BRIEF REPORT

State of Lung Cancer in Egypt: Moving Towards Improved Guidelines for Prevention, Screening, Treatment, and Clinical Care Programs

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ABSTRACT

Lung cancer remains a leading cause of cancer-related mortality globally and presents significant challenges in Egypt. In 2023, the first annual meeting of the Thoracic Oncology Multidisciplinary Faculty, organized by the Egyptian Cancer Research Network and the Egyptian Society of Respiratory Neoplasms, was held in Cairo, Egypt. The meeting aimed to address gaps in lung cancer management across Egypt and the broader Middle East and North Africa region. The discussions focused on the challenges posed by NSCLC and SCLC and emphasized the need for enhanced prevention, early detection, and treatment strategies. Key areas of concern include limited access to advanced diagnostics, such as comprehensive genomic profiling, and the underutilization of targeted therapies and immunotherapies, mainly owing to financial barriers. The meeting highlighted the importance of strengthening lung cancer screening programs, improving smoking cessation efforts, and addressing environmental risk factors like air pollution. Furthermore, the event underscored the need for greater research and collaboration, particularly in areas like precision oncology. The conference concluded with strategic recommendations to improve lung cancer prevention, screening, and treatment, aligning Egypt's lung cancer care with global advancements and ensuring equitable access to cutting-edge therapies.

Keywords: Lung cancer; MENA region; Global health; Smoking cessation; Air pollution

Introduction

Lung cancer stands as the leading cause of cancer-related mortality worldwide, and Egypt mirrors this global challenge. In Egypt, lung cancer is one of the most lethal malignancies, accounting for approximately 5% to 7% of all malignancies diagnosed in the country.[1] Between 2008 and 2020, there was a significant increase in new lung cancer cases, rising from 16,596 to 29,576 annually.[2] This sharp rise underscores the growing burden of lung cancer on Egypt's healthcare system and highlights the need for urgent interventions.

Egypt is the 30th largest country globally, with a population exceeding 100 million. Cairo, the nation's capital, is not only the largest urban area in the Middle East and North Africa (MENA) region but also the seventh most populous city worldwide. The high population density, especially in urban centers, contributes to the increasing incidence of lung cancer owing to factors such as environmental pollution and lifestyle behaviors.

Gender Disparities in Incidence

A significant gender disparity exists in the incidence of lung cancer in Egypt. It is the fourth most common cancer among men but remains relatively rare among women.[3] This disparity is primarily attributed to differences in tobacco smoking rates between genders.[1,2] Cultural and social norms have led to a higher prevalence of smoking among Egyptian men compared with women. As a result, men are disproportionately affected by lung cancer, reflecting the strong association between tobacco use and lung carcinogenesis.

Risk Factors: Smoking and Air Pollution

The primary risk factor for lung cancer in Egypt is tobacco smoking.[4] Traditional smoking practices, including cigarettes and waterpipes (shisha), are prevalent in the male population.[4] The high rate of tobacco consumption exposes individuals to carcinogenic compounds, significantly increasing their risk of developing lung cancer.

In addition to smoking, air pollution is a critical environmental risk factor contributing to lung cancer incidence in Egypt. Urban areas, particularly Cairo, experience high levels of air pollution due to industrial emissions, vehicle exhaust, and dust storms from the surrounding desert. Fine particulate matter (PM2.5) is of particular concern, as these particles can penetrate the respiratory tract, causing inflammation and cellular damage. Recent studies have linked exposure to PM2.5 with an increased risk of NSCLC, even among nonsmokers. The combined effects of tobacco smoke and polluted air exacerbate the risk, leading to higher incidence rates.

Projected Increase in Lung Cancer Cases

The burden of lung cancer in Egypt is projected to escalate significantly in the coming decades.[5] According to the 2014 Egyptian population-based cancer registry,[2] the cancer population is expected to increase by approximately 160% between 2013 and 2050. The anticipated rise in lung cancer cases is driven by Egypt's growing population, an aging demographic with increased cancer susceptibility, persisting risk factors like smoking and air pollution, and improved diagnostic capabilities, leading to higher detection rates. If effective prevention, early detection, and treatment strategies are not implemented, the healthcare system may face overwhelming challenges. The rising cost of cancer care adds financial strain, as many patients rely on government support for treatment. Addressing modifiable risk factors, such as smoking cessation and environmental pollution control, alongside enhancing screening and treatment accessibility, is crucial to mitigating the projected increase in lung cancer cases in Egypt.

Addressing Critical Lung Cancer Challenges

Given the escalating burden of lung cancer in Egypt and the unique challenges faced in its prevention, diagnosis, and treatment, it is imperative to address these issues comprehensively. Addressing the challenges of lung cancer is crucial not only for enhancing patient outcomes but also for alleviating the anticipated strain on Egypt's healthcare system due to the projected increase in cancer cases. This review first presents an overview of the conference—including the necessity for such a gathering, the participants involved, and the topics discussed. Subsequently, it analyzes the current state of lung cancer care in Egypt, identifies existing deficiencies, and proposes strategies for improvement on the basis of the conference's recommendations.

Summary of the First Annual Conference of the Egyptian Cancer Research Network and the Egyptian Society of Respiratory Neoplasms

The escalating burden of lung cancer in Egypt and the broader MENA region necessitated the convening of the first annual meeting of the Thoracic Oncology Multidisciplinary Faculty. Despite global advancements in lung cancer prevention, screening, and treatment, there are notable disparities in the implementation of these guidelines within Egypt. The country faces challenges accessing advanced diagnostic tools, such as comprehensive genomic profiling (CGP), and providing cutting-edge therapies like targeted treatments and immunotherapies. These disparities result in variations in patient outcomes and limit the ability to offer personalized medicine approaches that have become standard in other parts of the world.

The conference aimed to assess the current state of lung cancer management in Egypt and the MENA region, identifying gaps in prevention, screening, diagnosis, and treatment while facilitating discussions on the challenges of aligning with evolving advances in NSCLC and SCLC care. In addition, it sought to develop strategic plans for cancer research priorities, enhance health services, and promote collaboration between national and international stakeholders to improve lung cancer outcomes and standardize care protocols across the region. The conference sought to pave the way toward improved guidelines for lung cancer prevention, screening, treatment, and clinical care programs in Egypt by addressing these objectives.

Conference Participants

The conference, held in Cairo, Egypt, in 2023, was jointly organized by two prominent Egyptian organizations: the Egyptian Cancer Research Network and the Egyptian Society of Respiratory Neoplasms. These bodies brought together cancer centers and multidisciplinary lung cancer experts from across Egypt to address the pressing challenges in lung cancer care collaboratively. Participants included a diverse assembly of national and international thoracic oncology experts, key opinion leaders, and governmental officials.

As detailed in Table 1, attendees represented major Egyptian academic and medical institutions such as the National Cancer Institute of Cairo University (NCI-Cairo), Kasr Al Aini Faculty of Medicine, and Ain Shams University, with expertise spanning various specialties, including medical oncology, pulmonary medicine, thoracic surgery, radiology, pathology, and radiation oncology. International experts from esteemed institutions like the Inova Schar Cancer Institute (United States), Icahn School of Medicine at Mount Sinai (United States), Miami Cancer Institute (United States), and representatives from the International Association for the Study of Lung Cancer provided global perspectives and insights into cutting-edge practices in lung cancer management.

The attendees's roles and expertise were instrumental in fostering a comprehensive dialogue; clinicians shared experiences from the front lines of patient care, researchers discussed recent advancements and ongoing studies, and policymakers contributed insights into regulatory considerations and the implementation of national health strategies. By uniting this multidisciplinary team, the conference aimed to harness collective knowledge and foster collaborations that would lead to effective strategies for improving lung cancer care in Egypt and the MENA region.

Clinical and Research Sessions

Attendees covered a broad exploration of emerging lung cancer topics, addressing environmental and biological factors that influence disease development and treatment. In addition to discussions on the impact of air pollution and national screening programs, the evolving role of the microbiome in lung cancer was examined,[6] highlighting its potential influence on treatment outcomes and disease progression.

Session: Climate Change Panel Discussion. Air pollution has been linked to the development of NSCLC and may contribute to the rising number of cases not associated with tobacco use. Notably, PM2.5 has been identified as a potential cancer promoter, particularly in airway cells with pre-existing *EGFR* mutations. Modeling studies suggest this effect may be driven by macrophages releasing the inflammatory mediator interleukin-1β.[7]

Table 1. State of Lung Cancer in Egypt—A Strive for Improved Guidelines for Prevention, Screening, Treatment, and Clinical Care Programs

Title of the Session	Title of Lecture	Name of Speaker
Opening Session	The advancing role of liquid biopsy in lung cancer Front line therapy in advanced NSCLC without targetable mutations The future of predictive biomarkers in NSCLC	Dr. David Gandara Dr. Karen Kelly Dr. Philip Mack
Plenary Session I: Metastatic NSCLC	Targeting MET, RET, BRAF, and NTRK in lung cancer *EGFR, ALK, ROS* *KRAS* NSCLC Management algorithm of effusion-related disease	Dr. Janakiraman Subramanian Dr. Mohsen Mokhtar Dr. Yasser Abdelkader Dr. Amr Eldemery
CARIS Symposium	Re-imagining cancer management through the power of precision oncology	
Plenary Session II: Locally advanced stage NSCLC	Updates on the management of unresectable stage III NSCLC Locally advanced NSCLC, whom will benefit from surgery following Neoadjuvant therapy? Approach to bronchogenic carcinoma diagnosis and staging. The radiological point of view Interventional Pulmonary: Role of Robotic bronchoscopy in diagnosis	Dr. Jhanelle Gray Dr. Ahmed Mostafa Dr. Ahmed M. Osman Dr. Shaheen Islam
Plenary Session III: Early-Stage NSCLC	Neoadjuvant therapy in NSCLC Adjuvant therapy in NSCLC Updates in surgical management in early-stage NSCLC Impact of hospital and surgeon volume in patient's outcome following lung cancer surgery Role of embolizing agents in controlling post-lung biopsy complications Role of SBRT in early lung cancer Approach to lung nodules	Dr. Ahmed Bastawisy Dr. Ahmed Magdy Rabea Dr. Kei Suzuki Dr. Maged Zekry Dr. Nada Mohsen Salama Dr. Megan Daly Dr. Shaheen Islam
Special Session I: Strategic Development	- Strategic moves for Egypt & MENA region in thoracic oncology: opportunities for better standardization of practices and wider access to testing and therapeutics - Special Panel from Saudi Arabia and Egypt	Moderators: Dr. Ahmed Morsy Dr. Waleed Arafat Panelists: Egyptian Side: Dr. Dina Shoukry International Side: Dr. Asrar Al Ahmadi, KSA Dr. David Gandara Dr. Hamed Al Husaini, KSA Dr. Karen Kelly Dr. Manmeet Ahluwalia Dr. Nagla Abdel Karim Dr. Philip Mack Dr. Janakiraman Subramanian Dr. Triparna Sen
Plenary Session IV: Treatment Strategies in NSCLC	Management of brain metastases in the era of improved systemic therapies Pfizer Symposium I Meet ALK+NSCLC heads on with Lorbrena Pfizer Symposium II Start strong with Vizimpro for 1L EGFR+NSCLC	Dr. Manmeet Ahluwalia Dr. Nawal El Tohamy Dr. Emad Barsoum
Radiotherapy Workshop	SBRT in lung cancer	Workshop Supervisor: Dr. Ehab Khalil Workshop Instructors: Dr. Mohamed Amin Dr. Mohamed Farouk Dr. Nadim Melhem
Radiology Workshop	Role of artificial intelligence in lung cancer screening (By Millensys)	
Molecular Profiling Workshop: Sponsorship Opportunity CARIS	How to interpret the molecular profiling report	Panel Discussion Moderator: Dr. Philip Mack Panelists: Dr. Andreas Tsukada Dr. Chadi Nabhan Dr. David Gandara Dr. Lobna Shash Dr. Mervat Eldeftar Dr. Rasha Fahmy

(continued)

Table 1. Continued

Title of the Session	Title of Lecture	Name of Speaker
Plenary Session V: SCLC	Translational medicine updates in SCLC Treatment Updates in SCLC Insights into lung cancer microbiome	Dr. Triparna Sen Dr. Nagla Abdel Karim Dr. Neemat Kassem
Special Session II	Climate Change Panel Discussion	Moderators: Dr. Mai Sherif Dr. Radwa Marwan Dr. Triparna Sen Panelists: Dr. Lobna Shash Dr. Marwa Fayez Dr. Nagla Abdel Karim Dr. Philip Mack Dr. Rasha Fahmy Dr. Shereen El Gayar Dr. Taghrid Gaafar
Special Session III: A Medical Expedition Through Ancient Egypt	Unwrapping the past: Novel Imaging of the Mummies	Dr. Sahar Saleem
Pleanary Session VI: Mesothelioma	Updates in surgical techniques in malignant Mesothelioma Updates in medical management of malignant Mesothelioma	Dr. Abdelrahman Mohamed Dr. Amr Shafik
Presidential Session	The status of respiratory neoplasms in Egypt	Introduction: Dr. Noha Awad Dr. Mohamed Awad Tag El Din
National Research Initiatives	Clinical trials execution in Egypt management under the new laws in Egypt	Dr. Amr Youssef Ali Dr. Ashraf Hatem Dr. Dina Shokry General Dr. Khaled Amer Dr. Nadia Zakhary Dr. Rania Ibrahim Hassan Dr. Sherif Wadiea
Plenary Session VII: Lung Cancer Screening Program	Role of AI in diagnosis of lung cancer current implementation and future perspectives.	Dr. Galal Ghaly
	Value of diffusion weighted MRI and lesion to spinal cord signal intensity ratio in pulmonary lesions characterization Lung imaging reporting and data system (lung RADS) in radiology, strengths, weaknesses and improvement Final remarks	Dr. Marianne Fayek Dr. Hisham Wahba Dr. Mohamed Fawzi
Special Session IV: Thoracic Pediatric Tumors in Egypt	Pediatric solid tumors metastatic to the lung Pleuro-pulmonary blastoma Pulmonary LCH Primary Mediastinal B-cell lymphoma	Dr. Emad Ebeid Dr. Enas Mohsen Dr. Mohamed Sidky Dr. Riham Abdelaziz
Special Session V: Young Investigators Session	Is there a benefit for serial biopsies or liquid biopsies	Dr. Mostafa El Zaidy
Interventional Pulmonary Workshop	Part 1: EBUS workshop, how to develop experience to make it easy, accurate and safe including videos Part 2: Evolving role of robotic bronchoscopy, steps towards perfection including teaching videos	Chairman: Dr. Sabah Ahmed Moderator: Dr. Abdelrahman Mohamed Session Director: Dr. Shaheen Islam

AI, artificial intelligence; EBUS, endobronchial ultrasound; LCH, Langerhans cell histiocytosis; MRI, magnetic resonance imaging; RADS, Reporting and Data System.

In Egypt, high levels of particulate matter are estimated to contribute to around 10% of premature deaths.[8] Air quality is compromised by transportation, industry, and desert dust. According to IQAir, Egypt ranks as the ninth worst country globally in terms of air quality. Nevertheless, no systematic studies investigate the link between hazardous air pollutants and lung cancer or its molecular subtypes. The panel discussed the potential benefits of early detection programs in areas with high pollution, such as Cairo and other large cities.

Session: Egyptian National Lung Cancer Screen Program. The session focused on managing lung nodules, the role of artificial intelligence in diagnosis,[9,10] and updates to the national lung cancer screening program.[11] A multidisciplinary panel, including experts in pulmonology, radiology, and thoracic surgery, provided recommendations on biopsy procedures and patient management, emphasizing the implementation of the updated American College of Radiology Lung Imaging Reporting and Data System released in December 2022.[12,13]

As part of Egypt's Presidential initiative for early cancer detection, low-dose computed tomography (LDCT) has been adopted as the screening tool for high-risk individuals. A structured questionnaire guides individuals to the appropriate screening pathway. Led by a multidisciplinary team, the program extends to remote areas, particularly in Upper Egypt, screening individuals aged 45 and older with a smoking history of at least 20 pack-years, in line with international standards.

The challenges of lung biopsies for suspicious lesions were also addressed, including how these procedures differ from other image-guided biopsies, methods to minimize complications, and techniques to reduce the risk of pneumothorax.

In addition, the panel highlighted smoking cessation initiatives supported by the presidential program through counseling and adjunctive therapies. Although laws exist in Egypt to restrict smoking in public spaces and workplaces, enforcement remains lax.[3] Expanding education on the harms of smoking was identified as crucial for reducing lung cancer rates in the future.

Session: Presidential Directions. Government officials participated in the discussion, emphasizing Egypt's successful public health campaigns, including eradicating schistosomiasis and hepatitis C. The country is now focused on the prevention, control, and management of lung cancer. In 2023, the Presidential screening campaign was expanded to include lung cancer, and within the first ten days, 2100 individuals were screened, with many undergoing LDCT scans. This progress was made possible through several initiatives:

1. Egypt has a well-established network of dedicated pulmonary and chest hospitals and clinics, providing the infrastructure necessary for effective screening.
2. The country has implemented measures to prevent lung cancer, including a ban on asbestos imports by the Ministerial Council in 2004, which is expected to reduce the incidence of mesothelioma, peaking around 2040. With high rates of cigarette and shisha smoking, smoking cessation has been recognized as a critical priority for cancer prevention.
3. The expansion of imaging studies during the coronavirus disease 2019 pandemic contributed to the early detection of lung cancer, highlighting the potential efficacy of a dedicated lung cancer screening program.
4. Artificial intelligence is now employed in all CT scans conducted in the Egyptian Ministry of Health and university hospitals, aiding in the detection of small lung nodules.
5. While Egypt currently follows the American Cancer Society guidelines for lung cancer screening, there were discussions about adapting these guidelines to better suit the unique characteristics of the Egyptian population.
6. Updated campaigns for smoking cessation were also discussed, including counseling and strategies for managing nicotine withdrawal.

These efforts collectively underscore Egypt's commitment to reducing the incidence of lung cancer and improving its management across the country.

Key Outcomes

The conference culminated in the identification of several critical areas requiring immediate attention to enhance lung cancer management in Egypt and the MENA region:

1. Enhancement of Diagnostic Capabilities: There is an urgent need to improve access to advanced diagnostic tools, particularly CGP and next-generation sequencing (NGS). Establishing centralized laboratories equipped with modern technology was deemed essential to facilitate timely and accurate diagnoses. Limited access to molecular testing hinders the ability to personalize treatment and utilize targeted therapies effectively.
2. Improvement of Treatment Accessibility: Disparities in access to advanced therapies, such as targeted treatments and immunotherapies, were recognized as significant barriers. Economic constraints and the high cost of these treatments limit their availability in the public sector. Strategies to reduce financial barriers and integrate these therapies into standard care protocols are necessary to ensure equitable treatment options for all patients.
3. Strengthening of Prevention Efforts: The importance of bolstering smoking cessation programs and enforcing anti-smoking laws was emphasized. Cultural practices and the prevalence of alternative smoking methods, like shisha, present challenges that require tailored interventions. Addressing environmental risk factors, particularly air pollution, is critical to reducing lung cancer incidence.
4. Implementation of National Screening Programs: Expanding LDCT screening programs was highlighted as a priority for early detection. Adapting screening criteria to the Egyptian context and increasing public awareness are essential steps. Challenges include the need for specialized equipment, trained personnel, and standardized reporting systems.
5. Promotion of Research and Collaboration: Encouraging research on emerging areas, such as the role of microbiomes in lung cancer, and fostering international collaborations were identified as means to advance understanding and treatment. Building

clinical trials infrastructure and enhancing participation in global research efforts are vital for progress.

Analysis of Lung Cancer Care in the Egyptian Healthcare System

The analysis of lung cancer care in the Egyptian healthcare system highlights the complexities of delivering equitable and effective treatment across different healthcare sectors. Each sector—public, insurance-based, and private—plays a unique role in the overall system, but disparities in access, resources, and treatment options persist. Systemic barriers such as funding, infrastructure, and access to advanced diagnostics need to be accounted for, alongside their impact on patient outcomes.

Navigating Cancer Care

Healthcare in Egypt is delivered through three distinct types of healthcare services: public governmental hospitals, public insurance hospitals, and private hospitals and clinics.[3] Each offers varying levels of access to lung cancer treatments on the basis of an individual's eligibility for the respective system. Generally, public hospitals serve most of the population, insurance hospitals offer enhanced options, and private facilities provide the most advanced and specialized treatments for those who can afford them.

Public Governmental Hospitals. Public governmental hospitals, which include university hospitals and facilities operated by the Ministry of Health, provide essential healthcare services (Table 2) and are accessible to most of the population, particularly those without health insurance. These hospitals serve individuals from lower-income backgrounds or rural regions.

In the context of lung cancer care, public governmental hospitals in Egypt provide fundamental diagnostic and therapeutic interventions, including the administration of standard chemotherapy regimens (such as cisplatin, carboplatin, paclitaxel, gemcitabine, and docetaxel), radiation therapy for curative and palliative care (limited by equipment and resources), thoracic surgical procedures (such as lobectomies and pneumonectomies), palliative care to improve the quality of life for patients with advanced disease, and access to basic imaging modalities like chest radiographs and computed tomography (CT) scans.

Despite their pivotal role, public governmental hospitals face significant limitations and challenges that impede optimal lung cancer care. Chronic underfunding leads to shortages of essential medications, equipment, and supplies, with radiotherapy machines and surgical facilities often outdated or insufficient to meet patient demand. Advanced diagnostic tools are generally unavailable, such as positron emission tomography–CT scans and molecular testing for genetic mutations like EGFR and ALK. In addition, specialized healthcare professionals, including medical oncologists, radiation oncologists, and pathologists trained in the latest diagnostic and therapeutic techniques, are scarce. High patient volumes result in overcrowded facilities and prolonged wait times for diagnostic procedures and treatments, further straining the system. Geographic disparities exacerbate these challenges, as rural and underserved areas have limited access to public healthcare facilities, deepening health inequities across the country.

Public Insurance Hospitals. Operated under the Health Insurance Organization, these hospitals serve individuals enrolled in the national health insurance program. Typically, this coverage is available to employed individuals or those who qualify through specific state-run insurance schemes. These hospitals offer services similar to public governmental hospitals but with some

Table 2. List of University Hospitals and Cancer Centers in Egypt on the frontline for Lung Cancer Prevention and Management Procedures

Academic Cancer Center	NGO	Ministry of Health Center
National Cancer Institute, Cairo University	Baheya Breast Cancer Center, Cairo	Nasser Institute
Clinical Oncology Department, Kasr El Ainy	Mersal NGO, Cairo	6 October Center
Azhar University	Shefa El Orman Hospital, Luxor	Dar El Salam Center
Ain Shams University	Aswan Cancer Center	Madinat Nassr Center
Mansoura University		Salam Cancer Center
Zagazig University		
Tanta University		
Alexandria University		
Bani-Soeif University		
Assiut University		
Monofeya University		

NGO, non-governmental organization.

enhancements owing to additional funding mechanisms. Key services include advanced diagnostic imaging with access to positron emission tomography–CT scans for improved staging accuracy and metastasis detection, limited molecular testing for specific genetic mutations such as EGFR using techniques like immunohistochemistry and polymerase chain reaction often subsidized by pharmaceutical companies, provision of first-generation EGFR tyrosine kinase inhibitors like gefitinib and erlotinib for patients with confirmed *EGFR* mutations, and an expanded selection of chemotherapeutic agents compared with public governmental hospitals.

While public insurance hospitals offer enhanced services, they still face significant challenges, such as limited access to newer therapies like advanced targeted treatments and immunotherapies, which are generally unavailable because of high costs not covered by insurance. In addition, they struggle with infrastructure limitations, including resource constraints and equipment shortages, and not all citizens are covered under the national insurance scheme, leading to gaps in access to improved services.

Private Hospitals and Clinics. Private hospitals and clinics cater to patients who can afford out-of-pocket expenses or possess private health insurance. These facilities often provide services that align more closely with international standards of care. Patients using these services typically belong to higher socio-economic groups or have private insurance plans that cover these advanced treatment modalities.

Private hospitals and clinics offer more advanced services than public and insurance hospitals. These include comprehensive diagnostic services like full-panel NGS for detailed molecular profiling and access to third-generation therapies such as osimertinib, *ALK* inhibitors, anti-*VEGF* agents, and immune checkpoint inhibitors (ICIs) like pembrolizumab. They also provide state-of-the-art surgical techniques, including minimally invasive procedures such as video-assisted thoracoscopic surgery, robotic-assisted surgeries, enhanced palliative care, psychosocial support, and multidisciplinary tumor boards for personalized treatment planning.

Current Treatment Landscape

The treatment landscape for lung cancer in Egypt varies significantly on the basis of the stage, type of cancer, and the healthcare sector providing care. The following sections provide an overview of the current therapeutic approaches for different stages of NSCLC and SCLC, highlighting the availability of targeted therapies, chemotherapy, and advanced interventions across the public and private sectors.

Metastatic NSCLC. For patients with advanced or metastatic NSCLC,[14–16] systemic therapy options in Egypt include targeted therapies, immunotherapies, and traditional chemotherapy. While molecular profiling for EGFR and ALK mutations is critical in tailoring treatment, these tests are not widely available outside tertiary centers. Expanding access to CGP would enhance the early identification of patients who could benefit from targeted therapies.

Though the focus here is systemic therapy, surgical resection remains a crucial option for early-stage disease and should be considered before systemic treatments for resectable cases.

For patients with locally advanced disease, radiotherapy is often used in combination with systemic therapies, especially for those not eligible for surgery.

Targeted Therapies. Egyptian patients with EGFR-mutated NSCLC have access to first-generation EGFR-targeted agents such as gefitinib and erlotinib through governmental support. These medications are typically provided at academic centers for patients with *EGFR* exon 19 and 21 mutations. In the governmental insurance sector, first-generation *ALK* inhibitors are also available for patients with ALK-positive tumors.

In the private sector, osimertinib (a third-generation *EGFR* inhibitor), and other targeted therapies and ICIs, are accessible to patients who can afford these treatments or have comprehensive insurance coverage. Compassionate use programs, though available, are limited, offering a few treatment cycles to a small subset of patients.

Chemotherapy. Traditional chemotherapy remains a typically used treatment for NSCLC in Egypt. Cisplatin, carboplatin, paclitaxel, gemcitabine, and docetaxel are the most frequently used chemotherapeutic agents. These are administered in the public and private sectors, with varying degrees of accessibility depending on the patient's financial situation.

Early-Stage Resectable NSCLC. In Egypt, early-stage NSCLC is managed through a combination of surgery, radiation, and systemic therapies.[17] Well-trained teams proficient in bronchoscopy and endobronchial ultrasound perform accurate diagnoses and staging. This allows for early detection of NSCLC, particularly in tertiary centers with advanced diagnostic equipment. Recently, workshops on bronchoscopy techniques have been held, with significant participation from young trainees, including a high prevalence of women entering this field.

Surgical resection remains the mainstay of treatment for early-stage resectable NSCLC.[18–20] Highly trained

thoracic surgeons are available at NCI-Cairo and Ain Shams University. In other centers, cardiothoracic surgeons often manage patients with lung cancer. Video-assisted thoracoscopic surgery is available primarily in tertiary centers, providing less invasive options for patients. Nevertheless, robotic surgery is not yet available.

For patients who are not suitable for surgery or those requiring adjunctive therapy, radiation options such as stereotactic body radiation therapy are accessible, though more equipment is needed to meet patient demand. Radiation therapy plays a critical role in controlling localized tumors after surgery or as an alternative to surgery.

Neoadjuvant (presurgical) and adjuvant (postsurgical) systemic chemotherapy are available for patients with early-stage NSCLC.[21,22] Although chemotherapy is accessible, ICIs, which have shown promise in improving outcomes, are typically only available in the private sector, limiting broader access.[23,24]

Locally Advanced NSCLC. Early diagnosis is vital for preventing and detecting locally advanced NSCLC. In Egypt, efforts to enhance diagnostic capabilities, such as the use of multidisciplinary tumor boards (MDTs) and MDT-specific clinics at NCI-Cairo and other tertiary centers, have improved detection and planning for complex cases. Early detection is vital for determining the best treatment approach, including surgery, radiotherapy, and systemic therapies.

Surgery is often not feasible in locally advanced NSCLC due to the extent of the disease, which typically involves surrounding structures. Nevertheless, if a patient's condition allows for surgical intervention, it is considered, but this is rare in locally advanced cases.

For patients with locally advanced NSCLC, radiotherapy is often a key component of the treatment plan. In Egypt, concomitant chemoradiation remains the standard of care and is widely practiced, adhering to international guidelines. Radiotherapy helps control the tumor in conjunction with systemic therapies.

The combination of chemotherapy and radiation, also known as concomitant chemoradiation, is the primary standard of care in Egypt for locally advanced NSCLC. This approach is widely practiced, but consolidation therapy with durvalumab (an ICI that can extend survival after chemoradiation) is underutilized, despite its proven effectiveness.

Multidisciplinary tumor boards play a crucial role in managing complex cases of locally advanced NSCLC, ensuring that each patient's treatment plan is thoroughly reviewed by experts of various specialties. Notably, MDT-specific clinics are available at NCI-Cairo and other tertiary centers, ensuring that the treatment strategy follows international standards. Egypt's treatment guidelines for NSCLC largely adhere to the recommendations of the National Comprehensive Cancer Network, ensuring consistency with global best practices.

Extensive-Stage SCLC. SCLC accounts for approximately 15% of lung cancer cases globally,[24] and like other forms of lung cancer, prevention focuses on smoking cessation, as tobacco use is the leading risk factor. Early detection of SCLC is particularly challenging owing to its aggressive nature, and by the time it is diagnosed, the disease is often at an extensive stage.[25–33] In Egypt, the focus on early detection is improving with better screening programs, though SCLC remains challenging to catch at an early stage.

Surgery is generally not a viable option for patients with extensive stage–SCLC (ES-SCLC) owing to the rapid spread of the disease by the time of diagnosis. Surgical interventions are rarely considered unless the disease is localized, which is uncommon in SCLC cases.

Radiotherapy is an essential component in the treatment of ES-SCLC, often used for palliative care to control symptoms and improve quality of life, especially in cases of brain metastases. It is typically combined with systemic therapies such as chemotherapy.[34–36]

The standard of care for ES-SCLC in Egypt, as in many parts of the world, involves platinum-based chemotherapy, typically using a combination of platinum-etoposide. This regimen has been shown to be effective in achieving tumor control in the short term but does not significantly alter the long-term prognosis.

Unfortunately, the addition of newer therapies, such as ICIs or recently approved surface-targeted agents, is not widely utilized in Egypt, despite evidence suggesting that these treatments could improve outcomes when used in conjunction with chemotherapy. Limited access and high costs contribute to the underutilization of these newer therapies.

SCLC is often referred to as a "recalcitrant cancer" owing to its extremely poor prognosis. The median overall survival for patients with ES-SCLC is approximately seven months, with a five-year survival rate of less than 1%.[18–20,23] The challenges in improving survivorship are linked to the aggressive nature of the disease and the limited availability of advanced treatments such as immunotherapies.

Challenges and Deficiencies

Despite advancements in lung cancer treatment, Egypt faces significant challenges that hinder optimal patient care. The following subsections explore issues such as limited access to molecular testing, underutilization of targeted therapies, economic barriers, and the

need for improved infrastructure and national guidelines.

Limited Access to Molecular Testing. A significant barrier to effective lung cancer treatment in Egypt is the limited access to molecular testing. Without comprehensive tumor profiling, targeted therapies cannot be effectively utilized (Fig. 1). Tests for *EGFR, ALK, ROS1,* and *PD-L1* using immunohistochemistry, polymerase chain reaction, and NGS are sometimes provided and subsidized by pharmaceutical companies through their companion diagnostic laboratories. Nevertheless, local NGS testing is not universally available, particularly in remote regions lacking suitable laboratory facilities. This limitation hampers the ability to identify specific oncogene-driven NSCLC cases, leading to the underutilization of targeted therapies.

Absence of Centralized Reference Laboratories. The development of publicly accessible central reference laboratories in Egypt would significantly enhance access to critical molecular tests. The lack of such centralized facilities currently contributes to disparities in testing availability across the country. Local Egyptian laboratory leaders have participated in panel discussions advocating for the establishment of central labs. While expertise in conducting these tests exists, mechanisms for funding and widespread implementation are insufficient. Establishing central laboratories would streamline testing processes and ensure consistent quality, benefiting patients nationwide.

Underutilization of Targeted Therapies and Immunotherapies. Owing to limited molecular testing, targeted therapies are significantly underutilized in Egypt. Affordability, availability, and accessibility are key challenges. While some therapies are subsidized or provided through compassionate use programs, many patients, especially those in the public sector, lack access to the latest treatments. Immunotherapies are particularly rare owing to their high costs, leading to what is termed "economic toxicity." This underutilization means that patients may not receive the most effective treatments, potentially impacting survival outcomes.

Economic Barriers and Affordability Issues. Affordability remains a critical hurdle in the adoption of advanced lung cancer therapies. Improvements in the pricing of human immunodeficiency virus medications in low- and middle-income countries (LMICs) serve as a valuable model for making essential drugs more accessible. Similar strategies could be employed to reduce the costs of targeted therapies and immunotherapies for lung cancer. Addressing economic barriers would involve collaborative efforts between the government, healthcare providers, and pharmaceutical companies to develop cost-effective solutions that make treatments affordable for a broader patient population.

Need for National Implementation and Guidelines. National implementation of targeted therapies necessitates accurate data on the incidence and prevalence of specific oncogene-driven NSCLC. While structured national guidelines are being developed, current country-specific treatment guidelines largely follow

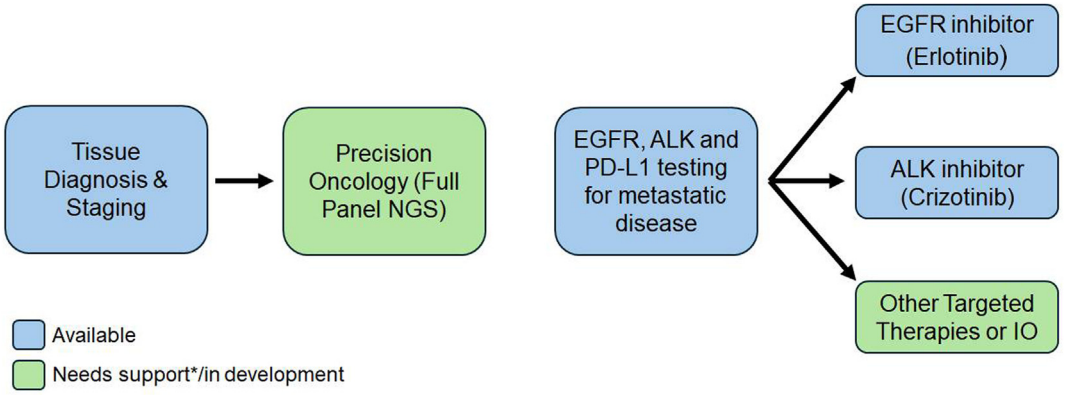

Figure 1. Treatment guideline for lung cancer (NSCLC). The figure outlines the diagnostic and treatment pathway for lung cancer, highlighting the transition from tissue diagnosis and staging to the implementation of precision oncology through full-panel NGS. It emphasizes the importance of EGFR, ALK, and PD-L1 testing for metastatic disease, with available targeted therapies including EGFR inhibitors (Erlotinib) and ALK inhibitors (Crizotinib). Other targeted therapies and IO treatments (such as Pembrolizumab) are in development and require further support to enhance access and implementation. The color coding indicates existing capabilities and areas that still need development. IO, immuno-oncology; NGS, next-generation sequencing.

standard international protocols, such as those from the National Comprehensive Cancer Network, but adapt them on the basis of patient characteristics and resource availability. Establishing comprehensive national guidelines would ensure a standardized approach to treatment and facilitate the integration of new therapies into clinical practice.

Challenges in Remote Regions. Patients in remote areas face additional challenges owing to the lack of access to specialized testing facilities. The expert panel discussed the potential use of liquid biopsies as a cost-effective method to improve testing rates and molecular diagnoses in these regions. Liquid biopsies could serve as a valuable diagnostic tool for individuals without access to radiologic and pathologic services, helping to identify undiagnosed lung cancer cases in rural populations. Implementing such technologies requires investment and training but could significantly enhance early detection and treatment outcomes.

Funding and Implementation Obstacles. Despite the availability of expertise within the country, there are significant obstacles related to funding and implementation of necessary infrastructure. Mechanisms for financing the establishment of central laboratories and expanding molecular testing are lacking. Addressing these challenges requires coordinated efforts to secure funding, possibly through government initiatives, public-private partnerships, or international aid. Overcoming these obstacles is essential to improve access to advanced diagnostics and therapies, ultimately enhancing patient care.

Strategies for Improvement Proposed by Conference Attendees

Lung cancer remains one of the leading causes of cancer-related deaths in Egypt, necessitating a comprehensive approach to prevention, early detection, and advanced treatment options. The conference attendees agreed on several strategic plans and recommendations to improve lung cancer management in Egypt (Fig. 2). This approach includes strategies ranging from primary prevention to targeted therapies aimed at reducing the incidence and improving outcomes for patients with lung cancer across Egypt. By addressing smoking, air pollution, access to advanced therapies, and fostering research collaborations, Egypt can enhance its lung cancer care infrastructure and provide equitable treatment options for all its citizens.

Primary Prevention: Smoking and Air Pollution

Primary prevention efforts aim to reduce the incidence of lung cancer by addressing the root causes of smoking and air pollution. The strategy focuses on educating the public about tobacco use and environmental pollution risks, enforcing laws, and expanding cessation programs, all while promoting cleaner air initiatives.

1. Raising Public Awareness: Tailor education campaigns to local communities, emphasizing the dangers of smoking (including shisha) and air pollution in major cities.
2. Stronger Enforcement of Anti-Smoking Laws: Ensure stricter enforcement of existing laws banning smoking in public spaces and workplaces.
3. Tobacco Cessation Programs: Expand smoking cessation programs across Egypt, making them easily accessible and integrating them into primary healthcare services.
4. Pollution Reduction Initiatives: Collaborate with environmental agencies to reduce industrial emissions, promote cleaner transportation, and strengthen air pollution monitoring systems.

Primary prevention through education, cessation programs, and environmental initiatives is a highly feasible approach that aligns with ongoing public health efforts in Egypt. Many of the proposed solutions, such as education campaigns and stricter law enforcement, build on existing infrastructure. Nevertheless, pollution control requires collaboration with environmental and industrial sectors and may face economic and logistical challenges. While smoking cessation programs can be scaled up within the healthcare system, pollution reduction will require long-term investments and sustained governmental support.

Secondary Prevention: Lung Cancer Screening

Secondary prevention focuses on early detection of lung cancer through screening programs, which can significantly improve outcomes. Egypt's Presidential initiative for lung cancer screening using LDCT should be scaled up, especially in high-risk populations such as long-term smokers and those exposed to pollution.

1. Scaling up the National Lung Cancer Screening Program: Expand screening programs to rural areas and underserved populations, ensuring high-risk individuals, such as long-term smokers, are prioritized.
2. Linking Screening with Cessation Programs: Pair lung cancer screening with smoking cessation services to address prevention and early detection simultaneously.
3. Increasing Awareness of Screening Programs: Launch public awareness campaigns to inform citizens about the importance and availability of lung cancer screening.

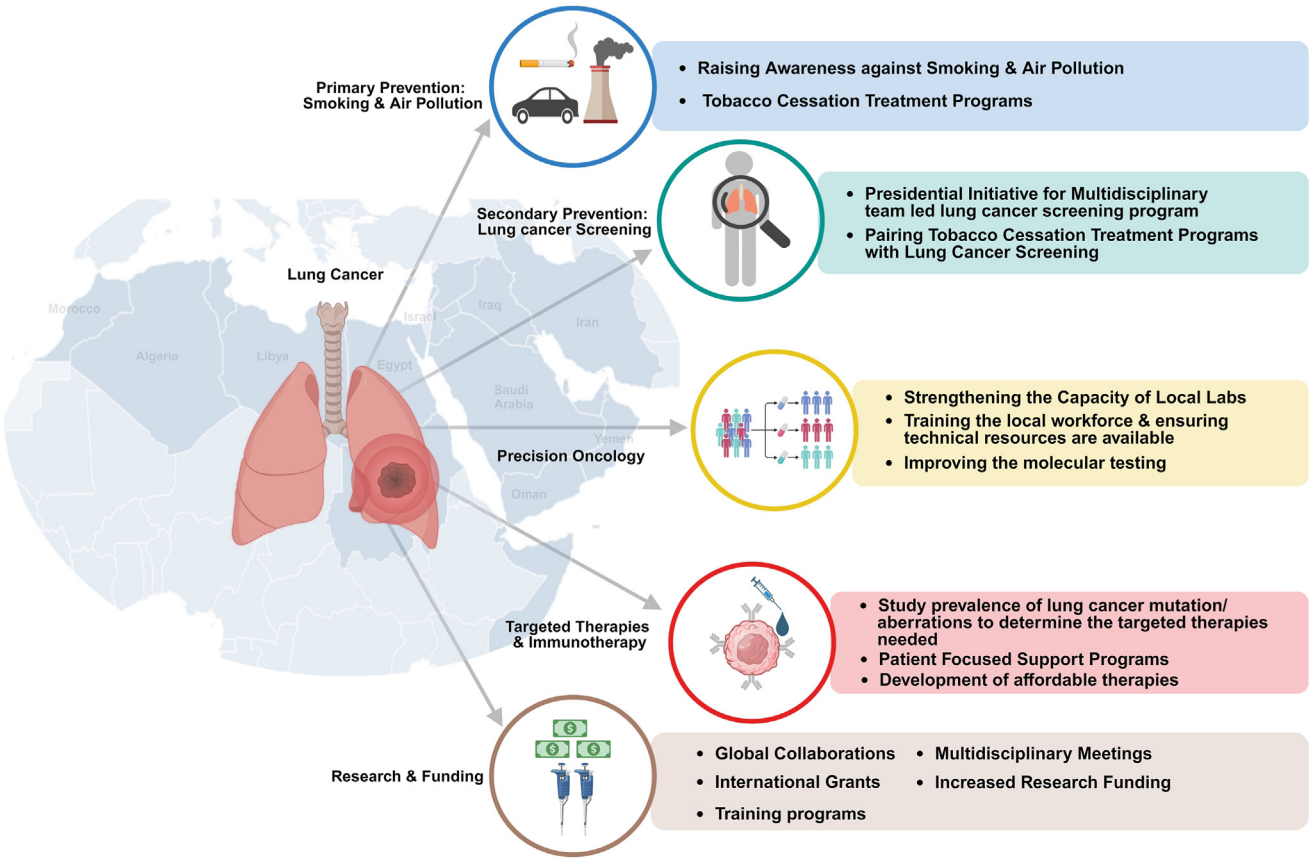

Figure 2. Current challenges and proposed solutions in the management of lung cancer in Egypt and the MENA region. This figure outlines the key challenges and proposed solutions for improving lung cancer management in Egypt and the MENA region. The strategies focus on primary prevention by raising awareness about smoking and air pollution, coupled with tobacco cessation treatment programs. For secondary prevention, initiatives emphasize lung cancer screening led by multidisciplinary teams paired with cessation programs. The approach to precision oncology highlights the need to strengthen local lab capacities, train the workforce, and enhance molecular testing capabilities. The use of targeted therapies and immunotherapy requires studying specific genetic mutations in the population and making treatments more affordable while also providing patient-focused support. In addition, the importance of research and funding is underscored, and promoting global collaborations, securing international grants, and developing training programs to advance lung cancer treatment in the region. MENA, Middle East and North Africa.

The expansion of lung cancer screening in Egypt is feasible given the existing infrastructure of the Presidential Initiative for Lung Cancer Screening, which already utilizes LDCT scans. Nevertheless, scaling the program to reach rural populations will require significant investment in healthcare facilities and mobile screening units. Public awareness efforts are manageable through government health campaigns, though ensuring broad participation, particularly in underserved areas, will necessitate focused outreach and collaboration with local healthcare providers.

Precision Oncology

Precision oncology aims to deliver personalized treatment on the basis of the molecular characteristics of each patient's cancer. This requires advanced molecular testing, which is currently limited in Egypt. The goal is to improve access to these tests and train local professionals to implement precision oncology widely.

1. Building Local Lab Capacity for Molecular Testing: Establish centralized laboratories for CGP and NGS in major cities.
2. Subsidizing Molecular Testing Costs: Develop public-private partnerships to subsidize the costs of molecular testing for patients, particularly in underserved regions.
3. Training the Local Workforce: Implement training programs to ensure healthcare workers can efficiently use molecular testing tools and interpret results to personalize treatment.

Expanding precision oncology and molecular testing capacity in Egypt is feasible but will likely require a phased approach. Centralized labs and workforce training can be developed with investments in infrastructure and

partnerships with international organizations. While costs may initially be high, particularly for genomic testing equipment, subsidies from public-private partnerships and support from pharmaceutical companies could help mitigate financial barriers. Long-term sustainability will depend on continued investment and training to keep pace with advancements in precision medicine.

Targeted Therapies and Immunotherapy

Targeted therapies and immunotherapies have transformed lung cancer treatment by offering options that attack specific genetic mutations or enhance the immune response. Egypt should study the genetic mutations prevalent in its population and make these therapies affordable and accessible.

1. Developing Patient Support Programs: Create financial support programs for patients to afford targeted therapies and immunotherapies, including expanded compassionate use programs.
2. Studying Genetic Mutations in the Egyptian Population: Research the prevalence of lung cancer mutations (e.g., *EGFR, ALK*) to guide the development of more effective, personalized treatment options.
3. Expanding Access to Targeted Therapies: Increase access to targeted therapies and immunotherapies in public hospitals, ensuring broader availability beyond private sector patients.

Adopting targeted therapies and immunotherapy in Egypt is possible, though affordability remains a key challenge. Egypt has access to some targeted therapies, but expanding this to public sector patients will require government subsidies and partnerships with pharmaceutical companies. Implementing patient support programs to reduce the financial burden on individuals is feasible through government or non-profit organizations. Nevertheless, scaling these therapies across all socioeconomic groups will require sustained funding and a coordinated national strategy to ensure equitable access.

Research and Funding

Increased research and funding are vital for advancing lung cancer care in Egypt. Collaborating with global institutions and securing international grants will help improve Egypt's research capacity and contribute to innovative treatment solutions.

1. Securing Global Collaborations and Grants: Actively seek partnerships with global organizations like the International Association for the Study of Lung Cancer to access new research, funding, and training opportunities.
2. Developing National Clinical Trials Infrastructure: Expand the infrastructure for conducting clinical trials, ensuring Egypt can participate in international research efforts and offer cutting-edge treatments to its patients.

The feasibility of increasing research and securing funding for lung cancer initiatives depends on Egypt's ability to foster global partnerships and attract international grants. Egypt has successfully participated in global research collaborations, and this experience can be leveraged to enhance its lung cancer research capacity. Establishing a national clinical trial infrastructure will require coordination between academic institutions, healthcare providers, and government agencies. While this is a long-term goal, early steps such as organizing multidisciplinary meetings and applying for international research grants are immediately actionable.

Conclusion

The first annual meeting of the Egyptian Cancer Research Network and the Egyptian Society of Respiratory Neoplasms brought together national and international stakeholders to assess existing lung cancer treatment guidelines, identify challenges, and develop new strategies for preventing, diagnosing, and treating lung cancer in Egypt and the broader MENA region. This collaboration is critical to addressing the unique challenges faced in the region and ensuring that all players in lung cancer care work towards a common goal.

Conference discussions highlighted several key issues in lung cancer care. For instance, third-generation targeted therapies, such as Osimertinib for patients with EGFR mutations and Anti-ALK therapies for curative treatment of NSCLC, have significantly advanced treatment options. Nevertheless, access to these therapies remains limited owing to economic constraints and logistical barriers. Moreover, resistance to targeted therapies remains a significant challenge, underscoring the need for ongoing research and innovation in treatment protocols.

Access to NGS testing, essential for identifying actionable mutations, is another global issue, but it is particularly acute in LMICs like Egypt. Expanding affordable NGS testing capabilities through the development of local laboratories was discussed as a priority. These labs require ongoing support to provide comprehensive NGS panels that enable the use of modern therapies for NSCLC. The role of NGS testing was also emphasized in the context of locally advanced NSCLC, especially in patient selection for consolidation therapy after chemoradiation.

The meeting also emphasized the critical need for tobacco cessation programs, in terms of implementation and public education. Strengthening these initiatives will help reduce the primary risk factor for lung cancer and decrease the disease burden in the region.

Importance of Implementing Proposed Strategies

Implementing the proposed strategies discussed during the conference is crucial for transforming lung cancer care in Egypt and the MENA region. Enhancing diagnostic capabilities, particularly through integrating full-panel NGS testing, will lead to earlier and more accurate detection of actionable mutations, allowing for personalized treatment plans that improve patient outcomes. Furthermore, expanding access to targeted therapies and immunotherapies, which have become standard in global cancer care, is essential for aligning treatment in Egypt with international guidelines.

Efforts to strengthen prevention initiatives, particularly in tobacco cessation, will address the root causes of lung cancer and reduce its incidence. Developing clear guidelines and educational programs for tobacco cessation will be crucial in ensuring the sustainability of these efforts.

Finally, expanding national screening programs and increasing public awareness are critical to ensuring early detection of lung cancer, which is key to improving survival rates.

Call to Action for Stakeholders

Addressing these challenges requires collaboration among all stakeholders, including government bodies, healthcare providers, non-governmental organizations, and international partners. Governments must commit to allocating resources, reducing economic barriers to treatment, and enacting policies that support the implementation of NGS testing and the availability of advanced therapies. Healthcare providers need to engage in multidisciplinary collaboration and stay up-to-date with evolving technologies, including the latest in targeted therapies, consolidation treatments, and diagnostic innovations.

International organizations and partners can play a crucial role in facilitating clinical trials and research collaborations. Despite financial and logistical challenges, cancer research in Egypt, including emerging microbiome studies, continues to grow. Although clinical trials remain limited, particularly in NSCLC, SCLC, and mesothelioma, establishing international collaborations and working with cooperative groups will help enhance research capabilities and provide education opportunities across the region.

Future Directions

Robust monitoring and evaluation frameworks will be vital to assess the success of implemented strategies and ensure continuous improvement. Establishing clear objectives and performance indicators will help gauge progress while documenting successful models, providing valuable insights for scaling up interventions within Egypt and other LMICs. Research in lung cancer diagnostics and treatment, such as advances in precision oncology and microbiome research, should be prioritized to keep pace with global developments.

Strengthening international collaborations will further enhance research and clinical trial capabilities, helping Egypt and the MENA region to overcome existing challenges and contribute to global efforts to reduce the burden of lung cancer.

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