



The Global Impact of Respiratory Disease

Second Edition



Forum of International Respiratory Societies

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– Second Edition

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Foreword

The World Health Organization (WHO) launched the Global Alliance Against Respiratory Diseases (GARD) in 2006 with the aim to bring together the combined knowledge of national and international organisations, institutions and agencies to improve the lives of more than one billion people affected by chronic and acute respiratory diseases.

The 2030 Sustainable Development Agenda was adopted by world leaders in 2015 at a historic UN Summit in New York and came into force on January 1, 2016. The very ambitious agenda is a plan of action to achieve 17 Sustainable Development Goals (SDGs) and 169 targets by the year 2030, which include the economic, social and environmental dimensions of sustainable development.

SDG goal 3: **Ensure healthy lives and promote well-being for all at all ages** is one of the most important goals and needs to receive special attention by governments and all stakeholders. Improved health will bring people out of poverty and contribute substantially to sustainable development. A lot of progress has been made in increasing life expectancy and reducing the burden of many diseases such as polio, maternal mortality and the spread of HIV/AIDS. However, many challenges remain to be addressed if countries are to achieve SDG 3.

Noncommunicable diseases (NCDs), including cardiovascular diseases, cancers, chronic respiratory diseases and diabetes, are the biggest killers today. One of the very ambitious goals is to reduce mortality from NCDs by 30% by the year 2030. The WHO Global Action Plan on NCDs has recognised the strong interaction between NCDs and infectious diseases, including tuberculosis in particular in low- and middle-income countries and is asking to explore opportunities to improve the detection and treatment of co-morbidities within health services.

This Forum of International Respiratory Societies (FIRS) report highlights these comorbidities but also addresses forcefully the link between respiratory diseases and the environment and emphasises the importance of prevention, which should start before birth. Tobacco smoke, indoor air pollution from burning fuels, air pollution from traffic and industrial sources are highlighted as contributing to most respiratory conditions.

We are living in a world with so many competing public health priorities and chronic respiratory diseases have not received the attention they would really deserve. Better advocacy for lung health is badly needed to convince policy makers, governments, donors, nongovernmental organisations and civil society to scale up prevention and control programmes in all countries, in particular in low- and middle-income countries. FIRS is contributing with this excellent report to put lung health high on the global agenda.

I would like to congratulate FIRS for having prepared this very impressive comprehensive report on the global impact of tuberculosis, asthma, COPD, acute lower respiratory tract infections and lung cancer. It summarises in a very concise way the burden of disease and outlines the possibilities to improve prevention and treatment programmes and outlines the scope for control and elimination of these conditions.

The report will no doubt increase awareness about the major lung diseases globally and lead to accelerated action among all interested stakeholders.

Professor Nikolai Khaltsev
Chair of GARD



Executive summary

We take our breathing and our respiratory health for granted, but the lung is a vital organ that is vulnerable to airborne infection and injury. Respiratory diseases are leading causes of death and disability in the world. About 65 million people suffer from chronic obstructive pulmonary disease (COPD) and 3 million die from it each year, making it the third leading cause of death worldwide. About 334 million people suffer from asthma, the most common chronic disease of childhood affecting 14% of all children globally. Pneumonia kills millions of people annually and is a leading cause of death among children under 5 years old. Over 10 million people develop tuberculosis (TB) and 1.4 million die from it each year, making it the most common lethal infectious disease. Lung cancer kills 1.6 million people each year and is the most deadly cancer. Globally, 4 million people die prematurely from chronic respiratory disease. At least 2 billion people are exposed to indoor toxic smoke, 1 billion inhale outdoor pollutant air and 1 billion are exposed to tobacco smoke. The truth is that many of us are naïve to these stark realities.

Fortunately, most respiratory diseases are preventable by improving the quality of the air. Common sources of unhealthy air are tobacco smoke, indoor and outdoor air pollution, and

air containing microbes, toxic particles, fumes or allergens. Reducing tobacco consumption is the most important first step. Controlling unhealthy air in the workplace can prevent occupational lung disease. Strengthening immunisation programmes can prevent many types of pneumonia. Improving respiratory health also entails strengthening healthcare systems, using established guidelines for health promotion and disease prevention, training medical personnel, research, and educating the populace.

Prevention, control and cure of these diseases and promotion of respiratory health must be a top priority in global decision-making in the health sector. These goals are achievable, and the control, prevention and cure of respiratory diseases are among the most important cost-effective health interventions available. The Forum of International Respiratory Societies (FIRS) asserts that alleviating the burden of respiratory disease should be a leading strategy of the Sustainable Development Goals and a requirement for nations to achieve.

The purpose of this report is to call attention to the importance of respiratory health in the world and to raise it to be a top priority in global decision-making.

Introduction

The lung is the internal organ most vulnerable to infection and injury from the external environment because of its constant exposure to particles, chemicals and infectious organisms in ambient air. Globally, at least 2 billion people are exposed to the toxic smoke of biomass fuel, typically burned inefficiently in poorly ventilated indoor stoves or fireplaces. One billion people inhale polluted outdoor air, and 1 billion are exposed to tobacco smoke. Although respiratory impairment causes disability and death in all regions of the world and in all social classes, poverty, crowding, environmental exposures and generally poor living conditions increase vulnerability to this large group of disorders.

Respiratory diseases impose an immense worldwide health burden. Five of these diseases are among most common causes of severe illness and death worldwide [1].

- An estimated 65 million people have moderate to severe **chronic obstructive pulmonary disease (COPD)**, from which about 3 million die each year, making it the third leading cause of death worldwide – and the numbers are increasing [2, 3].
- About 334 million people suffer from **asthma** [4], which is the most common chronic disease of childhood, affecting 14% of children globally. The prevalence of asthma in children is rising [5].
- For decades, **acute lower respiratory tract infections** have been among the top three causes of death and disability among both children and adults. Although the burden is difficult

to quantify, it is estimated that lower respiratory tract infection causes nearly 4 million deaths annually and is a leading cause of death among children under 5 years old [6]. Moreover, acute lower respiratory tract infections in children predispose for chronic respiratory diseases later in life. Respiratory tract infections caused by influenza kill between 250,000 and 500,000 people and cost between US\$71 and 167 billion annually [7].

- In 2015, 10.4 million people developed **tuberculosis (TB)** and 1.4 million people died from it [8].
- The most common lethal neoplasm in the world is **lung cancer**, which kills 1.6 million people each year [9]; and the numbers are growing.

In addition to these five, there are several respiratory disorders whose burden is great but less well quantified.

- More than 100 million people suffer from **sleep-disordered breathing** [2].
- Millions live with **pulmonary hypertension** [2].
- More than 50 million people struggle with **occupational lung diseases**.

Respiratory diseases account for more than 10% of all disability-adjusted life-years (DALYs), a metric that estimates the amount of active and productive life lost due to a condition. Respiratory diseases are second only to cardiovascular diseases (including stroke) [10].

Respiratory diseases make up five of the 30 most common causes of death: COPD is third; lower respiratory tract infection is fourth; tracheal, bronchial and lung cancer is sixth; TB is twelfth; and asthma is twenty-eighth [1]. Altogether, more than 1 billion people suffer from either acute or chronic respiratory conditions. The stark reality is that, each year, 4 million people die prematurely from chronic respiratory disease [11]. Infants and young children are particularly susceptible. A total of 9 million children under 5 years old die annually, and pneumonia is the world's leading killer of these children [1].

Even more distressing is the enormous suffering that living with these illnesses cause. Those who are most disadvantaged suffer most

from poor health. With this awareness, the United Nations (UN) created the **Sustainable Development Goals** (SDGs) in 2016 [12] to raise living standards globally. The Forum of International Respiratory Societies (FIRS) is part of a global effort to call for action to address the huge burden of respiratory diseases. FIRS asserts that alleviating this burden should be a leading strategy of the Sustainable Development Goals and a requirement for nations to achieve these goals. FIRS has previously published a report [13] to call for improvements in healthcare policies, systems and care delivery, as well as providing direction for future research, and this report aims to provide an update on what has happened in the intervening years.







THE BIG FIVE

COPD, asthma, acute lower respiratory tract infections, TB and lung cancer are among most common causes of severe illness and death worldwide.

COPD

Scope of the disease

COPD affects more than 200 million people in the world [2], 65 million of whom have moderate or severe airway disease [2], and most studies show it is underdiagnosed by 72 to 93% [14]. This is higher than reported for hypertension, hypercholesterolaemia and many other important disorders. Misdiagnosis is also common [15]. The high prevalence and severity of illness make its economic cost high. The direct cost of COPD is 6% of total healthcare spending (€38.6 billion annually) in the European Union and accounts for 56% of the total cost of treating respiratory diseases [16].

The most important factor leading to the development of COPD is tobacco smoking. Tobacco smoke causes destruction of lung tissue (emphysema) and obstruction of the small airways with inflammation and mucus (chronic bronchitis), leading to the cardinal symptoms of COPD, namely shortness of breath and cough. Indoor and outdoor air pollution, inhaled tobacco smoke and occupational dust, genetic syndromes (such as α_1 -antitrypsin deficiency), childhood pneumonia and other diseases that involve the airways (such as chronic asthma and TB) are also factors contributing to the development of COPD [17].

Prevention

Discouraging individuals from starting to smoke tobacco and encouraging smokers to reduce and quit smoking are the first and most important priorities in preventing COPD. Chimney cook stoves and other devices that decrease indoor smoke exposure lessen the

risk of respiratory infections in children and potentially the incidence of COPD in non-smokers, particularly in women. Childhood vaccines and prompt recognition and treatment of lower respiratory tract infections will minimise the airway injury that predisposes to COPD in adulthood. COPD may begin in childhood. Management of childhood asthma, controlling occupational exposure to dust and fumes, and other environmental controls could have substantial benefits in reducing the burden of COPD.

Widespread population screening for COPD in asymptomatic adults is not recommended [18], but performing spirometry in populations with risk factors and respiratory symptoms is [19]. For example, clinicians should pursue a diagnosis for people exposed to smoke from cigarettes and biomass fuels, occupational dusts and chemicals, and having a family history of α_1 -antitrypsin deficiency.

Treatment

Spirometry is required to establish a clinical diagnosis of COPD and is the first step in treatment. Using spirometry avoids misdiagnosis and assists in evaluating the severity of the airflow limitation. Identification and reduction of exposure to risk factors are essential to prevent and treat the disease. Avoiding air pollution and other precipitating factors is also important. All individuals who smoke should be identified and provided with assistance to enable them to quit. Vaccination against seasonal influenza can reduce the risk of severe exacerbations triggered by influenza [20].

Along with removal of respiratory irritants or triggers and early treatment of respiratory infections, inhaled bronchodilators are the basic medicines that help these patients. Treatment with long-acting bronchodilators, together with inhaled corticosteroids and other pharmacological and non-pharmacological agents, can help patients with frequent exacerbations and severe airflow obstruction.

Patients with low blood oxygen levels may require supplemental oxygen. Long-term oxygen therapy can increase survival and improve the quality of life in patients with very low oxygen levels. Maintaining physical fitness and activity is important because difficulty breathing may lead to a decreased activity and subsequent deconditioning. Therefore, exercise-based pulmonary rehabilitation is important for many people with COPD [21]. Treating coexisting illnesses can extend the life of many people.

Clinical strategies are available that outline the appropriate management of people with COPD [22]. Despite the availability of clinical practice guidelines, several studies have shown that COPD is undertreated in its early as well as advanced stages.

Control and elimination

The key element of reducing and controlling COPD is abolishing tobacco use. This is best addressed through political and public health initiatives. Public health and societal efforts are needed to reduce indoor smoke exposure and other COPD risk factors, and to develop cost-effective management protocols for COPD, especially in low-income settings. Age-specific mortality rates from COPD are now declining, but the ageing world population makes this a huge problem for decades to come. Research should lead to better understanding of how risk factors and comorbidities interact to affect the severity of disease, and which other factors cause COPD in smokers and non-smokers. Other important research questions include how best to identify and treat mild COPD, and how to manage COPD in the context of concomitant conditions, such as sleep apnoea, cardiovascular disease, depression, osteoporosis, diabetes, lung cancer, ageing and frailty. This research is needed to build management plans on a sound knowledge base.



Asthma

Scope of the disease

Asthma afflicts up to 334 million people worldwide [4] and its incidence has been increasing for the past three decades [5]. It affects all ages, races and ethnicities, though wide variation exists in different countries and in different groups within the same country. It is the most common chronic disease in children and is more severe in children living in non-affluent countries [23]. In these settings, underdiagnosis and under-treatment are common, and effective medicines may not be available or affordable. The burden of asthma is high [4, 10]. It is one of the most frequent reasons for preventable hospital admissions among children in high-income countries, but less information is available from low- and middle-income countries [4]. In some studies, asthma accounts for more than 30% of all paediatric hospitalisations and nearly 12% of readmissions within 180 days of discharge [24]. It is not widely realised that asthma causes about 489,000 deaths per year or more than 1,300 deaths per day [1]. Recent evidence indicates that children with asthma may have abnormal lung growth and are at risk for developing lifelong respiratory compromise and COPD [25].

The causes of the increase in global prevalence of asthma are not well understood. Genetic predisposition, exposure to environmental allergens, indoor and outdoor air pollution, lower respiratory tract infection early in life, airway microbiome makeup, dietary factors and abnormal immunological responses may promote the development of asthma. The timing and level of exposure to allergens,

infection or irritants may be major factors leading to the development of disease. Early viral infections and passive tobacco smoke exposure have been associated with the development of asthma in young children. Airborne allergens and irritants associated with asthma occur in the workplace and can lead to chronic and debilitating disease among workers if the exposure persists.

Prevention

The cause of most asthma is unknown and there is no effective strategy for primary prevention. However, potentially modifiable risk factors for development of asthma include smoking during pregnancy and use of broad-spectrum antibiotics in the first year of life.

Asthmatics who smoke have a more rapid decline in lung function than lifelong non-smokers. Avoiding smoking during pregnancy and avoidance of passive smoke exposure after birth can reduce asthma severity in children. Epidemiological interventions involving work-related asthma show that, in adulthood, early removal of allergens or irritants may lead to better control of the disease, although the burden and cost of the intervention need to be taken into account. There is little evidence for effective single-strategy indoor allergen avoidance interventions in adults outside the occupational context, except for remediation of dampness and mould. The use of maintenance controller medication can effectively prevent intercurrent asthma attacks with a resultant decline in lung function, and has been clearly shown to reduce mortality and hospitalisations [4].



Treatment

Making a correct diagnosis is essential for treatment, and improving access to spirometry will help to reduce misdiagnosis. Asthma is generally a lifelong disease that is not curable, but treatment with quality-assured essential asthma medicines can effectively control the disease. Inhaled corticosteroids are the cornerstone of effective asthma control. When used appropriately, that is, taken regularly with correct technique and a spacer or other device to assure inhalation, these medicines can decrease the severity and frequency of symptoms of asthma. They also reduce the need for reliever inhalers (rapid-acting bronchodilators) and the frequency of severe episodes (“exacerbations”) requiring urgent medical care, emergency room visits, hospitalisations and death. Inhaled bronchodilators are important for providing quick relief from asthma symptoms.

Unfortunately, many people suffering from asthma do not have access to effective quality-assured asthma medicines. Even though inhaled corticosteroids and inhaled bronchodilators are on the essential drug list of the World Health Organization (WHO), they are either unavailable or unaffordable in many settings [4, 26].

Lack of availability of medicines is not the only reason people with asthma do not receive effective care. Widespread misconceptions about the nature of the disease and its treatment often prevent people from

using appropriate treatments. Educational campaigns to encourage regular use of inhaled corticosteroids for control, avoidance of exposures that trigger asthma attacks and provision of written asthma action plans, so that the patient can respond to worsening asthma, are important parts of effective asthma control programmes.

Control and elimination

Additional research is needed to better understand the earliest origins of asthma, the causes of exacerbations and reasons for its rising prevalence in many countries [5]. Elimination is a distant vision. The International Study of Asthma and Allergies in Childhood (ISAAC) has provided insights into the disease and facilitated standardised research on asthma in children that has helped to define the prevalence, trends and determinants of asthma and allergies worldwide. This work and other research findings are being incorporated into evidence-based strategies for the management of asthma. Dissemination and implementation of these strategies will improve asthma control. Making quality-assured inhaled corticosteroids, bronchodilators and spacer devices widely available at an affordable price, and educating people with asthma about the disease and its management are key steps to improve outcomes for people with asthma. Strategies to reduce indoor air pollution, smoke exposure and respiratory infections will improve asthma control and reduce the need for healthcare utilisation.

Acute lower respiratory tract infection

Scope of the disease

Lower respiratory tract infection and pneumonia are two of the leading causes of death, accounting for more than 4 million fatalities annually. It is a particularly important cause of death in low- and middle-income countries [27]. Lower respiratory tract infection kills more people than human immunodeficiency virus (HIV), TB and malaria combined [6]. It is the leading cause of death in children under 5 years of age outside the neonatal period [6]. Pneumonia killed 920,136 children aged under 5 years in 2015, accounting for 15% of the deaths in this age group [28]. It is also the second leading cause of years of life lost due to premature mortality [27] and one of the most frequent reasons for hospitalisation.

Risk factors for pneumonia include being very young or elderly, crowded living conditions, malnutrition, HIV infection, lack of breastfeeding in infants, lack of immunisation, chronic health conditions and exposure to tobacco smoke or indoor air pollutants.

Streptococcus pneumoniae remains the most frequent bacterial cause of pneumonia and killed 393,000 children aged under 5 years in 2015 [1]. HIV infection increases the risk of pneumonia caused by this organism twenty-fold, although the incidence of severe disease has declined with better immunisation and the use of antiretroviral therapy. Pneumonia can also lead to chronic respiratory diseases, such as bronchiectasis.

Viral respiratory infections can occur in epidemics and spread rapidly within

communities across the globe. Every year, influenza leads to respiratory tract infections in 5–15% of the population and severe illness in 3–5 million people [29]. Respiratory syncytial virus (RSV) is the most common cause of acute respiratory infection in children, causing almost 34 million episodes annually. More than 90% of deaths from RSV respiratory infection in children occur in low- and middle-income countries [30].

Ominously, new respiratory pathogens are emerging. In 2003, severe acute respiratory syndrome (SARS), caused by a previously unrecognised coronavirus, rapidly spread throughout the world. Its lethality mobilised international efforts that rapidly identified the cause and the method of spread. Stringent infection control measures reduced its spread effectively and no further cases were identified [31]. The risk of another global epidemic caused by a new virus or a mutation in a known virus has encouraged health officials and researchers to find ways to limit or prevent such a catastrophe. These events can stress national healthcare systems, leading to widespread disaster. Respiratory viruses can spread quickly because of the ease of transmission, as has been seen in past influenza pandemics.

Prevention

Childhood respiratory disease can be prevented or ameliorated by several measures: improving childhood nutrition and promoting breastfeeding (both of which improve immune status); ensuring comprehensive immunisation; improving living conditions to prevent crowding; avoiding tobacco smoke

exposure from the time of conception through childhood; reducing indoor air pollution; treating or preventing HIV infection; giving prophylactic antibiotics in immunosuppressed children; and preventing mother-to-child HIV transmission. Several of these measures are also appropriate for respiratory disease prevention in adults.

Vaccination is one of the greatest achievements of modern public health, yet many children are unimmunised against preventable infections particularly in low- and middle-income countries. Countries with the lowest immunisation rates account for more than two-thirds of the vaccine-preventable disease burden and have the highest childhood mortality.

Treatment

The success of prevention or treatment of many respiratory infections is dependent on the quality of the healthcare system. Most bacterial infections are treatable with antibiotics and most viral infections are self-limited. Yet millions of people still die of pneumonia. The failure to prevent these deaths often results from lack of access to healthcare and effective preventive interventions including immunisation. Comorbidities, such as HIV infection and malnutrition, and lack of awareness and education may lead to advanced disease before the affected people seek medical attention. Late presentation leads to greater treatment failure.

The most effective way to manage these diseases is through standard case management. Case management is defined as “a collaborative process of assessment, planning, facilitation, care coordination, evaluation, and advocacy for options and services to meet an individual’s and a family’s comprehensive health needs through communication and available resources to promote quality cost-effective outcomes” [29].

For childhood pneumonia, a standard approach to diagnosis and treatment has been developed by the WHO in the Integrated Management of Childhood Illness programme. The cornerstone of pneumonia management is the appropriate diagnosis and use of antibiotics. Supplemental oxygen is essential for effective treatment of severe

pneumonia, although its delivery is not available in many low- or middle-income countries. Enhancing availability of oxygen delivery systems in these areas must be a global priority. In the management of adults with pneumonia, several national guidelines have been developed and many studies have documented that adherence to these guidelines is associated with better patient outcomes.

Control and elimination

Vaccines are essential for the control and elimination of many of these childhood diseases. The development of new conjugate vaccines against *Streptococcus pneumoniae* (pneumococcus) and *Haemophilus influenzae* type b have been important advances in prevention of pneumonia. Vaccines against bacteria, such as *S. pneumoniae*, *H. influenzae* type b and whooping cough (pertussis) are highly effective for preventing lower respiratory tract infections. The influenza vaccine is effective in preventing influenza. Vaccines against other viruses, such as measles, are so effective that they are virtually eliminating the diseases. Vaccination programmes for adolescents and adults, which are also effective, have frequently been neglected. Conjugate vaccines must be available as part of expanded programmes for immunisation in all countries. Development of improved vaccines with broader coverage is needed to control or eliminate specific infections.



Antibiotics have made most bacterial pneumonia curable, although antibiotic-resistant bacteria can complicate care. As with other diseases in which the causes are known and cures are available, key efforts must be made to improve the availability and delivery of quality healthcare and effective medicines. Greater availability of pulse oximeters to guide supplemental oxygen therapy coupled with better access to oxygen delivery systems must be a priority for effective treatment of severe respiratory infections [26].

Early diagnosis is essential, and includes the need for heightened awareness in the community. Better diagnostic tests, including better sampling procedures and better methods for the rapid detection of infectious agents, are needed.

Improved diagnosis enables targeted therapy. Misuse of antibiotics leads to the emergence and selection of resistant bacteria. More intelligent use of antibiotics may decrease the huge problem of antimicrobial drug resistance. Physicians worldwide now face situations in which infected patients cannot be treated adequately because the responsible bacterium is totally resistant to available antibiotics. Strategic areas of intervention include: 1) prudent use of available antibiotics in patients and animals, giving them only when they are needed, with the correct diagnosis, and in the correct dosage, dose intervals and duration; 2) hygienic precautions to control transmission of resistant strains between persons, including hand hygiene, screening for carriage of resistant strains and isolation of positive patients; and 3) research and development of effective antibiotics with new mechanisms of action [32].





Tuberculosis

Scope of the disease

In 2015, there were 10.4 million new cases of TB. Of these, 1 million were children, which is likely to be an underestimate because the diagnosis of paediatric TB is challenging. In 2015, there were an estimated 480,000 new cases of multidrug-resistant TB, and an additional 100,000 people developed rifampicin-resistant disease [8]. Among new cases of TB, 11% of people also had co-infection with HIV. In 2015, TB killed 1.4 million people, making it the greatest single infectious agent cause of death and a leading cause of overall deaths in the world. When combined with HIV, it killed another 400,000 people [8]. Twenty countries accounted for 84% of the cases of TB [8].

The incidence of TB is falling at a rate of about 1.5% per year, which is insufficient to end tuberculosis by the WHO's stated goal of 2035. Deaths due to TB decreased 17% between 2005 and 2015, and age-standardised TB death rates decreased 34% [1]. The treatment success rate is 83% for drug-sensitive TB, 52% for multidrug-resistant TB and 28% for extensively drug-resistant TB [8].

The global case-fatality rate remains high at 17%, but varies from less than 5% to more than 20% [8]. The cost of treating multiple drug-resistant TB is many times the cost of treating drug-sensitive disease and strains TB control programme budgets [33, 34]. About 910,000 persons living with HIV and 87,000 children aged under 5 years began treatment of latent TB in 2015, but this is only 7% of the eligible children [8].

Only recently has TB in children begun to receive the attention it deserves. Paediatric TB has been largely ignored because, in general, children are thought to not spread the disease. Moreover, TB is difficult to diagnose in young children because they usually do not produce sputum. The high susceptibility of infants and young children to extrapulmonary and disseminated disease adds to the complexity of diagnosis. Consequently, diagnostic approaches for children have lagged. Likewise, antituberculous drug formulations have not been developed for paediatric use until recently.



Prevention

In no disease is the phrase “treatment is prevention” truer than with TB. The factors promoting the spread of infection relate to the chance that an uninfected individual is exposed to a person with infectious TB: the more cases in the community, the more likely it is that an individual will become infected. Factors promoting the development of disease in infected individuals generally relate to the function of the immune system. The most potent factor causing an exposed person to develop active tuberculosis is infection with HIV, but other conditions that affect immunity, such as certain medications and the presence of poorly controlled diabetes, also increase the risk of developing active disease.

Inhaling only a few tuberculous bacteria can result in infection. However, only about one in 10 people infected with *Mycobacterium tuberculosis* will develop active disease, although the rate is much higher in young children and people with immunodeficiency conditions. TB lies dormant because the infection is contained by the body’s immune system, but it can become active at any point in a person’s lifetime. This two-phase sequence by which the disease develops provides an opportunity for prevention. By identifying persons who are proven or are highly likely to have latent infection and treating those who have conditions or circumstances that increase the risk of disease, the likelihood of developing active TB can be substantially reduced. Several drug regimens have been documented to be effective for treating latent tuberculosis [35].

The current vaccine, Bacille–Calmette–Guérin (BCG), offers only partial protection against TB but does reduce the risk of disseminated TB and tuberculous meningitis in children. Research centres around the world are working on developing a better vaccine for TB.

Treatment

Most cases of TB can be cured if diagnosed early and treated appropriately using standardised approaches that are based on evidence derived from clinical trials. The International Standards for Tuberculosis Care [36] should be followed by providers



in all healthcare sectors and countries. The long duration of therapy (usually 6 months with four drugs in uncomplicated cases) makes adherence to treatment challenging, especially in individuals who are taking other medications for chronic diseases, such as HIV infection. Failure to take the full course of prescribed drugs appropriately may result in relapse with drug-resistant disease, which is more difficult to treat and poses a risk to others. For this reason, supervised or directly observed therapy is recommended as the standard of care to ensure adherence throughout the course of treatment.

Treatment of patients with multidrug-resistant TB is a more complicated issue. Although the standard has been to treat with five or six drugs for 14–18 months, a recent trial has shown a shorter course of therapy is better [37] and now recommended by WHO.

Control and elimination

In May 2014, the World Health Assembly approved the End TB Strategy, a comprehensive set of principles and activities developed by WHO's Global Tuberculosis Programme over a 2-year period with broad global consultative input [38]. The activities within the Strategy are guided by a set of four overarching principles: 1) government stewardship and accountability with monitoring and evaluation; 2) strong coalition with civil society organisations and communities; 3) protection and promotion of human rights, ethics and equity; and 4) adaptation of the strategy and targets at country level, with global collaboration. The Strategy provides an overall global framework for TB control and, ultimately, elimination with targets of reducing deaths due to TB by 95% and the incidence of the disease by 90% by 2035, compared with 2015. These principles convey the responsibilities of government agencies, while at the same time indicating the requirement for all health sectors and civil society to be involved and for services to be delivered in an equitable manner with respect for human rights, with implementation of the strategy at country level [39].

Three main areas of activities (or “pillars”) are necessary to achieve these targets:

- **Pillar 1** Integrated patient care and prevention
- **Pillar 2** Bold policies and supportive systems
- **Pillar 3** Intensified research and innovation

In all pillars, there are activities that represent new ways of thinking about TB on a global scale and tend to unify approaches to control and elimination across low-, middle- and high-burden countries.

Taken together, the principles and activities provide a comprehensive globally applicable approach to TB control and elimination. Several areas have developed more detailed and specific plans for TB elimination [38].





Lung cancer

Scope of the disease

Cancer is a major global problem, with about 14.1 million new cases and 8.2 million deaths in 2012, based on GLOBOCAN estimates [9]. Of the major cancers, lung cancer remains the most common in the world, with an estimated 1.8 million new cases in 2012. Most (58%) of these occurred in the less developed regions. Lung cancer is also the most fatal cancer globally. In 2012, 1.6 million people died from lung cancer, accounting for 19.4% of the total deaths attributable to cancer [9]. The ratio of mortality to incidence is 0.87. If lung cancer has spread to other organs, the 5-year survival is only about 13% [40].

Tobacco smoke causes most cases of lung cancer by damaging DNA and mutating protective genes. Lung cancer risks correlate with the amount and duration of smoking. Since DNA-damaged genes accumulate over time, lung cancer may occur years after people begin or quit smoking. There are now more former smokers than smokers worldwide, but former smokers are not free from cancer risk.

Lung cancer can also occur in people who have never smoked, which is especially true for Asians. Other risk factors include passive exposure to tobacco smoke, biomass fuel, diesel exhaust, radon, asbestos, and other environmental and workplace carcinogens. Although asbestos is now banned from commercial use and production in most countries, these fibres persist in the environment, including insulation and fire-retardant materials inside and on the surface of many buildings, and remain present in prior manufacturing sites. Some countries where its

use is banned still produce and market it to other countries.

Prevention

Lung cancer is largely preventable through tobacco control. Public programmes that reduce smoking are effective, but more are urgently needed, especially in countries where smoking is increasing because the incidence of lung cancer follows increased smoking.

Environmental causes of lung cancer, such as radon and asbestos, can be monitored and reduced. Producers of asbestiform materials should have increased regulations to minimise or eliminate exports of their carcinogenic material. Countries must not be allowed to export asbestos to poorer countries. Other known modifiable risk factors, such as biomass fuels, diesel exhaust and air pollution, must also be addressed. Research is needed to determine other causes of lung cancer and how to translate this knowledge into effective health policy.

Treatment

Care of patients with lung cancer has become complex and is optimally provided by an expert multidisciplinary team when available. In lower-income countries, access to care and cost-effective treatments can reduce the human burden and societal impact of lung cancer.

To guide treatment and to determine prognosis, lung cancer patients undergo diagnostic and staging processes. Early-stage lung cancer is treated with curative-

intent surgery or radiation therapy. Selective patients may benefit from chemotherapy after surgical resection, while patients with local advanced disease may benefit from concurrent chemo-radiotherapy with or without surgery. Although advanced stage lung cancer is not curable, many patients may have symptom improvement and survival prolongation by effective treatment. Molecular targeted therapy against epidermal growth factor receptor (EGFR) mutations and anaplastic lymphoma kinase (ALK) re-arrangements attain tumour response rates of around 70%. However, cost is a major barrier to these treatments. Symptom relief and palliative care must be considered throughout an individual's lung cancer journey to provide patient-centred care. The benefits of treatment must be balanced against the risks of adverse effects in individual patients in order to achieve high-value healthcare.

Access to care remains a major challenge in lower- and middle-income countries, which emphasises the global need for affordable, cost-effective treatments and optimal care. "Personalised therapy" directed to factors such as specific mutations may improve the results of treatment. Such "precision medicine" and promising immunotherapeutics involve costly tests and treatments, which are not universally available.

Identifying and treating early cancer is a potential lifesaving strategy. A recent large-scale study showed that screening with CT

scans compared to chest radiography resulted in a 20% reduction in lung cancer-specific deaths [41]. The use of screening for lung cancer has been demonstrated, in principle, in high-income countries, but much cheaper and more accessible methods are needed for low-income settings.

Control and elimination

The overarching strategy for elimination of lung cancer depends on smoking cessation by helping current smokers to stop, and by reducing the number of people who start smoking. Legislation to regulate tobacco use and its promotion, to eliminate exposure to cigarette smoke in public areas, and to raise taxes on tobacco products are proven techniques that decrease tobacco use. These efforts are particularly important in countries where smoking rates are high or rising. Reducing the risk from other lung carcinogens such as air pollution, which is now classified as carcinogenic to humans [42], is needed.

Comparative effectiveness research into strategies aimed at tobacco use reduction and cessation through public policy is needed. Better screening, early diagnosis and identifying molecular targets for effective and cost-effective modern treatment should improve lung cancer outcomes. Globally, efforts to reduce inequity of care and access to effective and affordable treatments are also vital for addressing the lung cancer crisis around the world.



Other important respiratory conditions and concerns

In addition to the five respiratory diseases described, other respiratory conditions also impact global health. The lungs are the organ most affected by unhealthy air in the workplace, and **occupational lung disease** is a common health hazard that takes a huge toll, causing death, disability and absenteeism. Exposure to asbestos causes lung fibrosis (asbestosis) and mesothelioma. Exposure to mineral dusts causes silicosis or coal worker's pneumoconiosis, and exposure to organic antigens causes hypersensitivity pneumonitis and asthma. These diseases may be preventable by assuring clean air in the workplace. Importantly, inhalation of toxic material both inside and outside the workplace can cause acute and large-scale health problems.

Sleep disordered breathing (or sleep apnoea) is a common condition affecting 1–6% of adults. Sleep apnoea is more common in older individuals; one study reported up to 24% of men aged 30–60 years had obstructive sleep apnoea [43]. Sleep apnoea causes fragmented sleep and hypoxia, which has long been recognised to cause daytime somnolence and increased accidents. More recently, it has also been associated with many other illnesses, such as hypertension, cardiovascular disease, stroke, diabetes, poor cognitive function and neuropsychiatric disorders – not to mention effects on alertness causing problems with safety-sensitive activities. Furthermore, it appears to worsen many other illnesses. Paediatric sleep disorders are increasingly recognised as causes of morbidity and mortality. Obstructive sleep apnoea syndrome has been described in 5% of children tested, but exceeds 10% in

some paediatric populations. An important health condition that affects 1% of the world has great world health significance. The best preventive measures for sleep apnoea are maintaining a healthy bodyweight and doing physical exercise.

Pulmonary hypertension occurs in about 1% of the population in the world and up to 10% of those aged over 65 years. Much of this is related to left ventricular failure and lung disease, but schistosomiasis, HIV infection, rheumatic heart disease and sickle cell disease are other prominent causes [44]. Treatment and prevention of pulmonary hypertension vary depending on the cause and can often be controlled by alleviating the underlying conditions.

Pulmonary embolism is a common life-threatening disease estimated to occur in 6–20 per 10,000 European inhabitants annually [16], but the number is likely to be much higher because both mild and severe cases go unrecorded and often can be a diagnostic challenge. Mild cases may be self-limited and not reported; and end-of-life cases are usually associated with other severe diseases, which can be erroneously reported as the cause of death instead of pulmonary embolism. Pulmonary embolism is associated with age, many different health conditions, genetic predisposition and physical inactivity. Treatment is generally with anticoagulants.

The respiratory system is in the forefront of two current global health concerns – climate change and terrorism. **Climate change** affects respiratory diseases by several means. Temperature is closely associated with air

pollution, which affects many respiratory conditions. Ozone production increases with higher temperatures because higher temperature speeds the reactions of volatile organic compounds and nitrogen oxides to produce ozone. Climate change affects the incidence and severity of respiratory infections by their affecting vectors and habitats and changing the transmission patterns of viruses [45]. Weather events may alter human host response and susceptibilities to infectious and non-infectious diseases.

The deliberate use of biological agents

or chemicals to inflict casualties has been outlawed globally since 1925. In 1972, the United Nations' Biological and Toxin Weapons Convention "prohibited the development, production, accumulation, acquisition, and retention of biological agents or toxins." Unforgivably, they have been used in conflicts since then. The lungs are particularly vulnerable to **biological or chemical terrorism** because the causative agents are most often disseminated through the air. Defending against such attacks requires research to understand how best to protect the lungs.



What can be done to combat respiratory disease?

Prevention

The first step for respiratory health is to prevent illness before it occurs. Identifying and ameliorating the factors that cause or promote respiratory diseases can prevent them. Because respiratory diseases are often linked to the environment, respiratory conditions are more preventable than most other system diseases. The cost of prevention is only a fraction of the cost of treatment. Preventing and combating respiratory disease is a highly cost-effective “best buy” described by the WHO [46].

Prevention starts before birth. In utero and childhood exposure are major determinants of chronic adult respiratory disease. Paediatric factors associated with COPD in adults include maternal and paternal asthma, maternal smoking, childhood asthma and severe respiratory infections [47]. Furthermore, smoking in the grandmother increases the risk of asthma in both the mother and grandchild, even if the mother does not smoke. The deleterious effects of nicotine and tobacco smoke exposure are augmented if certain genes’ alleles are present in either the mother or the foetus [47]. Antenatal and early child exposure to indoor or outdoor air pollution affect lung growth and are associated with accelerated lung function decline later in life [47].

Breathing unhealthy air is a cause or contributor to most respiratory conditions. The most common sources of unhealthy air are tobacco smoke, indoor air pollution from the smoke of burning fuels, unhealthy air in the workplace, air pollution from traffic and industrial sources, and air containing microbes, toxic particles, fumes or allergens. Improving the quality

of the air is an important step in promoting respiratory health.

The best measure to prevent lung disease is to reduce tobacco use. Smoking was estimated to be responsible for one in seven deaths in men and one in 15 deaths in women globally in 2004 [48]. It is projected that as many as 1 billion people will die from tobacco smoking in the twenty-first century [49]. Of these deaths, most will result from cardiovascular or respiratory disease, including lung cancer and COPD. In the USA, current smokers are 25 times more likely to die of lung cancer than those who never smoked [50]. The rate of death from all causes is three times higher in smokers than non-smokers and life expectancy is shortened by 10 years in smokers [51]. In Europe, the total health cost of tobacco is about €544 billion annually, which represents about 5% of the European Union GDP [52].

Passive smoke exposure also leads to respiratory disease. Since 1964, about 2.5 million non-smokers died from health problems caused by exposure to second-hand smoke [53]. In children, second-hand smoke causes ear infections, asthma attacks, bronchitis and pneumonia. It increases the risk for sudden infant death syndrome. Heart disease and stroke are also increased. An estimated 34,000 heart disease deaths and more than 7,300 lung cancer deaths have been attributed to second-hand smoke annually in the USA [53].

Intensive educational campaigns in Western Europe and North and South America have decreased the number of smokers in many countries, but the tobacco industry moved its

target to susceptible populations in Eastern Europe, Asia and Africa to increase sales of its products. More than 300 million Chinese smoke more than 2 trillion cigarettes per year – more than the next four highest tobacco-consuming nations combined. In China, a person dies every 30 seconds from tobacco use [54].

Tobacco smoking is a solvable global problem. The first international treaty developed for purposes of health was the WHO's Framework Convention on Tobacco Control [55]. The treaty is an important mechanism by which governments can control the tobacco industry by using laws, regulations, administrative decisions and enforcement measures. Effective strategies, termed MPOWER [49], have been developed by the WHO Tobacco-Free Initiative to support implementation of the Framework to prevent and reduce smoking and the demand for tobacco products. Much more remains to do, particularly in low- and middle-income countries to mitigate the pernicious impact of tobacco smoking.

Poor indoor air quality is an important contributor to respiratory disease. About 50% of all households in the world and 90% of rural households use fuels that allow smoke to be present in the living area, exposing over 2 billion people to noxious smoke [56]. The WHO estimates that 4.3 million deaths per year can be attributed to indoor air pollution. Most disease and death attributable to exposure to poor indoor air quality occurs in women and children, especially in low-income families [57]. Exposure to indoor smoke used for heating and cooking leads to COPD, lung cancer and, in children, pneumonia and asthma [57].

People with lung disease are particularly susceptible to the effects of outdoor air pollution. Increased concentrations of airborne fine particles are associated with increased hospital admissions and deaths [58]. It is estimated that poor air quality in Europe leads to an average loss of 8.6 months of life expectancy [59]. There is a growing body of evidence that air pollution affects the unborn child, leading to enhanced susceptibility to infection, and respiratory and cardiovascular disease later in life [60]. Children, especially those with chronic lung disease, are also more susceptible to the adverse effects of

air pollution [61]. The environmental risks are greater in low- and middle-income countries and among the disadvantaged and low socioeconomic sections of society.

Appropriate nutrition and physical activity are critical for health. Both malnutrition and obesity contribute to respiratory diseases. Obesity is linked to obstructive sleep apnoea in Western societies and to asthma, heart disease and diabetes. Malnutrition is an important risk factor for childhood pneumonia and severe illness.

Prevention of respiratory disease entails strengthening healthcare systems, using established guidelines for health promotion and disease prevention, training medical personnel and educating the populace.

Treatment and cure

Once disease occurs, the goal is to lessen its effects and cure it if possible. Reducing its effects is best accomplished by early detection, prompt diagnosis and early effective treatment. Successful treatment is based on sound medical evidence, is cost-effective and is generally in accordance with standardised guidelines. Patients and healthcare workers can manage diseases better if they are properly trained and necessary resources are available. The WHO, FIRS member organisations and other governmental agencies or respiratory societies have developed recommendations for standards of care for specific clinical conditions. Unfortunately, effective and uniform implementation, promotion and adherence to these standards have been lacking. Great medical breakthroughs are only significant when they reach the communities and patients that need them.

In recent decades, medicine has increased the length and quality of life, although changing lifestyles, new types of infection and changing environments have created new challenges. These advances have brought costs. Healthcare for those who are ill or dying is expensive. Increasing healthcare costs have threatened the financial health of many nations. On the other hand, work losses secondary to ill health affect national productivity. The economic development of countries is linked to the health of its citizens. Poor health, both individual and public, along



with lack of education and lack of an enabling social structure are major impediments to a country's development and are the roots of poverty.

Healthcare delivery can be readily improved with programmatic research, education, a trained work force, funding, infrastructure and an efficient system in which to operate. Evidence-based guidelines should be implemented system wide. Specific targeted national (or regional) interventions should prioritise interventions that are effective, easy to implement and monitor, and that target persons most at risk. For example, in asthma, this could include a programme with early treatment with inhaled corticosteroids, reduction in exposure to tobacco smoke and appropriate education in the use of inhalers [62].

Economic barriers limit access to care even in resource-rich settings. Many people simply cannot afford to obtain good-quality care. In resource-poor settings, many people do not seek care from the public health system because it is lacking, of poor quality or inaccessible. In many countries, public healthcare systems are seen as a drain on public funds. They are vulnerable to abrupt change in funding, which depends on the political and economic climate. In some countries, health insurance systems limit medications and services. Direct patient costs are greater in resource-poor countries where up to 90% of the money spent on healthcare may be paid directly from the patients to the providers. About 150 million people experience financial catastrophes from healthcare costs annually [63]. Governments may define an essential package of care, but that care may not be adequate. Restrictions on healthcare should depend on evidence-based standards of care.

Disease control and global reduction or elimination

Controlling and eliminating respiratory diseases requires optimal use of the current, effective tools coupled with additional research. Basic, clinical and public health research all have important roles in reduction and elimination of respiratory disease. The investment in respiratory research has paid enormous dividends. The rate of pneumonia and TB is decreasing worldwide [8], as is

tobacco use in certain countries. These successes must stimulate the world to consolidate and extend these gains to more countries and more diseases. It cannot be a short-sighted rationale for reducing effort.

People are living longer and are healthier, and we are on the threshold of even greater advances. Many diseases now have genetic profiles and scientists are working hard to uncover their basic mechanisms. The complicated network of cells, signals and structures is being revealed and used to identify susceptible individuals, develop better diagnostic tests and find new treatments. Equally important is research on how to apply new research findings to help people and control disease. The results of clinical trials are distilled into guidelines on how best to prevent and manage an illness. These evidence-based recommendations can be powerful tools to secure uniform high-quality medical care throughout the world. Knowledge created through research is cross-cultural and enduring, but it must be applied to be valuable.

In addition to public health measures, developing healthcare capacity requires the education and training of clinicians and researchers. Governments, professional societies and global governmental and charitable organisations must act together to assure the next generation is well equipped to meet the health needs of the world.

Summary

Respiratory diseases are an enormous challenge to life, health and productive human activity. Prevention, control and cure of these diseases and promotion of respiratory health must be a top priority in global decision-making in the health sector. The control, prevention and cure of respiratory diseases are among the most cost-effective health interventions available – a “best-buy” in the view of the WHO. Investment in respiratory health will pay manifold dividends in longevity, healthy living days and national economies.

Public awareness and control of the environment are important steps to preventing respiratory diseases. The key controllable factors are reduction in tobacco smoking and improvement in air quality, which includes reduction in second-hand tobacco smoke, smoke from indoor fire, and unhealthy public and workplace air. Strengthening childhood immunisation programmes and greater availability of the pneumococcal conjugate vaccine must be a priority in low-income countries. Prevention and timely treatment of HIV infection can have major impact in reducing the burden of respiratory illness. Effective training of healthcare workers and making available medications and appropriate diagnostics are keys to better lung health.

FIRS calls on all governments, communities, healthcare practitioners and individuals to promote these effective preventive measures that have reduced tobacco consumption in many countries.

The health benefits of clean air policies are far reaching. Several studies have shown

improvement in air quality has reduced deaths and hospitalisations for heart and lung diseases. Legislation and political action on clean air makes a difference. **The respiratory societies of the world believe that everyone has the right to breathe clean air [59] and we ask lawmakers to enact and enforce clean air standards in all countries.**

Finally, research in respiratory diseases is the hope for today and the promise for tomorrow. Research must answer many questions: how do lung diseases arise, how do they are spread, who is vulnerable, and what actions can be used control or cure them, to name a few. Research must also help us understand what keeps people healthy. Measures developed from the research must be cost-effective and widely applicable. Increased funding to support respiratory research is needed.



Recommendations

FIRS calls for these essential actions to reduce the burden of respiratory disease and improve global health:

- 1.** Increase public and policy makers' awareness that respiratory health is essential to global health and that childhood respiratory disease may have long-term negative consequences on adult health by advocating at world health meetings and through publications and media postings
- 2.** Reduce, and then eliminate, the use of all tobacco products through universal support of the Framework Convention on Tobacco Control
- 3.** Adopt WHO standards, at a minimum, to reduce ambient, indoor, and occupational air pollution for all countries
- 4.** Promote universal access to quality healthcare, including the availability of affordable, quality-assured, essential medicines and universal coverage for childhood and adult immunisations, including new conjugate vaccines by advocacy through WHO and government programmes
- 5.** Improve early diagnosis of respiratory diseases through improving awareness and access to current procedures and the development of new tools through world health meetings and publications
- 6.** Increase education and training of health professionals in respiratory disease worldwide through programmes of the FIRS societies, WHO and other governmental and non-governmental organisations
- 7.** Standardise the monitoring of the prevalence, severity and management of respiratory diseases to enable development of well-informed national strategies through programmes of WHO and governmental and non-governmental organisations
- 8.** Increase respiratory research to develop programmes, tools and strategies to better prevent and treat respiratory diseases through advocacy for governmental and non-governmental research organisations

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About FIRS

Formed in 2001, the Forum of International Respiratory Societies (FIRS) is composed of the leading international respiratory societies. Each society is made up of medical specialists in respiratory diseases. Their memberships together have more than 70,000 professionals, who devote their working lives to some aspect of respiratory health or disease.

The journals of these societies publish the vast majority of respiratory scientific breakthroughs in the world. Their annual meetings provide a forum for nearly all important research in the field. Their educational venues teach or train the majority of respiratory specialists in the world.

These societies hold meetings at which individuals with the greatest knowledge and expertise discuss their latest research findings. The findings include information

about the nature, prevalence, burden, causes, prevention, control and cure of diseases. The societies' expert members develop statements, guidelines and recommendations on respiratory topics. These guidelines influence how healthcare providers everywhere diagnose, treat and care for their patients with respiratory problems. The members of these societies are distributed across the globe and interact and impact on the lives of many, or most, people with serious respiratory disease.

The goal of FIRS is to promote respiratory health worldwide. FIRS speaks with one voice to communicate the importance of respiratory health for global health and prosperity. FIRS, its societies, their members and the patients they serve, with millions of voices harmonised, call for action to reduce, prevent, cure and control the terrible burden of respiratory disease.

FIRS member societies

Asian Pacific Society of Respirology (APSR)

The APSR was established in 1986. It is composed of national societies from the Asia-Pacific region. Its objectives are the advancement and promotion of knowledge of the respiratory system in health and disease. It promotes and coordinates activities in the field of respiratory medicine, fosters research activities in respiratory medicine, organises and coordinates regular congresses and meetings. Its publications include the flagship journal, *Respirology*, as well as *Respirology Case Reports*, APSR Respiratory Updates and the APSR Newsletter. APSR has many educational programmes administered through the ESAP (Educational Seminar of the APSR) programme. Its scholarships, research awards and travel awards promote the careers of young scientists by encouraging involvement with other researchers in an international forum.

Website: www.apsresp.org

Headquarters: 2F UK's Bldg., 2-29-3, Hongo, Bunkyo-ku, Tokyo 113-0033, Japan

Contact: apsrinfo@theapsr.org (APSR secretariat office)

Number of Members: 14,520

Publications: *Respirology*, *Respirology Case Reports*, APSR Respiratory Updates, APSR Bulletin, APSR Newsletter

Asociación Latinoamericana de Tórax (ALAT)

ALAT (or the Latin-American Thoracic Association) was founded in 1996. It comprises specialists in respiratory medicine from Latin America, and works closely with the national medical associations of the region. ALAT's mission is to alleviate the suffering of respiratory disease and promote lung health through research, knowledge exchange and continuing medical education. One of ALAT's priorities is tuberculosis control, which remains a prevalent disease in large areas of Latin America. ALAT promotes development in the treatment of chest diseases in Latin America through many activities, including the publication of its journal (*Archivos de Bronconeumología*) in collaboration with Sociedad Española De Neumología y Cirugía Torácica (SEPAR). It holds a biennial congress of specialists in respiratory medicine in Spanish and Portuguese and supports many other national and regional events. It offers training scholarships for young specialists and continuing medical education courses for specialists and primary care physicians. It has developed many manuals and guidelines for respiratory health professionals in Latin America.

Website: www.alatorax.org and www.congresosalat.org

Headquarters: Libertad 2848, 11300 Montevideo, Uruguay

Contact: secretaria.alat@gmail.com (ALAT Secretary)

Number of members: 2,823

Publication: *Archivos de Bronconeumología*

American Thoracic Society (ATS)

Created in 1905, ATS is the oldest respiratory society in the world. Its founding philosophy “that disease and suffering can be eliminated faster when discoveries and knowledge are shared” has been expanded to encompass all aspects of pulmonary, critical care and sleep medicine. With its widening mission, the Society’s membership has become increasingly diverse, and nearly one-third of the Society’s members are non-US based. The mission is to improve health worldwide by advancing research, clinical care and public health in respiratory disease, critical illness and sleep disorders.

ATS publishes three premier journals that meet the needs of basic, translational and clinical scientists, produces clinical care guidelines, advocates for clean air and tobacco control, works to defeat tuberculosis in developing countries, and trains physicians in Latin America, Africa and Asia to become researchers through its Methods in Epidemiologic, Operations and Clinical Research (MECOR) programme. Each year, the Society also convenes the world’s leading experts in pulmonary, critical care and sleep medicine to present and discuss the latest research in these fields. These meetings have more than 6,000 original abstracts and more than 15,000 participants from most countries in the world.

Website: www.thoracic.org

Headquarters: 25 Broadway, 18th Floor, New York City, New York 10004, USA

Contact: atsinfo@thoracic.org

Number of Members: 15,000

Publications: *American Journal of Respiratory and Critical Care Medicine*, *American Journal of Respiratory Cell and Molecular Biology*, *Annals of the American Thoracic Society*

CHEST (American College of Chest Physicians)

Founded in 1935, CHEST champions the prevention, diagnosis and treatment of chest diseases through education, communication and research. By embracing a multidisciplinary membership from over 100 countries and

innovative educational techniques, CHEST is a global leader in providing clinical education in pulmonary, critical care and sleep medicine. CHEST’s premier publication, the journal *CHEST*, features outstanding clinical research and reviews through print, online and mobile editions. CHEST also publishes *CHEST Physician* (a monthly newspaper), *CHEST NewsBrief* (a weekly e-newsletter) and *CHEST Today* (a daily publication), which offer varied resources for continuing education and practice management. Clinicians also know CHEST for its clinical guidelines in antithrombotics, cough, lung cancer and more. In addition to its annual meetings, CHEST provides preparation for certification or accreditation and live and e-learning education in pulmonary, critical care, sleep and paediatric pulmonary medicine, all designed to enable clinicians to provide the best care for their patients. The CHEST Foundation, the charitable foundation of the American College of Chest Physicians founded in 1996, champions lung health by providing support for clinical research, community service and patient education. By forming strategic relationships with public and private sector organisations around the world, the CHEST Foundation makes an impact on world health, one community at a time.

Website: <http://www.chestnet.org>

Headquarters: 2595 Patriot Boulevard, Glenview, Illinois 60026, USA

Contact: helpteam@chestnet.org

Number of members: 19,000

Publication: *CHEST*, *CHEST Physician*, *SEEK*

European Respiratory Society (ERS)

ERS is an international organisation that brings together physicians, healthcare professionals, scientists and other experts working in respiratory medicine. ERS is one of the leading medical organisations in the respiratory field, with a growing membership representing over 140 countries worldwide.

The ERS mission is to promote lung health in order to alleviate suffering from disease and drive standards for respiratory medicine globally. Science, education and advocacy are at the core of everything ERS does. ERS

is involved in promoting scientific research and driving standards through the training of respiratory professionals. It also plays a key role in education and in advocacy – raising awareness of lung disease amongst the public and politicians.

Website: www.ersnet.org

Headquarters: European Respiratory Society, 4 Avenue St-Luce, 1003 Lausanne, Switzerland

Contact: info@ersnet.org

Number of Members: 36,000

Publications: *European Respiratory Journal*, *ERJ Open Research*, *European Respiratory Review*, *ERS Monograph*, *Breathe*, *ERS Handbooks*, *European Lung White Book*

Pan African Thoracic Society (PATS)

The Pan African Thoracic Society (PATS) was formed in 2003 to create a representative African respiratory society for the region and to address the high burden of respiratory illness in Africa, and members originate from 33 different African countries. The overall aim of PATS is to promote lung health in Africa through education, training, research and advocacy. PATS has developed several sentinel activities to achieve its aims. The Pan African Thoracic Society programme in Methods in Epidemiologic, Clinical and Operations Research (PATS-MECOR) began in 2007 with the aim of developing research capacity in Africa. Highly successful courses have been held annually for trainees from several African countries. The *African Journal of Respiratory Medicine (AJRM)* is closely linked with PATS, including a PATS-elected editorial board.

Website: www.africanthoracic.org

Headquarters: Virtual society

Contact: www.africanthoracic.org

Number of members: 720

Publication: *African Journal of Respiratory Medicine*

The Union (International Union Against Tuberculosis and Lung Disease)

Since its founding as a global scientific organisation in 1920, The Union has drawn from the best evidence and the skills, expertise and reach of its members, staff and consultants to advance solutions for the most pressing public health challenges affecting people living in poverty. The Union works with stakeholders across the globe from every sector, including governments, international agencies, civil society and the private sector. Its annual World Conference on Lung Health attracts upwards of 4,000 delegates and the organisation is currently developing solutions for tuberculosis, HIV and other lung diseases, and policies to reduce tobacco use and prevent non-communicable diseases. With more than 20,000 members and publication subscribers from 146 countries, The Union has its headquarters in Paris and 10 offices worldwide in Africa, the Asia Pacific region, Europe, Latin America, North America, and South East Asia.

Website: www.theunion.org

Headquarters: 68, boulevard Saint-Michel, 75006, Paris, France

Contact: www.theunion.org/contact

Number of Members: 20,000

Publications: *The International Journal of Tuberculosis and Lung Disease*, *Public Health Action*, and many technical manuals and other educational and scientific works