantly increased the mortality rate. Dust actually affects the respiratory organ, the lungs, reducing the flow of air. Dust can be found everywhere, including our houses, carpets, rugs, detergent, buildings, and the environment. This high level of dust, when inhaled, might cause an asthma attack by irritating the airways [17, 18].

2.4 Old buildings: People who reside in historic buildings may be at risk of having asthma due to the high dust levels. Old houses may have home environment exposure that affects children's respiratory health, such as stuffy buildings [19].

2.5 Building materials/paints of buildings: Indoor materials and items used in houses or buildings emit hazardous compounds into the air that are extremely harmful to the human respiratory system. Air pollutants generated from flooring materials, such as DEHP (di-ethyl-hexyl phthalate) and DBP, are hazardous to the human body and can cause asthma. Also, paints used in our homes may emit substances that are harmful to the human body [20].

2.6 Genetics: Although the exact etiology of asthma has not been determined but genetics may be a contributing factor. The genes of an individual are hereditary and can be passed down from generation to generation [21].

2.7 Pollen Grains: These pollen particles are subsequently broken down into smaller pieces when raindrops land on them. The particles worsen the asthma reaction when they enter the lungs [22].

2.8 Obesity and low weight: Inflammatory chemicals produced by fat can impact the lungs and cause an asthma attack. Low weight can cause organs like the lungs to not develop properly, which can result in asthma attacks in children and adults [23].

2.9 Stress: Stress may result from people residing in urban or low areas. When a person experiences poverty and neighborhood stress, it may have an impact on their mental health, which may result in stress. Asthma may also be exacerbated by stress from several sources. One of the main causes of asthma is stress. Stress impairs our ability to breathe, which damages the lungs and may lead to the emergence of asthma. Adolescents who live in low-urban or impoverished areas are more likely to experience stress related to their standard of living and other aspects of their lives, which can result in the development of asthma [24].

3. Symptoms of asthma:

Asthma is a chronic respiratory condition characterized by a range of symptoms that vary in intensity and frequency. Common respiratory symptoms include wheezing, a high-pitched whistling sound during breathing, along with persistent coughing that often worsens at night or early morning. Shortness of breath is another hallmark symptom, frequently triggered by exercise, allergens, or environmental irritants. Chest-related symptoms such as chest tightness and discomfort are also common, particularly during asthma attacks. Additionally, nasal symptoms like congestion, runny nose, and postnasal drip may accompany allergic asthma. In severe cases, individuals may experience extreme breathlessness, an inability to speak in full sentences, and bluish discoloration of the lips or fingertips (cyanosis). These symptoms can significantly impact daily activities and sleep quality, emphasizing the importance of early diagnosis and appropriate management strategies to improve patient outcomes.

S no	Symptoms category	Specific symptoms	References
1.	**Respiratory Symptoms**	• **Wheezing:** High-pitched whistling sound during breathing. • **Coughing:** Persistent cough, often worse at night or early morning. • **Shortness of Breath:** Difficulty breathing or feeling out of breath.	25, 26

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2.	**Chest Symptoms**	• **Chest Tightness:** Sensation of pressure or constriction in the chest. • **Chest Pain:** Discomfort or pain in the chest area.	25
3.	**Nasal Symptoms**	• **Nasal Congestion:** Blocked or stuffy nose. • **Runny Nose:** Excess nasal discharge. • **Postnasal Drip:** Mucus accumulation in the throat.	26
4.	**Sleep Disturbances**	• **Nocturnal Awakenings:** Waking up during the night due to breathing difficulties.	25
5.	**Activity Limitations**	• **Exercise-Induced Symptoms:** Breathing difficulties during or after physical activity	26
6.	**Allergic Symptoms**	• **Rhinitis:** Inflammation of the nasal mucous membrane, often due to allergies.	26
7.	**Severe Symptoms (Asthma Attack)**	• Inability to speak, cyanosis (blue lips/fingertips), extreme fatigue	26

4. Prevention/management ofasthma

Patients who are aware of their susceptibility to asthma attacks or triggers should stay away from smoke-filled environments. People shouldn't live close to smoke-emitting industries or chemical manufacturing facilities. People should abstain from smoking since it is a leading cause of asthma [27]. Asthma can be effectively prevented and managed by combining medicine, environmental control techniques, and lifestyle changes. Important strategies consist of:

- To avoid or prevent asthma, buildings should have improved ventilation flow [28].
- The toxicity and exposure assessment of texanol as a chemical should be thoroughly examined [29].
- It is important to thoroughly inspect and analyze building materials and paints before using them to prevent the release of dangerous levels of chemical pollutants that are harmful to human lungs [30].
- To prevent asthma, dust-containing items and structures in homes and buildings, such as carpets and rugs, should be cleaned on a regular basis [31].
- To prevent asthma, it's also important to evaluate the environment at home and at school. Since children spend the majority of their time in their homes and schools, it is important that these spaces be kept hygienic to reduce the risk of asthma and its symptoms [32].
- People with high levels of anxiety and stress should also routinely check their mental health and always talk to others about avoiding asthma triggers [33].
- People should also avoid eating a lot of fatty foods because fats contribute to the inflammatory diseases that cause asthma [34].
- Inhalers and mobile health apps are further tools for managing and preventing asthma. People who frequently experience asthma attacks should always carry their inhalers with them, or they can be connected to mobile health apps for improved asthma management and monitoring [35].

5. Asthma and its medical devices

Although asthma cannot be completely cured, it can be managed or controlled with proper supervision. Medical devices such as a nebuliser, dry powder inhalers, metered dose inhalers, and respimat soft mist inhalers can be used to accomplish this. One of the most frequent issues among asthmatic patients is improper use of inhaler devices, which can decrease the effectiveness of medications. Patients also frequently fail to carefully follow instructions, which raise the expense of purchasing new inhalers or medications

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[36]. Despite the fact that there are several kinds of inhalers, each has benefits and drawbacks depending on how well it functions. To achieve the intended effects and prevent further difficulties, it is crucial to carefully follow the instructions about asthma medical equipment.

The World Health Organization (WHO) states that herbal medicine can be used as medications that are added to inhalers to treat and manage asthma because it is safe, effective, and less harmful [37]. Medical device developments in recent years have greatly improved asthma treatment, giving patients more control over their illness and a better quality of life. Key medical devices used to treat asthma are included in the table below, along with references and new developments:

S No	Device name	Description	Recent developments	Reference
1.	**Inhalers**	Devices that give medications directly to the lungs	Efforts to reduce environmental impact by developing inhalers with lower greenhouse gas emissions.	38
2.	**Digital inhalers**	Sensor-equipped inhalers for tracking and monitoring drug consumption	Shown to enhance long-term asthma control and drug adherence.	39
3.	**Nebulizers**	Devices that turn liquid drugs into an inhalable mist	CO_2 -enriched air and nebulized perflubron are combined in innovations such as S-1226 to improve treatment outcomes.	39
4.	**Smart masks**	Breath-analysis masks for identifying signs of lung illness	Smart masks that can identify asthma symptoms by analyzing exhaled breath.	40
5.	**AI-Driven Diagnostic Tools**	AI-powered tools for customized asthma therapies.	Individual biological profiles are used by RhinoMAP technology to customize therapies.	41
6.	**Digital Monitoring Devices**	Tools for monitoring inhaler use and evaluating patient compliance	Poor inhaler technique and severe asthma can be distinguished with the INCA device.	42
7.	**Nasal Swab Diagnostic Tests**	Non-invasive nose examinations that detect biomarkers for asthma	Faster and more accurate identification of asthma subtypes is possible with new diagnostic technologies.	43

These developments highlight how important medical devices are to improving asthma treatment by providing patients and healthcare professionals with more individualized, effective, and ecologically friendly options.

6. Asthma and its medication:

Medication comes in two varieties: short-term prescriptions and long-term prescriptions. While the long-term drug is intended to stop future asthma attacks, the quick relief medication is used to reduce symptoms. The medications are separated into four categories:

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S No	Medication	Description	Dose and Time interval	Adverse effects	References
1.	**Reliever (Airomir Asmol Bricanyl Ventolin)**	• The se are quick-acting medications that are utilized during acute symptoms or asthma attacks. • The metered dose inhaler can be used as a reliever	Typically, the dosages of this medication range from 1.5 to 50 µg and last for 14 days.	• Nervousness or anxiety • Headache • Muscle cramps • Dry mouth • Throat irritation • Cough • Blurred vision	44
2.	**Preventer (Airomir Asmol Bricanyl Ventolin)**	• The preventer's function is to stop or avoid an asthma attack. • Acc uhaler dry powder inhalers and mesh nebulizers are typically used as preventers.	20 mg should be taken for two to six weeks.	• Osteoporosis (with long-term use) • Cataracts and glaucoma • Oral thrush (candidiasis) • Hoarseness (dysphonia) • Sore throat • Cough	45
3.	**Symptom controller medication** (Albuterol Xopenex or Pulmicort (steroid)	• The symptom controller helps to control and manage the symptoms of asthma. • It also uses antibiotics which help to control the asthma symptoms.	20 mg is taken for two to six weeks.	• Chest pain • Arrhythmia • Headache • Risk of adrenal suppression (with prolonged high doses)	46
4.	**Combination medication** (Salmeterol, Formoterol)	• Asth ma is prevented and controlled with	The dosage ranges from 0.6µg to 8.0g for three months.	• Oral thrush (candidiasis) • Increased risk of pneumonia (especially in elderly patients) • Adrenal	46

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		combination medications. • N-acetylcysteine and Seretide (Flixotide and Serevent) are the drugs used in combination medications. • For asthma, the Turbuhaler dry powder inhaler is a device that uses combination medications.		suppression (with prolonged high doses) • Paradoxical bronchospasm	

II. CONCLUSION

Asthma has been seen to be one of the respiratory diseases that bring about reduction of population in any nation. As little as asthma could look like, it has been a major cause of population death. There are so many causes of asthma and asthma attacks. Population percentage was carried out in different countries and it is seen how people died because of asthma. Proper management and treatment of asthma is very important and vital for asthma patients especially for a nation to be productive. It is important for these patients to know the causes of asthma so that it could be avoided or managed properly. A major cause of asthma could be smoke. Smoke affects the lungs which block the airways from receiving sufficient air which is necessary for living/survival. Other causes of asthma include stress, anxiety, dust etc. When the lungs cannot inhale the sufficient air needed by the lungs, the lungs become inflamed and begin to swell and the only way/solution is to use drugs/medication that can reduce the swelling and inflammation to allow airflow.

One of the ways to properly manage and treat asthma is by using medical devices for asthma. The medical device used for asthma attacks is called an inhaler. Inhalers are small medical instruments that contain drugs and medication that are used to open the airways of an asthma patient or an individual during an asthma attack. In this review, we looked and compared different types of inhalers using the fuzzy method and we found out that it was efficient, less expensive and reliable. Inhalers come in different forms: from mist to dry powder and then to normal medication and drugs. Each asthma patient may have a suitable inhaler that is preferred for him/her. What works suitably for one patient may differ from the next patient. So therefore, it is essential for each asthma patient to know the inhaler that is best suitable for them. Some patients because of their age and physical strength, it is necessary to use an extension such as a spacer or spacer with a mask. There are four types of inhalers which are Respimat, soft mist, dry Powder and nebulizers. Each inhaler has different techniques on how they are used and it is best important to know what works for each individual.

Proper education and programs on asthma should be done by nurses, doctors or medical practitioners on what asthma are causes, etiology, how to manage and treat an asthma patient and how to avoid asthma attacks. Asthma patients need to have proper education on how to handle the medical devices because inability to handle these devices properly could lead to death. Each inhaler works differently and it is important to know what works for them individually. Asthma causes stress to caregivers. Caregivers are people that take care of people that are physically ill or handicap. Asthmatic patients bring anxiety and stress to the caregivers because the caregivers are scared that if the asthma patients are left alone, an asthma attack

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may occur. Asthma attacks can occur in any minute this is why an asthma patient should always walk around with his/her inhaler. The inhalers are portable, small and cheap and carrying it around would not be difficult.

The purpose of this study is to have a general knowledge on asthma and the medical devices used in the treatment and management of asthma. With using the Multi-criteria decision making technique, fuzzy PROMETHEE; we obtained the ranking results of the asthma device based on their most important parameters. Results showed that the first three best alternatives are: Accuhaler, Soft Mist inhaler and Jet nebulizer based on the given parameters and their importance levels.

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