

“Lung cancer: Epidemiology, Risk Factors and Future Perspectives”

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Abstract

Lung cancer is one of the most common cancers and can cause problems and death around the world. It is caused because of cigarette smoking or tobacco. Nonetheless, there have been some improvements in the techniques of diagnosis as well as treatment. Nevertheless, lung cancer remains a public health problem. Due to late diagnosis, it shows poor treatment efficacy and consequentially poor survival. The review analyzes the lung cancer epidemiology, etiology and risk factors, classification, pathophysiology, diagnosis, and clinical presentation along with lung cancer pharmacotherapy.

More people worldwide are getting lung cancer, especially in poorer regions - this shift ties closely to higher rates of smoking, air contamination, and job-related contact with harmful substances. Starting from genes and ending in cells, the causes of lung cancer mix different elements together; while tobacco stands out sharply as the main driver, breathing problems, inherited traits, and daily habits also play roles. Instead of treating one type the same as another, doctors split lung cancer into two kinds - small cell versus non-small cell - because each follows distinct paths at the tissue and gene levels, shaping how it spreads and what medicines work. What drives it is a web of subtle chemical changes at the molecular level - changes that spark uncontrolled growth in cells, along with new blood vessel formation, spread to distant sites, and a refusal to die by programmed shutdown.

Though tools like scanning or blood tests give clearer views on health, spotting problems at the start is still hard. Treatments like chemo, focused medicines, or immune activation do better now at managing illness - but side effects and treatments that fail are still around. New ways of giving medicine, such as tiny particle forms, fat-like capsules, or breathing-in methods, show real hope in guiding drugs more precisely, boosting how much they take effect, and reducing unwanted reactions across the body.

This overview points out key difficulties when dealing with lung cancer, while also suggesting where things might go next - toward tailored treatments, therapies guided by specific markers, and fresh ways to get drugs into the body, hoping these steps help people live longer and feel better.

Keyword: Lung Cancer; Epidemiology; Tobacco; Cancer; Breathing.

Introduction

Ahead of most cancers, lung disease spreads fast and returns often. It starts usually where air flows - inside small tubes and soft tissue of the lung. Aggression marks it early, along with hidden spread and weak chances for recovery. Even with better tests and treatments now, this illness still kills more people with cancer than any other around the globe. Most deaths happen because the condition shows up too late, the body reacts in confusing ways, while current therapies do not lastingly work well. Every year, a large number of people are told they have lung cancer, according to medical research. While it once affected far more men than women, current data show women are now getting diagnosed just as often. Factors like shifting smoking behaviors

and longer contact with dirty environments clearly play a role here. Across places like India, where cities grow fast, public health struggles deepen - dirty air spreads, jobs involve chemical risks, and quitting remains rare among smokers. Life gets harder for patients, plus their survival chances drop when the illness strikes. Beyond health expenses, daily output slows down around those affected. Medical bills climb fast under these conditions. Lung cancer doesn't come from just one cause - it's shaped by many influences. Smoking stands out as the main driver behind this illness. Being around smoke, either by lighting up yourself or breathing secondhand air, builds danger over time because of harmful mixtures locked inside tobacco fumes. Beyond cigarettes, places people work in or live in often hold risks too. Minerals like asbestos, hidden gases called radon, toxic metals, and tiny airborne particles play roles in sparking disease. Born with certain traits, people may also face risks from long-standing breathing issues or habits shaped by daily life. Inflammation that never fully fades can add weight, while genes already leaning toward trouble make the body more sensitive. Together, these forces twist without warning, showing how much surroundings and inner chemistry shape illness from its earliest sparks forward.

Broadly, lung cancer splits into small cell and non-small cell types - each shows different tissue, genetic, and behavior patterns. Recent gains in understanding DNA and gene activity point toward many hidden changes inside cancer cells. Such shifts push cells to grow without stop, resist death signals, keep blood vessel formation alive, move into spaces, then spread elsewhere. Looking closer at cancer growth, certain molecules stand out. One reason tumors form ties back to changes in epidermal growth factor receptor. Another piece of the puzzle links to alterations in anaplastic lymphoma kinase activity. Mutations within Kirsten rat sarcoma viral oncogene also play a key role here. These shifts often push cells forward into aggressive behavior. Seeing these changes in molecules changed how doctors test and treat patients, helping launch personalized treatments.

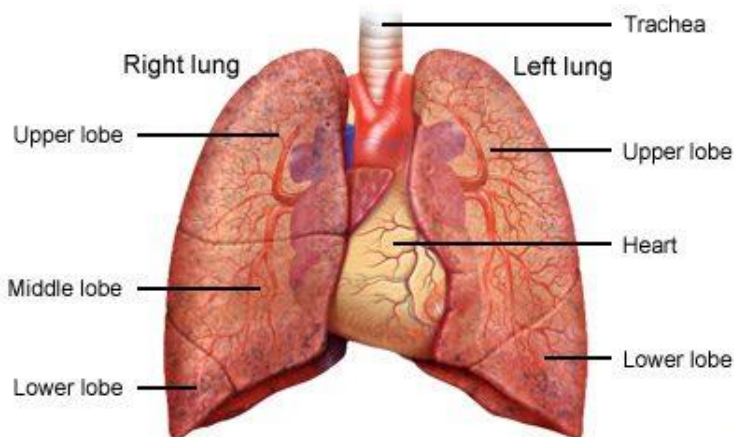
Most people miss lung cancer's early signs because warning markers show up too late for clear answers. By the time symptoms show up, the problem has usually spread far enough to make treatment harder. Even with better scans and blood tests that check genes, many patients still arrive with late-stage illness. Waiting too long cuts down chances for strong outcomes, leaving doctors with fewer tools to act early. What stands out is how quickly things can change - better ways to spot problems early are now more essential than ever.

Lung cancer treatment changed a lot in recent years. Instead of old methods, newer options emerged. Standard approaches once relied heavily on drugs that spread through the body. These tended to cause harsh side effects along with limited gains in time gained. Now comes a shift - with precision drugs and immune-based treatments changing how diseases are handled. Still, resistance grows when cancers adapt, even with new tools. At the same time, variation within tumors confounds outcomes, while side effects from modern approaches linger. Progress feels uneven across patients.

Lately, new ways of delivering drugs have drawn more focus than old methods because they might fix what traditional treatments fall short on. These updated setups work toward making more of the medicine available to the body, guiding it straight to cancer sites, while lowering harm across broader areas - which could lead to better results. Given how lung cancer works now, what treatments look like today, what progress shows up in delivery tools, and where progress may head next, grasping these layers helps shape smarter approaches for handling illness and boosting lives at risk.

Lung Cancer

Lung cancer has become top reason for deaths that come from cancer. Both a women and men can experience it. It is seen a lot in the people who are older. Learning about lung cancer can be easier by knowing the lung functioning. When air is inhaled, it passes inside nose, goes down trachea, and then goes into lungs. Air then spreads into the lungs through tubes called the bronchi. Most cases of lung cancer start in cells that cover these tubes. Smoking is not always necessary for a lung cancer to happen. There are a various kinds of lung cancer.



Non-small-cell lung cancer (NSCLC) and **small-cell lung cancer (SCLS)** represent about 96 percent of lung cancers. Most often found lung cancer is NSCLC, which grows very slowly in body. Close to 80 percent of diagnosed cases of lung cancer are NSCLC. Some types of the NSCLC are listed here:

- Adenocarcinomas, like an In Situ Pulmonary Adenocarcinoma (AIS) that was earlier called Bronchioloalveolar carcinoma;
- Squamous cell carcinoma or Epipermoid;
- A Pancoast or Pulmonary sulcus tumor;
- Large cell undifferentiated carcinoma.

Adenocarcinomas: If we want to know what is called an adenocarcinoma, think about the word for a while. Adeno means a gland while carcinoma means kind of dangerous tumor. Tumors like these are usually noticed on outer lung parts. This commonest type of NSCLC is seen in people. Adenocarcinomas is often to grow slow and people can find them usually before the cancer has gone to other places outside lungs. AIS tumors are called “in situ”,so this means cancer did not go to other places. That also helps patients get a better chance because small tumor may be taken out.

Squamous cell carcinomas mean tumors formed from squamous cells, which are flat cells lining the lung airways. Most often these tumors are discovered close to center of the lungs near bronchus, an air tube. Compared with some other kinds, they often show slower growing speed.

Pancoast tumor means an lung cancer form, which originates at the top part of lung and then moves into the tissues next to it like ribs and also spine. Surgical removal of these patients is often very challenging caused by where it is. Only below 5 percent of main lung cancers are called the Pancoast tumors.

Large cell carcinomas: These carcinomas may develop at any area of the lung. The cells that make up large cell carcinomas are in fact bigger than normal lung cells. Usually this kind of lung cancer has a dynamic

growth so it can sometimes be hard to treat it. I mean, sometimes treatment works quick and sometimes it doesn't.

Small-cell lung cancer (SCLC) is not so frequent and is rare in people who have not smoked. Just close to 15–25 percent of the lung cancer are SCLC. This type normally is quick in growth compared to the others. SCLCs sometimes get called an oat cell cancer as well as neuroendocrine cancer. SCLC usually spreads faster than non-small-cell lung cancer. Most of the time, SCLC has spread in body before the doctors find it.

That describes a type of lung cancer made up of both NSCLC and SCLC. These are called mixed small cell/large cell cancers. This is not common. Less common forms of lung cancer include:

- Mesothelioma — A tumor in the lining of the chest or abdomen, most often associated with exposure to asbestos.
- Carcinoid: A slowing-growing tumor. Carcinoids are more commonly located in the gastrointestinal system found at different locations, however; they also may be found in the lung.
- Sarcoma: Sarcomas are tumors that start in the soft tissues including fat, muscle, connective tissue or blood vessels.

Sometimes cancer begins in another part of the body and spreads to the lungs. That's called metastatic cancer to the lung, not lung cancer, if that is true.

Epidemiology of Lung Cancer

Cancer shows up more often in lungs than anywhere else - worst numbers across every country. This type of illness claims more lives than almost any other form of the disease worldwide. Data from 2022, gathered by IARC, counted close to 20 million fresh diagnoses when counting non-melanoma skin types too. Deaths tied to these illnesses hit around 9.7 million during that time. Over the course of life, odds say roughly twenty percent of humans face a cancer diagnosis at some point. For males, death rates land near eleven percent; among females, it's closer to eight percent. One out of every eight cancer diagnoses in 2022 was lung cancer. That year saw 2.5 million people receive that diagnosis. Breast cancer came close behind, but only among women, accounting for nearly 12 percent. Colorectal tumors showed up often too, affecting about 1 in 10 cases across genders. Prostate issues followed at just over 7 percent, while stomach cancers made up less than 5. Meanwhile, when counting lives lost, lungs again topped the list - almost 1.8 million deaths worldwide. Death rates from colon and rectum cancers ranked second, claiming roughly 9 out of every 100 tumor-related fatalities. Liver problems caused more than 7 percent of such deaths overall. Women faced higher mortality from breast tumors than any other type except lung ones. Men mostly died from lung tumors more than anything else. Even so, stomach cancer played a role in over two-thirds of one-tenth of all cancer deaths.

Australia and New Zealand saw incidence rates jump past 500, hitting 507.9 per 100,000, while West Africa stayed below 100 at 97.1. For women, numbers climbed above 400 in that same Pacific region - specifically 410.5 - but dipped close to 100 in South Central Asia with 103.3 recorded.

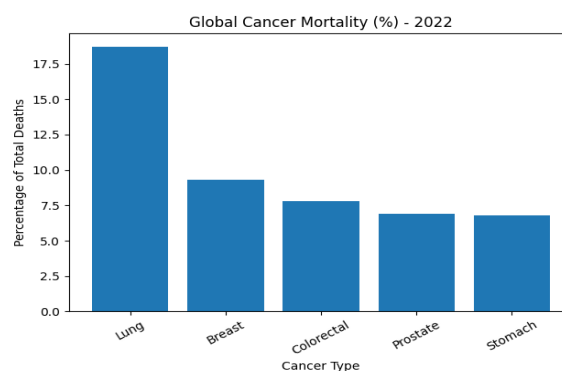
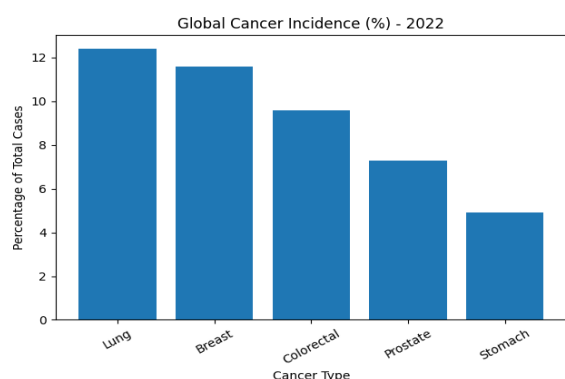


Fig.no.1: “Distribution of cancer cases worldwide (2022) Distribution (2022)”

Fig.no.2: “Cancer-related Death

Epidemiology and changing trends in lung cancer

Every year, around 18.1 million people get diagnosed with cancer - that's what the GLOBOCAN 2018 data showed. Among them, nearly 2.1 million cases belong to lung cancer across every age and gender, which is about 11.6 percent; its cumulative risk stands at 2.75. This type ranks as number one when compared to others like breast, prostate, or colon tumors. When it comes to death, almost one in five cancer deaths ties back to lung issues: 1.76 million lives lost out of 9.57 million total fatalities, a share of 18.4 percent. The chance of dying from it over a lifetime hits 2.22 on average. Other big killers include bowel, stomach, and liver cancers, but none surpass lung cancer's toll.

Lung cancer ranked fourth among cancers in India during 2018, affecting 67,795 people with a 0.65 cumulative risk - falling behind breast, lip, oral cavity, and cervical or uterine types, per GLOBOCAN data showing it caused 5.9 percent of cases. When it came to fatal outcomes, nearly one out of twelve cancer deaths nationwide - exactly 63,475 lives - was linked to lung tumors, accounting for 8.1 percent of fatalities and placing it third overall, trailing only cancers of the breast, lips, and mouth. Yet compared to figures from six years earlier, both new diagnoses and death rates have dipped slightly since the 2012 estimates of 6.9 and 9.3 percent reported by GLOBCAN.

One team tracking illness across India noticed big differences in how often people got the ten most common cancers between 1990 and 2016. These gaps changed widely depending on location - some states saw rates up to 11.6 times higher than others for key types like mouth, breast, lung, and stomach tumors. For males, raw numbers showed Kerala and Mizoram leading in lung cases: 19.5 and 18.9 per 100,000. Women faced similar patterns; Mizoram again topped the list at 18.9, while Manipur recorded 8.3. By 2016, loss of healthy years due to lung cancer hit hardest in Mizoram with a score near 503, then trailed off through Kerala, Manipur, and Jammu and Kashmir. One study on lung cancer in India found that nearly half of disability cases tied to the disease came from smoking. Air quality problems accounted for just about the same share during the same year. These two causes stand out when looking at what drives lung cancer there. People who do not smoke often face a type called adenocarcinoma. Those who smoke regularly are more likely to develop SqCC instead.

Of all lung cancer types, adenocarcinoma usually shows up most often in Western and several Asian nations - yet something else happened in North India. Looking back at 1,301 cases there between 2011 and 2015, both adenocarcinoma and squamous cell carcinoma held identical shares, each at 36.4%. Meanwhile, an

unclear subtype - called NSCLC-NOS - took a noticeable dip: down from 10.9% in 2012 to just 5.1% five years later, a shift flagged with strong statistical backing. Most people stepping into clinics with fresh diagnoses carried late-stage illness, mainly stage IIIB or IV, making up 83.4% altogether. Smoking played a role too - three out of four were either still lighting up or had done so before. But further south, another picture emerged. Data pulled in 2018 from Kerala revealed squamous cell cases edged ahead at 29%, while adenocarcinomas settled behind at 26%. Even though squamous cell carcinoma used to dominate lung cancer cases in India, newer reports point toward a rise in adenocarcinoma. From a major hospital in Chennai, records gathered ahead of time and later reviewed revealed that among diagnosed individuals over five years, nearly two out of every five had adenocarcinoma. Squamous types appeared far less often under the microscope - only about one in six. Farther south, in Madurai, researchers looking at people thought to have lung cancer between 2018 and 2019 saw half with glandular tumors instead of flat-cell ones. When doctors there analyzed treated patients earlier, slightly more than half carried the same subtype. One such report from 2017 based in the city confirmed it in just over fifty percent. What once seemed rare now shows up most.

Screening of Lung Cancer

Some screening methods for NSCLC come from recent medical practice, others emerge from ongoing trial research. Guidelines about lung cancer testing have been released by multiple groups. Still, nobody advises widespread checks to catch lung cancer early right now. The U.S. Preventive Services Task Force once stated evidence too weak to back or block testing in people showing no symptoms. On top of that, the American Cancer Society doesn't push screening even for those more likely to develop it.

Scenario of Lung Cancer Screening in India

Starting off, lung cancer checks in India face real hurdles - costs pile up while basic tools stay out of reach in distant regions. Remote clinics often lack what's needed just to spot the disease early. Building a working system isn't straightforward either; it stumbles on shaky groundwork. Instead of rushing ahead, testing small-scale trials first might make more sense here. On top of that, helping heavy smokers quit could shift outcomes where risk runs high. Personal plans for those most at danger may matter more than one-size-fits-all rules. Without low-cost methods, even smart ideas stall before they start. Reaching goals means pricing can't be ignored - it shapes who gets help.

Risk factor of Lung Cancer

Agents identified as causing lung cancer. Role that tobacco plays in this disease is very well-known. It is said by scientists that about 80 to 90 percent of lung cancer cases are in connection to smoking. Carcinogenic stuff inside the tobacco smoke gives reasons for this problem. This serious risk changes for certain people and also on how they use the tobacco like:

- How many cigarettes someone smokes every day. As this gets bigger, also the danger is rising.
- How long person has had habit. The more years of smoking, the higher chance to get lung cancer.
- How old you were when starting. This still needs to be proved by an scientists but when you begin early, the risks become higher.
- Manner of breathing in smoke. If you breathe smoke deeper or more often, risk is going up.
- Having a filter in your cigarette. This can help lower the cancer risk a little. Tobacco smoke has in it more than 2,500 chemicals and nearly 60 can be either probably or maybe cause cancer.

In the early 1980s, two reports showed that exposure to secondhand smoke was probably connected to bronchial cancer especially among women whose husbands smoked. Over 50 epidemiological research works since that time have examined the influence of tobacco smoke from others at home or at work. In almost every case, research shows a big rise in death from bronchial cancer where people breathe secondhand smoke.

Asbestos is for sure leading job-related exposure linked with bronchial cancer. Every type of asbestos fiber currently is seen as dangerous and an risk for lung cancer. People who have most risk are in textile industry with odds ratios, like from 2 going all way up to 10 and workers in thermal insulation have number between 3 to 6, then for manufacturing of asbestos cement it goes from 1.5 until 5.5, and friction material industries the figure stands from 1.5 to 3.5.

With crystalline silica, lung cancer risk in work-related exposures is mostly counted between 1.2 and 1.4 but when a person also has silicosis, then risk usually is between 2 or even reaching 2.5 and one study after adjusting because of smoking found approximately 1.6.

Recent groups of people studied who were exposed to cadmium at work show, that mostly cancer of lung is found in workers who have worked with cadmium for a long time and had the highest cumulative exposures. There might also be other cancer-causing agents involved but some are not fully researched yet.

Not much information is there about how environmental cadmium causes risk of lung cancer. The risk of getting lung cancer from radiation exposure has now been decided as a true, and a number of studies calculate dose and its effect, mainly from external exposure or breathing radon. It is not clear still about risks when exposures are only inside the body.

In research on hormones, scientists still study hormone replacement therapy in big population surveys, a lot of these, with samples from ten thousand to twenty thousand people, did not show positive results, a small rise in non-small cell lung cancer cases turned up in the VITAL project, which followed close to 168,000 people across the U.S. When it came to hormone treatments mixing estrogen and progestin, chances went up - by about 48 percent - but stayed nearly flat with estrogen on its own, where risk shifted just four percent. Then there's data from

Switzerland; Bouchardy's team found those using drugs blocking estrogen for breast issues tended to live longer if they got lung tumors. That adds weight to the idea hormones might influence how lung cancer unfolds once present.

Risk Factors Still Debated

Despite some findings, evidence remains weak in linking lung cancer to man made mineral fibers - like glass wool, rock wool, or slag wool - in industrial settings. Right now, there's simply not enough information to judge whether refractory ceramic fibers pose a lung cancer threat. When it comes to diesel exhaust, here's what the Environmental Protection Agency has determined:

When looking at the data, signs point toward diesel fumes playing a role in lung cancer. Luck doesn't seem to explain what researchers keep finding. Though smoking details were missing in many reports, that gap probably isn't skewing the outcome - people in different groups live much alike. What stands out is how often the pattern repeats across investigations.

Between 1.2 and 2.6 lies the measure of connection - modest when seen through an epidemiologist's eyes. Some research shows higher exposure leads to greater effect, hinting at a pattern. What makes it click? Diesel smoke affecting human lungs fits well within known body processes. This idea lines up with what studies show, according to numerous academic groups.

Picking apart how pesticides tie to lung cancer gets tricky when you consider the wide range of chemicals involved. Each era brings different formulas, shaped by what farmers grow and when they apply them. Sorting truth from noise means tracking changes across time, crop by crop, chemical by chemical.

Starting off, some workplace chemicals beyond asbestos raise lung cancer risks. Ionizing radiation shows up in disease records linked to jobs. Chromic acid along with its compounds appears on those lists too. Coal tars, plus related oils and soot from burning coal count as well. Breathing in arsenic dust or fumes is another known factor. Dust or vapors from arsenic pyrites also belong in that group. Asbestos fibers in air remain a recognized hazard. Roasting nickel matte brings more risk into play. Working deep inside iron mines has ties to the illness. Airborne cadmium particles - when breathed - are part of the list. Cobalt dust mixed with tungsten carbide enters lungs during certain tasks. A chemical called bis(chloromethyl) ether adds danger too. Beryllium exposure may lead to tumors just like the others.

Smoke in the air has been studied by two French health groups, Inserm and Afsset. Their findings came out in late 2008. Cars and factories release harmful emissions into the sky. These substances might raise the chance of getting lung cancer. Tobacco smoke remains far more dangerous than dirty air. Yet polluted skies still play a role. Gases like SO₂, NO₂, O₃ contribute to this mix. Diesel exhaust also adds to the problem. Scientists point to Trédaniel's work from 2009 as reference. Still, early results need further checking.

Personal and family history : A past with breathing problems raises the chance of lung cancer, especially when COPD, silicosis, berylliosis or tuberculosis were involved. Those surviving one round of lung cancer face higher odds of another compared to most others. Family patterns matter too - if relatives had it, risk climbs (Li et al., 2008).

It's likely some people carry genes that shield them. Most smokers - over eighty percent - never get lung cancer, possibly thanks to stronger breakdown of harmful chemicals in smoke. Yet others inherit traits making them more prone. Variations in specific genes raise the odds. Take those guiding the $\alpha 3$, $\alpha 5$, and $\beta 4$ parts of nicotine-linked brain receptors; certain DNA shifts here tie closely to both heavy smoking and tumor growth (Amos et al., 2008). Another player: TERT, involved in rebuilding chromosome tips (McKay et al., 2008). These versions stir higher danger. Not clear how those genetic differences link to cancer. In one family with several lung adenocarcinoma cases, Bell and team spotted a p.T790M change passed down through generations in the EGFR gene (Bell et al. 2005). That variant had shown up before - but only inside tumors, not inherited. When it appears, drugs targeting EGFR tend to fail. Later on, another inherited shift turned up in EGFR's exon 21: p.V843I (Ikeda et al. 2008).

Agents Causing Lung Cancers

1. Tobacco-related Factors

Factor	Description	Risk Level
Smoking	80–90% lung cancer cases linked to smoking	Very High
Number of cigarettes/day	More cigarettes → higher risk	High
Duration of smoking	More years → higher risk	High
Early age of smoking	Early start increases risk	Moderate–High
Deep inhalation	Deep breathing of smoke increases exposure	High
Filter cigarettes	Slightly reduce risk	Low benefit
Tobacco chemicals	~2500 chemicals, ~60 carcinogenic	Very High

2. Secondhand Smoke

Factor	Description	Risk Level
Passive smoking	Exposure at home/work	High
Spouse smoking	Increased risk in women	High
Long-term exposure	Increased bronchial cancer deaths	High

3. Occupational Exposure (Asbestos & Industry)

Industry	Risk (Odds Ratio)	Risk Level
Textile industry	2 – 10	Very High
Thermal insulation	3 – 6	High
Asbestos cement	1.5 – 5.5	Moderate–High
Friction materials	1.5 – 3.5	Moderate

4. Other Occupational & Environmental Factors

Agent	Risk Range	Description
Silica	1.2 – 1.4	Occupational exposure
Silicosis	2 – 2.5	Higher risk with disease

Agent	Risk Range	Description
Cadmium	Increased	Long-term exposure risk
Radiation (Radon)	High	Proven carcinogen
Diesel exhaust	1.2 – 2.6	Air pollution source

5. Chemical Carcinogens

Chemical	Source
Arsenic	Dust, fumes
Chromium compounds	Industrial exposure
Nickel compounds	Metal industry
Coal tar & soot	Burning coal
Beryllium	Industrial processes
Bis(chloromethyl) ether	Chemical exposure

6. Air Pollution

Pollutant	Effect
SO ₂	Lung irritation
NO ₂	Increased cancer risk
O ₃	Respiratory damage
Diesel smoke	Carcinogenic

7. Personal & Genetic Factors

Factor	Description
COPD, TB, silicosis	Increase lung cancer risk
Family history	Higher susceptibility
Genetic mutations (EGFR, TERT)	Increased risk
Nicotine receptor genes ($\alpha 3$, $\alpha 5$, $\beta 4$)	Linked to smoking behavior

8. Hormonal Factors

Factor	Effect
Estrogen + Progestin therapy	~48% increased risk
Estrogen alone	Minimal effect
Anti-estrogen drugs	May improve survival

9. Uncertain / Debated Factors

Factor	Status
Man-made mineral fibers	Limited evidence
Ceramic fibers	Not confirmed
Pesticides	Complex, unclear link

Future Perspectives

Though lung cancer still poses serious global health issues, fresh progress in science is quietly reshaping what lies ahead. Looking forward, efforts center on catching the disease sooner, tailoring therapies, exploring new treatments, avoiding risk where possible, while weaving in tools like machine learning. Findings across many investigations suggest better outcomes come from combining expertise and targeting care more precisely. Much rides on how well different fields work together - survival rates may rise, along with daily living, when methods grow sharper. Looking ahead, catching lung cancer earlier stands out. Usually it shows up late, when treatment options shrink. Still, studies like the National Lung Screening Trial show a different path - low-dose CT scans cut death rates among heavy smokers. Work now shifts toward sharper tools: clues from genes, body markers, and better forecasts help pinpoint who faces the greatest odds. Blood tests that spot loose tumor DNA are gaining ground - a quiet shift where signs might surface well before shadows on an X-ray.

One big focus now is matching treatments to a person's unique cancer traits instead of using one-size-fits-all approaches. Because science has gotten better at reading how cells work on a tiny level, doctors can spot exact gene errors tied to lung tumors - like glitches in EGFR, ALK, or KRAS. When drugs aim right at those broken parts, people with non-small cell lung cancer often do better than before. Looking ahead, researchers are building stronger versions of these medicines to beat back cancers that stop responding over time. Trying several smart drugs together - one after another or at once - is being tested too, since hitting more than one weak spot might slow down stubborn disease.

A fresh turn in lung cancer care comes through training the body's defenses to fight back. Instead of attacking tumors directly, certain medicines release brakes on immune cells so they can act. Take drugs that block PD-1 or PD-L1 - these have lifted survival numbers where older methods fell short. Some patients now live longer thanks to treatments like Pembrolizumab and Nivolumab becoming routine choices. Scientists are digging into clues inside each person's tumor to find who will respond best. Matching therapy to individual biology could open doors for many more down the line. New paths include teaching the immune system with vaccine-like tools. Another route places modified killer cells straight into the battle, aiming for lasting

control. Progress moves quietly but steadily toward smarter ways to harness immunity. Looking ahead, artificial intelligence mixed with machine learning opens new paths in handling lung cancer. Instead of relying only on traditional methods, computers now study X-rays, tissue samples, and DNA details to sharpen diagnosis and guess how therapies might work. Some research points out these systems spot small lung spots on scan images better than doctors sometimes do. Later on, smart software may guide choices about patient risks, next steps, and therapy design - tightening up care while boosting reliability. Efficiency and precision could rise simply by weaving AI into routine judgments. New ways of using radiation and surgery continue to change how lung cancer is treated. Instead of large cuts, doctors now often use small incisions with camera help or robot support, leading to fewer problems after operations while healing happens faster. A method called SBRT focuses radiation very exactly so nearby organs stay safer during treatment. Coming improvements will link these physical methods with drug-based treatments to boost overall results.

A fresh look begins with stopping illness before it starts. Because cigarettes lead to most lung cancer cases, pushing forward on anti-smoking rules helps slow the spread. Education campaigns matter just as much as support for people trying to quit. Instead of waiting, acting early through stronger laws makes a difference. When workplaces cut contact with dangerous substances, risk goes down. Think about radon seeping into homes or dusty factory air - removing those lowers odds over time. Cleaner environments add up to fewer cases later.

Looking ahead, spotting key biological signs could change how care moves forward. When clear markers show up early, doctors may adjust treatments more precisely. Instead of one-size-fits-all plans, choices might match each person's pattern. By pulling together data from genes, proteins, and chemicals, scientists dig into what fuels tumors. New leads for drugs often come out of these layered views. Progress hides in those details, slowly becoming options down the line.

Even with progress, problems still exist. Because tumors differ so much from one person to another, treatments do not always work. Some cancers stop responding over time, which makes healing harder. On top of that, many people in poorer nations cannot reach new medical options. Since technology spreads unevenly, scientists need to study fairer ways forward. One path involves creating cheaper methods that more lives can benefit from. Equal care might grow once solutions fit real-world limits.

Conclusion

Lung cancer is still considered as one of main health problems around the world and is still the biggest reason for deaths that are caused by cancer globally. The way lung cancer happens in populations shows that there is a rising load, whether in poorer or richer countries. In different places, this is affected by how people live, what they are exposed to in environment, and how much money they make. Some countries see cases not rising because less people smoke, but worldwide the number still stays high. Urban areas that become bigger face more people getting lung cancer, because of pollution in the air and dangers at jobs getting worse. Lung cancer risk factors are many and well known but also are a bit mixed together sometimes. Using tobacco remains the top source and is causing most instances. Breathing in secondhand smoke, air that is dirty, work dangers like an asbestos and different metals, as well as having genes from parents, also are reasons more people get lung cancer. This complicated set of factors shows lung cancer does not only result from one thing. It is a mix from being exposed to bad stuff in environment and differences in people's bodies.

In last years, there has been a lot discovered regarding lung cancer on molecular biology part, and this made possible to get better at finding it and treating it. Early discovery with low-dose CT scanning and new

biomarkers finds more patients on time. New drug treatments like targeted ones and immunotherapy have changed significantly way to fight lung cancer, giving more patient-centered and successful treatments.

When thinking about future, best results for lung cancer can be expected combining finding it soon, using a precision medicine, and including new technologies like artificial intelligence. Prevention efforts matter also, so controlling tobacco, protecting environment, and educating people about health are very important for making lung cancer not so common. However, there are still problems such as cases found late, tumors stop reacting to therapies and not all people can get healthcare they need, this is even more in less rich places.

To sum up, while lung cancer is still a big danger, research that keeps going, better health plans, and people working together in world give a hope for improvements, so that prevention, timely diagnosis, and better treatments can be achieved later.

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