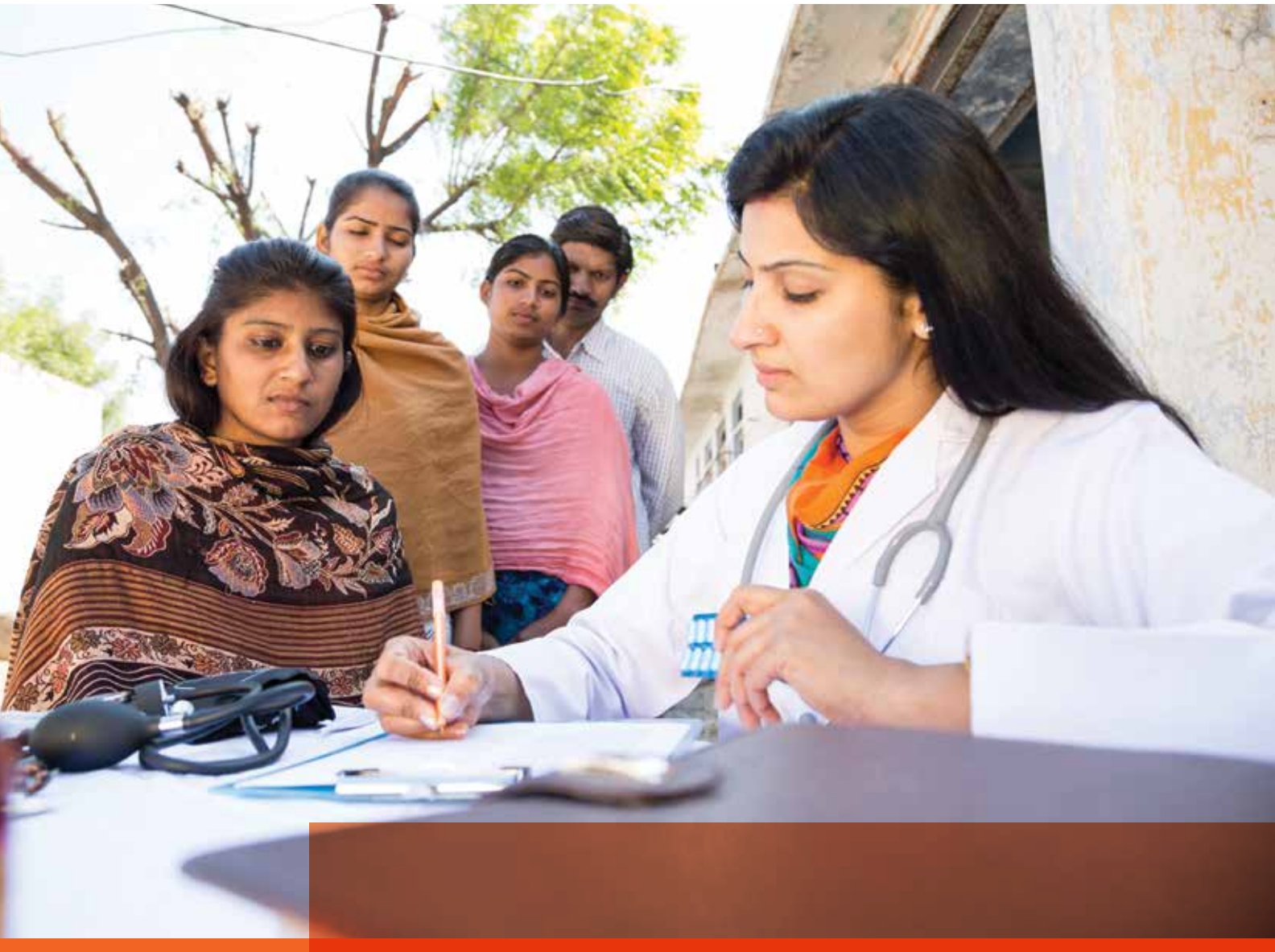
Centre for Chronic Disease Control

WHO Collaborating Centre for Surveillance, Capacity building and Translational Research in Cardio-Metabolic Diseases

Health Care Without Harm



# UNDERSTANDING KNOWLEDGE, ATTITUDE AND PRACTICE OF HEALTH PRACTITIONERS TOWARDS HEALTH EFFECTS OF AIR POLLUTION IN INDIA

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**JUNE 2020**

*Report prepared by:*

Centre for Chronic Disease Control

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*Supported by:*

Health Care Without Harm

# Acknowledgement

This report was developed by the Centre for Chronic Disease Control (CCDC) under the supervision of Dr. Poornima Prabhakaran, Additional Professor & Deputy Director, Centre for Environmental Health (CEH), Public Health Foundation of India (PHFI). The core writing team that drafted this report was led by Shriram Manogaran, Research Associate & Program Coordinator (Technical), Vidushi Bahuguna, Research Associate & Program Coordinator (Policy) and included Titiksha Shukla, Research Fellow.

This study would not have been possible without the co-operation and support of all the physicians in the four selected states. We are deeply indebted to them for their time and patience during their interactions with us to provide critical insights to this work. We would like to acknowledge the ethics committee of CCDC for reviewing and approving this important work and Mr. Bhargav Krishna, Manager (Technical), CEH for supporting the launch of this study. Our team would also like to extend our gratitude to Dr Alex Thomas, President, Association of Healthcare Providers (India), and Chair, Health and Environment Leadership Platform (HELP) who encouraged a lot of physicians to participate in our research. We were fortunate to receive logistics and administrative support throughout the study from the Centre for Chronic Disease Control(CCDC). We would like to record our deep appreciation and thanks to all of members of the CCDC administration.

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**This study would not have been possible without the co-operation and support of all the physicians in the four selected states.**

## About Centre for Chronic Disease Control

Centre for Chronic Disease Control (CCDC) is a New Delhi based not-for-profit organization, established in December 2000. The mission of CCDC is primarily intended to address the growing challenge of chronic diseases, in varied settings of the developing countries through:

- Knowledge generation, which can inform policies and empower programmes for the prevention and control of chronic diseases
- Knowledge translation intended to operationalize research results by bridging the critical gaps between relevant research and effective implementation, through analytic work, capacity building, advocacy and development of educational resources for enhancing the empowerment of people and professionals.

CCDC has been recognized as a Scientific and Industrial Research Organization (SIRO) by Department of Scientific & Industrial Research (DSIR), Ministry of Science and Technology, Government of India. It also holds registration under Foreign Contribution (Regulation) Act, 1976. CCDC undertakes clinical research with special emphasis on chronic non-communicable diseases (NCD). Within the spectrum of chronic diseases, our main focus areas are: cardiology, diabetes and metabolic disease, vascular diseases, cancers and mental health. In addition, basic science research in diet/nutrition and cardiac biochemistry are also carried out. The research work at CCDC has produced major insights into the epidemiology, developmental origin, and biomarkers of CVD and diabetes in India; practice patterns on Acute Coronary Syndrome; translation research in CVDs; and development of low-cost combination drugs for primary and secondary prevention of CVDs in South Asia. CCDC holds recognition as a 'Centre of Excellence in Clinical Research' from the Clinical Development Service Agency (CDSA), Department of Biotechnology, Government of India. It is also a WHO Collaborating Centre for Surveillance, Capacity building and Translational Research in Cardio-Metabolic Diseases.

**Within the spectrum of chronic diseases, our main focus areas are: cardiology, diabetes and metabolic disease, vascular diseases, cancers and mental health.**

## About Health Care Without Harm

Health Care Without Harm (HCWH) is an international NGO that seeks to transform the health sector worldwide so that it becomes ecologically sustainable and a leading advocate for environmental health and justice. Health Care Without Harm has worked for 23 years with the health care sector to reduce its use of toxic chemicals and generation of waste, while transforming the supply chain and fostering climate action. With offices in the United States, Europe, Asia; a regional team in Latin America; and country-level partnerships with national organizations in Australia, Brazil, China, India, South Africa, and Nepal; Health Care Without Harm is a leader in mobilizing the health care sector to realize this vision. Health Care Without Harm's staff of health professionals, researchers, and advocates

work with hospitals, health systems, governments, and international agencies to accelerate health care decarbonization, resilience, and climate policy leadership around the world. Health Care Without Harm's Global Green and Healthy Hospitals Network has 1,200 institutional members across 60 countries, all working to bring the health sector into the climate movement and expand their healing mission beyond the four walls of their facilities.

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## Authors contribution:

**Shriram Manogaran:** Contributed to revision of the survey instrument, data collection; and co-authored chapters 1, 2, 3, 6, 7 and 8.

**Vidushi Bahuguna:** Contributed to revision of the survey instrument, data collection and analysis; led cleaning of the data; and co-authored chapters 1,3, 5, and 7.

**Titiksha Shukla:** Contributed to revision of the survey instrument and data collection.

**Dr. Poornima Prabhakaran:** Led the execution of the entire project; provided inputs at every stage; authored the executive summary and contributed to all other chapters; and reviewed and edited the entire manuscript.

# List of Abbreviations

**AQI** – Air Quality Index
**CO** – Carbon monoxide
**COPD** – chronic obstructive pulmonary disease
**DALYs** – disability adjusted life-years
**GDP** – Gross Domestic Product
**HMIS** – health management information systems
**IHD** – ischemic heart disease
**INR** – Indian Rupee
**LPG** – liquefied petroleum gas
**MCH** – Maternal and Child Health
**MoHFW** – Ministry of Health and Family Welfare
**NAAQS** – National Ambient Air Quality Standards
**NAMP** – National Air Quality Monitoring Programme
**NAPCC** – National Action Plan on Climate Change
**NCAP** – National Clean Air Programme
**NCD** – Non-Communicable Disease
**NCR** – National Capital Region
**NFHS** – National Family Health Survey
**$NO_2$** – oxides of Nitrogen
**PM** – Particulate Matter
**PMUY** – Pradhan Mantri Ujjawala Yojna
**$SO_2$** – oxides of Sulphur
**US** – United States
**USEPA** – United States Environmental Protection Agency
**UT** – Union Territory
**WHO** – World Health Organization
**µg** – Micro-gram

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# Executive Summary

This study sought to explore and establish for the first time, through a qualitative study and interview-based approach, the current status of knowledge, awareness and practice of health care professionals with regard to air pollution and its impacts on health. Findings from this work point to a less than adequate and appropriate level of awareness, often limited to certain domain specialists. The linkages between exposure to harmful levels of air pollutants and their myriad effects on different aspects of human health – respiratory, cardiovascular, neurocognitive development, pregnancy outcomes etc. is not fully understood across all health sector practitioners. This gap in knowledge and awareness can have serious impacts on the way the disease burden due to air pollution is dealt with across healthcare in India.

**Findings from this work point to a less than adequate and appropriate level of awareness, often limited to certain domain specialists.**

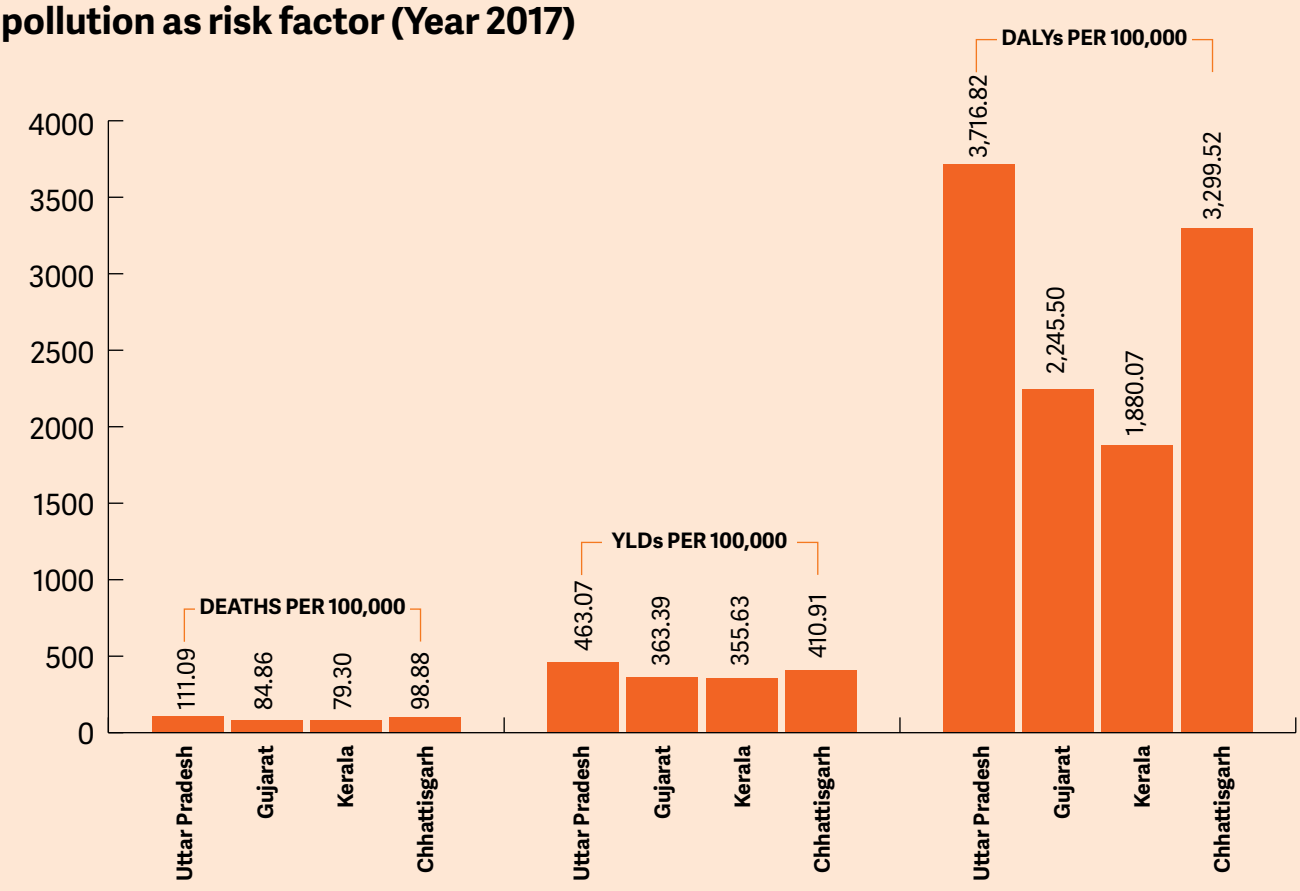
The findings of the study include:

- While there is some awareness about air pollution and its impacts on health, it is not currently of utmost importance or a topic of conversation which garners much interest within the community of doctors
- Most doctors reported that the topic of 'air pollution', in particular, was not a part of their medical curriculum in any detail. It used to be present in some part in the respiratory medicine curriculum as well as in the social and preventive medicine curriculum.
- Whilst global recognition of air pollution as a risk factor of cardio-vascular diseases, chronic and acute respiratory diseases and lung cancer, among others is growing, doctors and communities here still don't see it as a big problem.
- While pulmonologists and pediatricians recognize evidence linking air pollution with adverse impacts on health especially diseases such as chronic obstructive pulmonary disease, lung disease, asthma and respiratory tract infections, the other respondents suggest lack of sufficient evidence base to effectively link exposure to air pollution as a serious risk factor over other factors such as smoking.

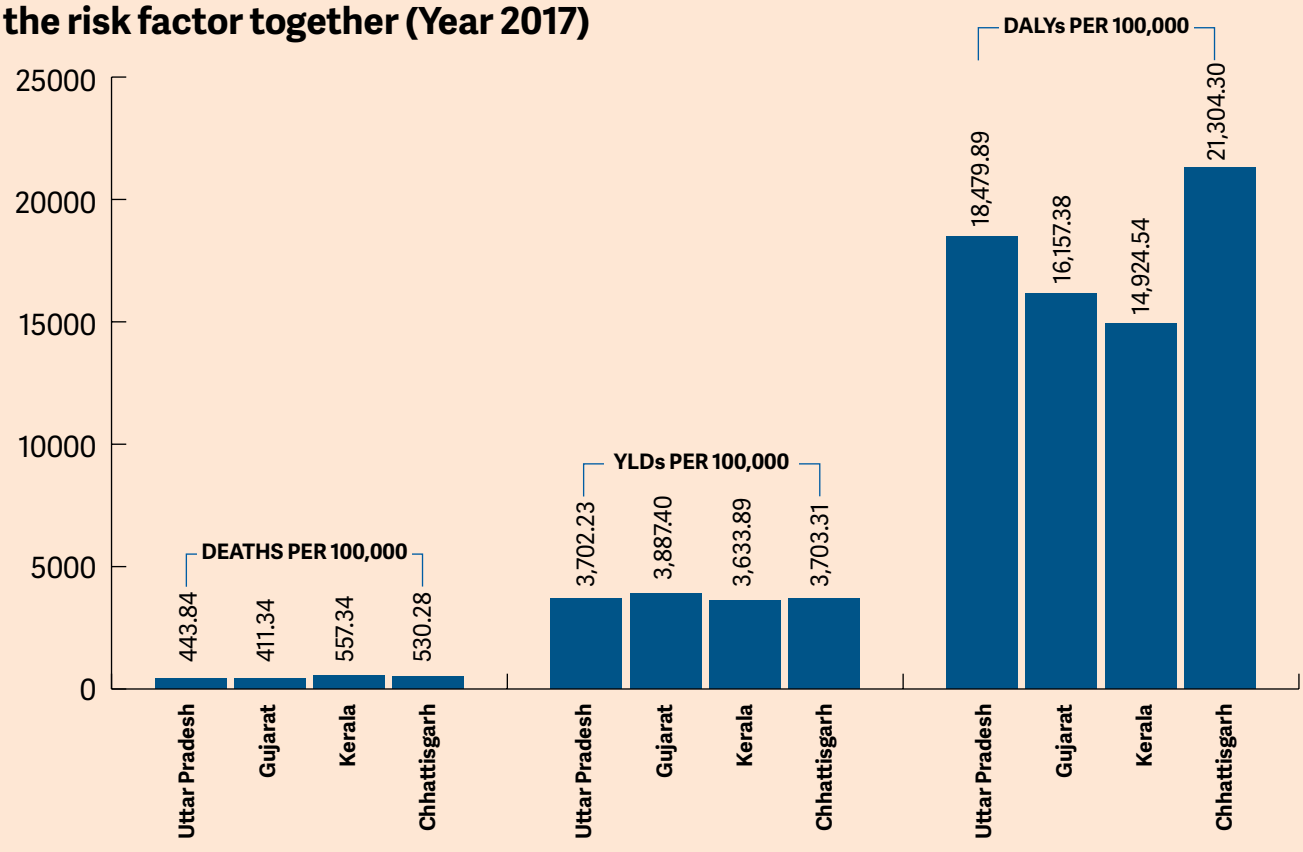
- While doctors across categories recognize the harmful effects of air pollution, they believe that they themselves cannot make much of a difference to address the problem. Almost all doctors, across study sites and categories, stated that the government should do more and that policies were just not enough.

While recognizing the gaps that currently exist in our medical training in India, we suggest recommendations to incorporate changes in the medical training for future under-graduate and post-graduate levels while proposing other strategies for current practitioners as well. A sea change in our capacity building must be brought about with immediate effect to ensure that the knowledge, attitude, awareness and practice of healthcare practitioners in handling the growing burden of air-pollution related diseases in India is ensured.

## Figure 1: Burden of Disease of four states with Air pollution as risk factor (Year 2017)




## Figure 2: Burden of Disease of four states with all the risk factor together (Year 2017)



# 1. Introduction

Air pollution is increasingly becoming a major risk factor around the world, with deteriorating air quality especially common in rapidly urbanizing, developing country settings. Populations in growing economies like India and China have faced the greatest exposures in recent years (1,2,3), (4,5,6). According to the World Health Organization's figures, 97% of the cities in the low- and middle- income countries which have more than 100,000 inhabitants do not meet WHO air quality guidelines (7). The last couple of years have seen air pollution become a major concern in India due to a number of natural as well as anthropogenic activities such as rapid industrialization, solid waste and biomass burning, vehicular exhaust fumes, and re-suspended road dust, accompanied by meteorological conditions driven by climate change (8,9). As per the Global Burden of Disease comparative risk assessment for 2015, air pollution exposure contributes to approximately 1.8 million premature deaths and 49 million disability adjusted life-years (DALYs) lost, ranking it among the top risk factors for ill health in India. India is home to 15 of the top 20 cities with the highest annual average levels of PM2.5 as per the WHO Urban Ambient Air Quality Database (2016) (10), with several studies showing a worsening trend over time (12).

**As per the Global Burden of Disease comparative risk assessment for 2015, air pollution exposure contributes to approximately 1.8 million premature deaths and 49 million disability adjusted life-years (DALYs) lost**

While there is heterogeneity in pollutant profiles and sources of air pollution, poor air quality affects both rural as well as urban areas of the country quite severely (13,14,15,8). Air pollution has been termed a democratizing force (11) affecting all populations and ages, but also propagates existing environmental injustices in some settings. Studies have shown that children and the elderly are particularly vulnerable to air pollution exposure. Air pollution exposure has shown to slow lung development in children (16,17), affect cognitive

development (18,19,20), and has resulted in high levels of morbidity and mortality from respiratory infections (21,22). The elderly are more likely to develop chronic respiratory and cardiac illnesses as a result of long-term exposure, and are more susceptible to heart attacks and strokes during episodic high pollution events (23). Also vulnerable are those of a lower socio-economic status, with studies showing they are more susceptible to insults from air pollution exposure for a variety of reasons including occupation, crowded housing often with poor ventilation and types and duration of cooking fuel use, the common link being poverty (24,25).

While environment, health and development are frequently pitted in adversarial roles in the discourse on economic growth, published evidence argues that they are very much in consonance (26, 28). A study published by the World Bank in 2016 revealed that air pollution costs India approximately 8% of its GDP or $560 billion in 2013, as a result of lost productivity due to premature mortality and morbidity (26, 27, 28). This study, while a great first step, failed to capture the healthcare costs of treating air pollution-induced illnesses, which if factored in, could produce a far larger number (28).

To address the multi-dimensional, multi-sectoral problem of air pollution requires a cogent approach that takes into account the best available epidemiological evidence of air pollution and its health effects, cost-benefit analyses of various interventions, and a strong communications platform to ensure broad awareness of the health impacts of air pollution and the advantages of mitigation. The role of healthcare professionals in this battle against air pollution cannot be understated-spanning from recognising and dealing with the rising disease burden to functioning as advocates for steering effective, adequate and appropriate policy-making to address air pollution.

**While environment, health and development are frequently pitted in adversarial roles in the discourse on economic growth, published evidence argues that they are very much in consonance.**

# 2. Aim of the study

Air pollution has increasingly become a recognised risk factor for ill health. While there is a growing evidence base on the linkages between air pollution and its effects on health, there still exist gaps in knowledge and awareness to recognise and deal appropriately with this growing burden. This is not only true amongst the lay public, increasingly influenced by anecdotal evidence, personal experiences and media coverage of the growing menace of air pollution, but also among the city planners, policy makers and even healthcare professionals who are ultimately at the forefront of delivering care. There is, therefore, an urgent need to engage the public, city planners, policy makers and the health professionals in the collective advocacy process towards achieving a cleaner environment. This study aims to focus on the healthcare professionals to understand perspectives of doctors on the growing health impacts of air pollution and how they approach patient care through preventive advice, curative care and also play a critical role in advocating for health in all clean air policies.

This study aims to understand current knowledge, awareness and perspectives amongst doctors about the prevalence of air pollution as a risk factor for health as well as the importance of effective communication and outreach to patients. A comprehensive qualitative study was conducted in selected settings to assess and bring forth gaps that exist between present knowledge about harmful impacts of air pollution on health and doctor's awareness about it. Air pollution, as compared to an established risk factor like tobacco use and smoking for acute and chronic respiratory diseases, is still not adequately covered in medical education. The objective of this study was therefore to understand if and how the medical community perceives

**Air pollution, as compared to an established risk factor like tobacco use and smoking for acute and chronic respiratory diseases, is still not adequately covered in medical education.**

the issue of air pollution, whether or not it is perceived as a possible threat or risk factor for various health outcomes and why. The idea would also be to understand if doctors talk about air pollution as a potential risk factor with their patients, which specific cases do they do so in and if not, then why? This will enable us to address the gaps and build their capabilities in addressing health challenges of air pollution.

This study, conducted in multiple states, often in tier 2 and tier 3 cities, with varying contexts (industrial versus non-industrial areas, higher and lower levels of PM2.5 and disease burden estimates), provided an opportunity for taking the focus away from Delhi –NCR and cross-learning across states in terms of how the issue is being addressed, if at all. An additional important benefit of this exercise was to raise awareness around air pollution as a risk factor for many diseases among various domain specialists namely, physicians, cardiologists and pediatricians, to assess and create a better understanding of their perspectives on the health impacts of air pollution exposure, and the need for effective communication with patients around the same.

While the primary objective of this study is to assess awareness and perspectives around air pollution amongst the first responders (doctors in this case), and make them the voice of change in dealing with this issue, it also aims to simultaneously facilitate a greater presence of the health rationale in the design, implementation and enforcement of energy and environmental policies.

# 3. Background – Air pollution and health in India

Air quality in India has worsened over the years and continues to do so (1,2,3). Several factors are responsible for this increase in air pollution levels in the country, however, the main contributors of air pollutants in most cities are vehicular emissions, road dust and construction/demolition work, open waste burning, industrial emissions, agricultural activities, emissions from coal-fired thermal power plants (29) in various proportions. Atmospheric pollutants can be classified into two categories: particulate matter pollutants and gaseous pollutants (30). Particulate matter (PM) pollution, a term for a mixture of solid particles and liquid droplets in the air (USEPA) are mostly composed of dust, dirt, soot, or smoke. PM are defined by their size; PM 2.5 can only be detected using an electron microscope, while PM10 is large or dark enough to be detected with a naked eye. PM 10 primarily comprises dust, while PM2.5 is the by-product of combustion either natural (e.g. forest fires) or man-made (e.g. vehicles, industrial emissions, biomass burning). Due to sustained economic expansion in the last two decades, Indian cities have seen rapid urbanization which has directly contributed to ambient/outdoor air pollution (31). While industrialization, vehicles and construction dust has contributed to worsening the urban air quality, indigenous cook stoves which use coal and wood as fuel, kerosene lighting, and agricultural residue burning are top pollutant sources in rural India (13,14,15,8). In recent times, PM2.5 has been classified as the biggest concern for health and high priority target for reduction (32). The current state of air quality is a colossal hazard to human health and a major cause for concern (27).

**The main contributors of air pollutants in most cities are vehicular emissions, road dust and construction/ demolition work, open waste burning, industrial emissions, agricultural activities, emissions from coal-fired thermal power plants.**

In the past few years, there has been a growing attention to air pollution levels with a focus only on national capital territory (NCR-Delhi and surrounding areas) and a few metropolitan cities, but the levels of air pollution have been high throughout the country, especially so in the Indo-Gangetic plains of India (33). The reports from Global Burden of Disease (2015) suggests that these levels contribute to over 10% of all Indian deaths each year and contributed to 26.2% of the global DALYs as a result of exposure to air pollution (34, 35). Globally, Indian cities rank very poorly in terms of air quality index. This is evident as a majority of all the monitoring sites across India report high concentration of pollutants which exceed the global standards set by the World Health Organization as well as the more lenient National Ambient Air Quality Standards (NAAQS) (36). In 2015, more than half the Indian population was exposed to ambient PM2.5 concentrations that do not comply with NAAQS. The Lancet (2018) findings suggest that 77% of Indian population was exposed to PM2.5 greater than 40 µg/m3 in 2017 which is the level recommended by the National Ambient Air Quality Standards in India. None of the Indian states have met the WHO recommended criteria for ambient air quality which is a level of 10 µg/m3 (34,35). About one quarter of the population inhaled extreme particulate concentration which exceeds WHO standards by nine times over an annual time period. The amount of concentration inhaled by the vulnerable population on a 24-hour basis is so high that it has resulted in thousands of premature deaths annually (37).

**The Lancet (2018) findings suggest that 77% of Indian population was exposed to PM2.5 greater than 40 µg/m3 in 2017 which is the level recommended by the National Ambient Air Quality Standards in India.**

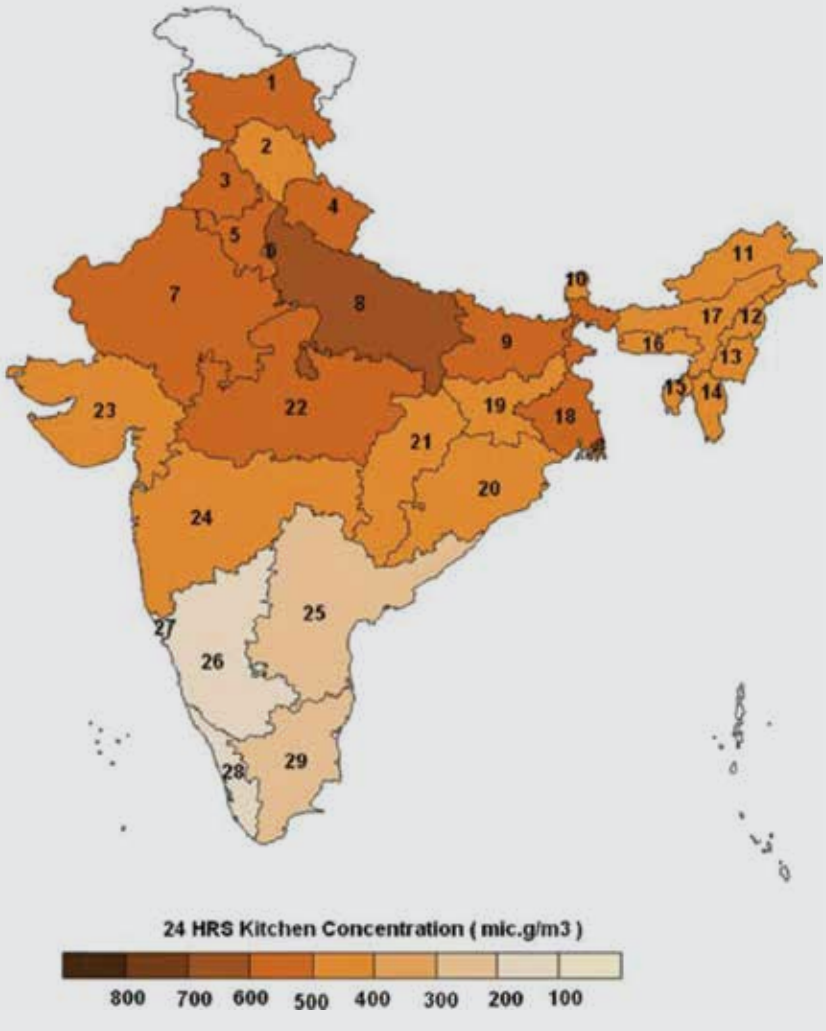
Other pollutants like ozone are a major factor in causing asthma, or exacerbating such health conditions. Nitrogen oxides and Sulphur dioxides, a major product of combustion of fossil fuels can also cause or worsen asthma, bronchial symptoms, lung inflammation and reduced lung function (38). Actions to contain or reduce these particulate matter and oxides readily is a daunting task. Meanwhile, the infants and children have become one of the most vulnerable population in Indian cities (39). Every year, half a million children (below the age of five) die from illness directly related to air pollution. Air pollution is also linked to premature birth and low-birth weight. Reports and studies have also started to link low-cognitive skills and high pollution concentration (40, 18, 19, 20). Children's exposure to air pollution has started raising concerns because their immune system and lungs are not developed to combat the level of concentration they are inhaling. In addition, children spend more time outside than adults, when the concentration from traffic and other combustion sources are high. While air pollution has been considered to exacerbate minor acute illnesses (17), recent studies show that traffic-related pollution, particularly, is associated with infant mortality and development of asthma (40, 41,42,43).

Exposure to air pollution is not just limited to outdoor or ambient pollutants but can also occur within living quarters. Household air pollution occurs primarily due to combustion of solid fuels such as coal, wood, dung or charcoal for cooking or heating, due to active/passive smoking, use of chemicals/sprays,

or the presence of mold (44, 26). Over 700 million individuals in India use solid fuels for cooking or heating, with most living in rural areas (45).
Figure 3 shows the regional distribution of kitchen PM2.5 concentrations across India. Furthermore, WHO data suggests that 8 of the top 20 cities with the highest annual average PM2.5 levels, were in India (2020). Lung function is very important for respiratory health and impacts cardiorespiratory morbidity and mortality. There are evidences on how long term exposure has an impact on development of lung function in children and adults (46).

Numerous health impact studies over the years have linked air pollution with lower respiratory tract disorder, COPD, Ischemic Heart Disease (IHD), stroke and lung cancers. Furthermore, particulate matter concentration has also been associated with diabetes, neuro development and cognitive disorders,

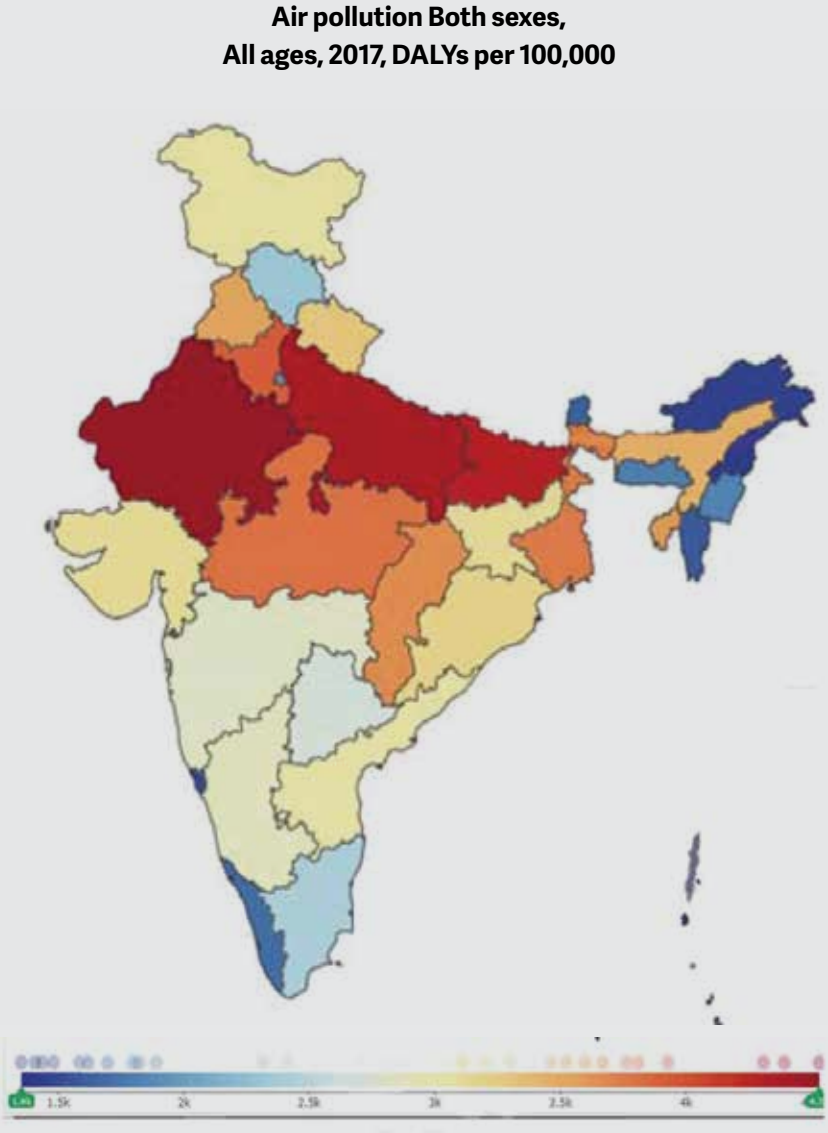
**Figure 3: Weighted state estimates for average 24-hour kitchen area concentrations of PM 2.5 for all solid- fuel-using households in India**




*(Source: Balakrishnan, Kalpana et al., 2013)*

birth outcomes, amongst other conditions (47,48). As per the Global Burden of Disease 2016 data, exposure to air pollution (household or ambient) in India is associated with more than 1.9 million deaths, and 54 million DALYs lost (Fig. 4). With numerous studies, awareness efforts, policy reforms by government, private, and academic institutions, global interest has peaked to reduce air pollution and ameliorate its impacts. Given the situation, what degree of awareness do doctors have to handle air pollution or inculcate this knowledge in their practice is an important issue.

**Figure 4: Global Burden of Disease- India Comparison with Air Pollution as a risk factor**




*(Source: https://vizhub.healthdata.org/gbd-compare/india)*

The global scientific community has provided enough evidence based research to conclude that air pollution has dire health impacts. But only a handful of studies have concluded that knowledge on health impacts from air pollution has been lacking among general physicians and doctors. Previously conducted studies outside India show that there is some degree of lack of awareness or comprehensive understanding of health impacts of air pollution. This lack of knowledge reflects in ways in which doctors communicate with their patients (49). For instance, a study in Poland aimed to assess the knowledge of Polish doctors about the impact of air pollution on health. The results showed that only 27% of physicians think their knowledge on air pollution is sufficient, however only 3.5% were right. Only 5% of physicians knew about WHO or the national ambient air quality standards and knowledge of what pollution concentration was acceptable. Less than 3% of doctors inform or communicate about air pollution in their conversation. Majority of physicians (59%) did not know about the main air pollutant in their city. In cases like asthma, doctors identified air pollution as a hazardous factor. Although in other cases, air pollution was not considered or mentioned as a factor for declining health (49,50).

**Table 1: AQI categories for pollutants**

AQI Category, Pollutants and Health Breakpoints

| AQI Category (Range) | $PM_{10}$ 24-hr | $PM_{2.5}$ 24-hr | $NO_2$ 24-hr | $O_3$ 8-hr | CO 8-hr (mg/m3) | $SO_2$ 24-hr | $NH_3$ 24-hr | Pb 24-hr |
|---|---|---|---|---|---|---|---|---|
| **Good (0-50)** | 0-50 | 0-30 | 0-40 | 0-50 | 0-1.0 | 0-40 | 0-200 | 0-0.5 |
| **Satisfactory (51-100)** | 51-100 | 31-60 | 41-80 | 51-100 | 1.1-2.0 | 41-80 | 201-400 | 0.05-1.0 |
| **Moderately polluted (101-200)** | 101-250 | 61-90 | 81-180 | 101-168 | 2.1-10 | 81-380 | 401-800 | 1.1-2.0 |
| **Poor (201-300)** | 251-350 | 91-120 | 181-280 | 169-208 | 10-17 | 381-800 | 801-1200 | 2.1-3.0 |
| **Very poor (301-400)** | 351-430 | 121-250 | 281-400 | 209-748* | 17-34 | 801-1600 | 1200-1800 | 3.1-3.5 |
| **Severe (401-500)** | 430 + | 250 + | 400 + | 748+* | 34 + | 1600 + | 1800 + | 3.5 + |

**One hourly monitoring (for mathematical calculations only)*

*(Source: Press Information Bureau, Government of India, Ministry of Environment, Forest and Climate Change.* ***https://pib.gov.in/newsite/PrintRelease.aspx?relid=110654)***

## Table 2: National Air Quality Index[1]

| AQI | Associated Health Impacts |
|---|---|
| Good (0–50) | Minimal Impact |
| Satisfactory (51–100) | May cause minor breathing discomfort to sensitive people. |
| Moderately polluted (101–200) | May cause breathing discomfort to people with lung disease such as asthma, and discomfort to people with heart disease, children and older adults. |
| Poor (201–300) | May cause breathing discomfort to people on prolonged exposure, and discomfort to people with heart disease |
| Very Poor (301–400) | May cause respiratory illness to the people on prolonged exposure. Effect may be more pronounced in people with lung and heart diseases. |
| Severe (401-500) | May cause respiratory impact even on healthy people, and serious health impacts on people with lung/heart disease. The health impacts may be experienced even during light physical activity. |

[1] http://www.cpcb.nic.in/About_AQI.pdf

Table 1 gives details of the current permissible limit for each of the pollutants according to the AQI. The AQI accounts for eight types of gaseous as well as particulate matter pollutants to ascertain the level of air quality in that particular region.

Corresponding to the above table on the air quality index calculated as a weighted average of the various pollutants, a national Air Quality Index was further developed. Table 2 below shows how each range of AQI corresponds to the associated health impacts.

Even though the last few years have seen a significant and very visible rise in the levels of air pollution leading to a sharp increase in the number of people suffering from the ill effects of air pollution, the response to this has been tardy and inadequate. While the discourse on air quality management continues, there is an urgent need for doctors in particular to be sensitive to existing environmental issues like air pollution. They need to be accountable in their practice to be prepared to respond to these growing environmental challenges and their growing impacts on health. Since there is much to progress in terms of policy towards containing air pollution, doctors need to be equipped as advocates for effective policy-making and be first responders to ameliorate the existing air pollution risk on health. At present, in India, an understanding of doctors' approach and capabilities around the issue of air pollution are mostly anecdotal. Such existing anecdotal understanding does not help us to conclusively say how far aware or prepared Indian doctors are in the context of dealing with the health impacts of air pollution. This research study will shed light on some aspects of this mutual relationship between doctors, patients and a growing environmental issue.

**At present, in India, an understanding of doctors' approach and capabilities around the issue of air pollution are mostly anecdotal.**

# 4. Methodology

Study design: The study was designed as a qualitative study with in-depth interviews conducted with specialists in the field of cardiology, pulmonology, paediatrics and general medicine, from a purposively selected sample of states. The participants were requested to provide responses to a series of questions relating to how they perceive, understand and approach air pollution as a health related issue with their patients.

Study Objectives:

i. To understand doctors' awareness and preparedness to address the health impacts of air pollution in selected study states.

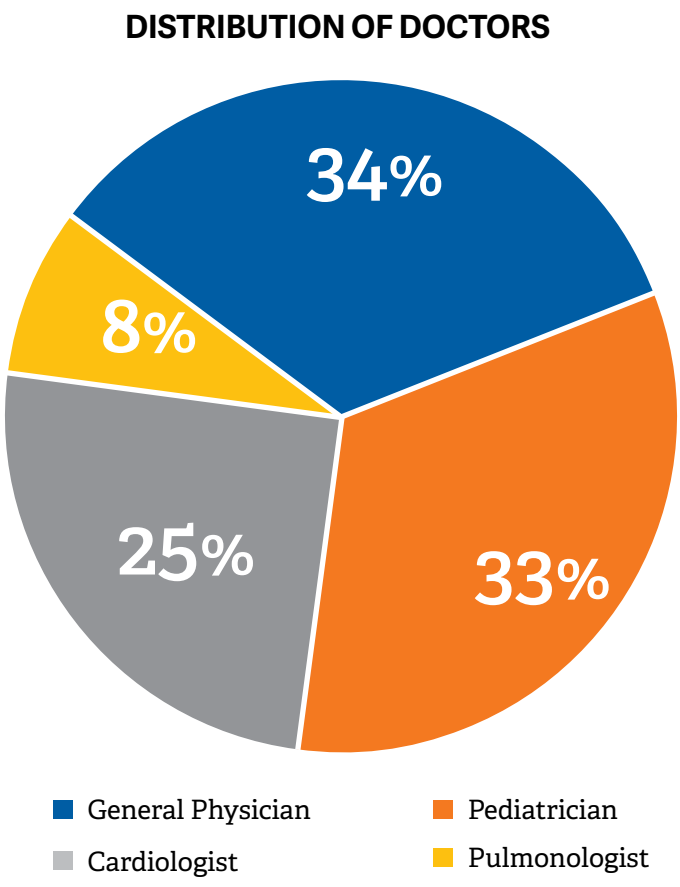
ii. To assess any differences amongst different specialist categories in preventive and curative care with regard to air-pollution related health issues

iii. To develop a roadmap and recommendations for enhancing health practitioners' awareness of environmental health issues, with special focus on air pollution

iv. To sensitise physician advocates for health-centric policies

The study focuses on the following categories of doctors: Cardiologists, Pulmonologists, Pediatricians and General Physicians. These categories have been selected as they give us a broad spectrum of specialists as well as first point of contact for most patients. These categories will help us understand if and how air pollution as a health risk factor is taken into consideration at various stages of patient care.

**Chart 1: Pie chart showing distribution of Doctors interview by specialty**





**Kochi & Ahmedabad are also expected to expand in terms of scale and size, hence may foresee increased activity and pollution.**

## Study setting

Geographically, the study was conducted in four different cities/states Kochi, (Kerala), Raipur (Chhattisgarh), Ahmedabad (Gujarat) and Lucknow (Uttar Pradesh) in India. The states were selected based on the annual ambient air quality index, high population densities, rapid urbanization, industrial clusters, and risk of any diseases with air pollution as the risk factor. Raipur and Lucknow have high annual ambient air quality index and high risk of disease burden from air pollution. Kochi and Ahmedabad are sparsely polluted compared to Raipur and Lucknow's annual air quality. But, their rapid urbanisaton and deteriorating air quality in the last decade prompted their selection as study sites. These cities are also expected to expand in terms of scale and size, hence may foresee increased activity and pollution. Six doctors were interviewed from each city, three doctors from public hospitals and three from private hospitals. A cardiologist, pulmonologist, pediatrician and general physician were included from both sectors. A semi-structured questionnaire was followed in the interviews, with a basic set of questions for all the doctors and a select set of questions for each category based on their specialization. The study was conducted in the months of February to September in 2018.

**Table 3: Total disease burden from air pollution in study states (2017)**

| States | Deaths per 100,000 | YLDs per 100,000 | DALYs per 100,000 |
|---|---|---|---|
| Uttar Pradesh | 111.09 | 463.07 | 3,716.82 |
| Gujarat | 84.86 | 363.39 | 2,245.50 |
| Kerala | 79.30 | 355.63 | 1,880.07 |
| Chhattisgarh | 98.88 | 410.91 | 3,299.52 |

**Table 4: Total disease burden from all risk factors in study states (2017)**

| States | Deaths per 100,000 | YLDs per 100,000 | DALYs per 100,000 |
|---|---|---|---|
| Uttar Pradesh | 443.84 | 3,702.23 | 18,479.89 |
| Gujarat | 411.34 | 3,887.40 | 16,157.38 |
| Kerala | 557.34 | 3,633.89 | 14,924.54 |
| Chhattisgarh | 530.28 | 3,703.31 | 21,304.30 |

# 5. Findings of the study

The results of the interviewer-administered questionnaires were analyzed and the findings are presented here covering knowledge, awareness and management approaches.

## 5.1. Understanding of 'air pollution'

While there is some awareness about air pollution and its impacts on health, it is not of utmost importance or a topic of conversation which garners much interest within the community of doctors. During our conversation with doctors in various parts of the country, there was an evident lack of knowledge regarding air pollution. Not many were able to reflect on the incidences of pollution to correlate those with episodes of increase in patient footfall. Even the basic question such as their understanding of the phrase 'air pollution', most often than not, did not get a complete response. According to one:

> ***"Definition……would be bit difficult but if we compare with the village areas, or with the hill area, then lot of molecules which should not be in the normal air, are there, mostly in the cities…you know toxic fuels from the various industrial areas, then another problem is toxic molecules coming out of the automobiles of these areas"***

While most could identify sources of air pollutants than pollutant categories themselves, some doctors, especially those from private hospitals, were able to better articulate about the types of pollutants and distinguish between particulate matter and gaseous pollutants in the air.

When it came to the sources of air pollution in their own cities, doctors from

most public as well as private hospitals identified vehicular emissions and ongoing construction work (roads and metro) as primary sources. This is also reported by most newspapers, which were stated to be the primary source of information by majority of doctors. Incidentally, most see pollution as a problem arising from the presence of a large number of vehicles primarily, even though in states such as Chhattisgarh, a well-known hub of coal mines, a significant proportion of air pollution is due to the factories, industries and thermal power plants set up across the state.

Indoor air pollution is mostly understood to occur as a result of ambient air pollution where the polluted air from outside percolates indoors. Few doctors related indoor air pollution as a consequence of smoking indoors and use of mosquito coils. While the use of 'dirty fuels' such as biomass, wood, coal etc. is known to be prevalent especially across north India, not many doctors stated this as a challenge when countering the adverse effects of air pollution.

In the last few years, due to episodic incidences of air quality levels, Delhi has become the center of all activity and noise regarding air pollution. However, this has led to a common misconception that air pollution is a Delhi-centric problem. The bad air quality levels in Delhi especially during the winters, seems to have become a reference point for all across the country.

As one physician commented on the levels in their city:

> ***"The Kerala media does talk about it. But we are not as obsessed as the Delhi media because we don't see that extent of pollution..."***

Another respondent commented on how air pollution is not a focus in other parts of the country:

> ***"...no disastrous things or any other events, have happened because of this air pollution, what happened in Delhi bureaucrats are talking with each other and lot of things are happening...that much like in Delhi is not happening here"***

**The bad air quality levels in Delhi especially during the winters, seems to have become a reference point for all across the country.**

## 5.2. Training in air pollution and associated health risks

Most doctors reported that the topic of 'air pollution', in particular was not a part of their medical curriculum in any detail. It used to be present in some part in the respiratory medicine curriculum as well as in the preventive and social medicine curriculum but not in the detail required or needed to counter its adverse effects on health. Some respondents claimed that with increasing episodic incidents of rising air pollution leading to respiratory and other health issues, there is now a recent practice of adding this topic to the curriculum. These reports however, remain unconfirmed. Most categories of respondents stated learning about the diseases associated with air pollution which can lead to the correlation that air pollution may be a risk factor for that particular disease.

> ***"...not discussed in forums such as general pediatrics. separate chapter for allergic rhinitis in the academy where discussion on air quality happens."***

Given that air pollution has become a serious threat to life across the world and especially in India, surprisingly air pollution is yet to find a place in formal conferences or meetings/workshops/continuing medical education (CME) fora or informal meetings of doctors. There are hardly any conferences with sessions solely dedicated to the topic of environmental health or air pollution in the country. But as one pulmonologist shared, he went for a conference to Delhi during winter season and everybody seemed to be talking about air pollution being so evident. Out of all the categories of doctors interviewed, only pulmonologists and in few cases, pediatricians, mentioned air pollution starting to become a topic which is discussed by doctors. As a leading pulmonologist stated:

> ***"...in a normal doctor meeting with other colleagues it never comes in the discussion. It is only in a specialized group it comes. I think it is not much important for other doctors."***

Cardiologists have a difficult time associating air pollution as a health risk factor with their general practice:

> ***"...passive mention in some chapters. Even in cardiology forums the discussion about air pollution is not that robust. In many of the conferences we are attending, air pollution as a specific risk factor has not been stressed upon. That due importance has not been given."***

Another doctor responded by saying that air pollution is an issue to be taken care of by the administration and therefore they do not talk about it:

> ***"...to be taken care of by the administration and by the big authorities. Doctors, of course can only educate the patient but we cannot improve upon our transportation system. We cannot do much hence don't talk about it that much."***

For most respondents, newspapers and television were the main sources of learning about air pollution. According to most respondents across all states, air pollution was covered on the television and newspapers as an issue prevalent in Delhi primarily and only the local news channels and newspapers there usually cover the issue of air pollution. Some of the respondents, from Kochi and Raipur specifically, however, said that the display boards showing the air quality levels in particular areas of the city also helped them know about the air quality.

It is mostly out of personal interest that doctors start to read up and learn about air pollution and associated health risks to then actively engage in the subject. For instance, only two doctors (a pediatrician in Lucknow and a

pulmonologist in Kochi) during the course of this study wanted to engage and take steps to help create awareness by getting involved in discussions around air pollution.

## 5.3. Practice of environmental history taking

Most respondents stated history taking as a central part of their practice. This includes taking into account the socio-economic background of patients and their environmental surroundings. Interestingly, while pediatricians mentioned children (and in some cases, the elderly) to be the most vulnerable to indoor and outdoor air pollution, cardiologists did not particularly relate to air pollution as a risk factor in their practice and placed much more importance on a history of hereditary factors leading to heart disease. According to a cardiologist:

> ***"I won't be asking for air pollution since most of the time the conventional risk factors will be there. If I don't see any conventional risk factors in this...a patient in early 30s, he is not a smoker, no family history...I would be asking specific occupation, specific exposures..."***

Cardiologists stated smoking as "the most conventional risk factor". In some cases, it may be difficult to correlate, for instance, a person who works as a painter will get exposed to chemicals such as lead and others in the paint but may also be a smoker. When asking about history, cardiologists mostly refer to medical history of diabetes, blood pressure etc. in addition to practices such as smoking. Therefore, air pollution is not on the top of their minds when treating patients who come with symptoms/complaints relating to cardiovascular diseases.

> ***"...I have specifically not seen any or have thought about this earlier, but I do give suggestions about preventing oneself from pollution..."***

In contrast to this, pulmonologists and pediatricians asked patients about their surroundings and environment. During history taking of patients, they stated asking questions about the location of their houses – whether they lived too close to the main roads or factories which would increase their exposure to air pollution; their housing - whether they lived in small areas with poor ventilation, their preferred method of cooking and the fuel which they used for cooking and heating purposes. In addition, they also asked if family members smoked inside the house leading to exposure to very high concentrations of particulate matter; whether they used mosquito coils and agarbattis in closed rooms, etc. Since there is a higher footfall recorded in public hospitals, from nearby villages and towns as well, the question of socio-economic status during history taking becomes all the more relevant. Doctors in public hospitals, therefore, categorically asked questions on the above parameters and the exposure of the vulnerable groups, namely children and older people to these sources.

## 5.4. Relating the Impacts of Air Pollution on Health in their Practice

According to the WHO, air pollution results in a higher risk of cardio-vascular diseases, chronic and acute respiratory diseases, lung cancer, chronic bronchitis, acute respiratory infections in children, asthma, low birth and pre-term weight, among others (59). However, despite evidence, air pollution is still not seen as a big problem by people and doctors alike. During the course of this exercise, many respondents did not think of it as a major concern:

> ***"I would not call it such a major factor even though it is indeed one and we have lot of patients coming in with air pollution related diseases..."***

While most doctors may correlate the effect of air pollution on the respiratory system, many (even cardiologists in some cases) are not aware of the other adverse effects of air pollution on the cardiovascular system.

> ***"To tell you frankly, until you people asked I was not thinking of air pollution in my day to day practice. I don't think that many cardiologists are thinking in that direction about the patients...that this symptom or disease was triggered by recent exposure to air pollution..."***

It was observed that pediatricians and pulmonologists seemed to be the most sensitive to accepting air pollution as a serious health risk factor. They regularly asked for symptoms such as cough, sneezing, breathlessness, etc. in patients who they think may be exposed to air pollution. Pediatricians and pulmonologists agree to have witnessed rising incidences of upper respiratory tract infection, lower respiratory infection, lung cancer, pneumonia, bronchitis, allergic rhinitis, other allergies, etc. and relate indoor cooking using biomass as a common factor especially in rural India. For pediatricians, even shifting of localities to more open, green spaces seem to have had benefits and has resulted in improvement of their patient's health.

Respondents from other categories mentioned chronic obstructive pulmonary disorder (COPD), chronic bronchitis, interstitial lung disease, etc. as health issues arising out of air pollution but could not relate this to their practice. Cardiologists in general did not relate much with the topic of air pollution and also did not necessarily spend much time on patient's exposure to environmental health hazards during their interactions.

In the words of one respondent:

> ***"Intervention is the only prevention"***

## 5.5. Linking existing data on exposure to air pollution with health impacts

While pulmonologists and pediatricians corroborate with evidence linking air pollution with adverse impacts on health especially diseases such as, asthma

and respiratory tract infections, COPD, lung cancer, the other respondents suggest lack of sufficient evidence base to effectively link exposure to air pollution as a serious risk factor over other factors such as smoking.

At the hospital facilities themselves, data is not properly maintained due to the high footfall and lack of enough staff, especially in government facilities. This, therefore, makes it extremely difficult to correlate increasing levels of air pollution across the country with rates of hospitalization or in some cases, even death. Even for private hospitals with their own hospital management information systems, morbidity and mortality may not directly be correlated with exposure to air pollution as a risk factor.

> ***"Air pollution does not tell us in definitive ways if it has caused a certain problem. I deal with patients who suffer from cardio vascular diseases. Air pollution might have played a role at some point but to what extent and when is not known. Therefore, I cannot rely on air pollution as a cause"***

Doctors across the country believe that there is need for more research studies in India which provide a strong evidence base linking air pollution and its impact on the cardiovascular system, among others. However, none of the doctors interviewed (in public as well as private hospital settings) wished to conduct such study themselves.

## 5.6. Doctors as 'drivers of change' in policy

> ***"The problem is that this air pollution is having very chronic effect, we can't recognize it one day, and the problem with us that as long as anything will not happen immediately, we will do nothing. If you will survive in this kind of pollution you will suffer with heart disease after 10 years so 10 years is a long period. So how will you bring it in public awareness, so that people realize, that we have to work on it."***

While doctors across categories recognize the harmful effects of air pollution, they believe that they themselves cannot make much of a difference. Almost all doctors, across study sites and categories, stated that the government should do more and that policies were just not enough. Most suggested that diesel vehicles be phased out and more solar or electric powered vehicles be promoted. They believe that if the government enforces laws more stringently, it would make people more aware of and take steps to combat air pollution. They also suggest that once we have solid data backed by research, the government would start to take air pollution as a problem more seriously and take action. They believe that small actions can play a big role in combating the enormous problem of air pollution currently being witnessed by the country. Incidentally so, none of the respondents believed that doctors or their community could become active voices of change and influence policymaking in the country.

# 6. Way Forward

## 6.1. Increasing awareness about air pollution within the medical fraternity

The ill effects of air pollution are most perceptible by doctors during the course of their practice. At the moment, they may not be able to associate the two but there is a pressing need for increasing the level of awareness among doctors and the medical fraternity in general. Healthcare providers should be trained to deliver air-pollution related information and advice, including harm-reduction strategies to their patients to protect themselves from harmful levels of exposure. Past experiences from US and Australia have shown the importance of unified voice from the health sector on issues of environmental pollution.

Past experience on inter-sectoral matters, such as tobacco control, has shown that sustained advocacy from a unified health sector has the potential to drive transformational change in policy and public opinion.

There is also a need to incorporate environmental health and associated risks in the medical curriculum and in allied health curricula education including nursing schools to raise awareness in the healthcare community. Based on our conversations with doctors during the course of this study, it was evident that air pollution is not being given due importance as a risk factor leading to a large proportion of deaths and DALYs in the country. Only pulmonologists reported learning about air pollution during their medical training at post-graduate level. This may explain why air pollution exposure is being linked to respiratory diseases but even now, after significant evidence has come about, doctors do not make the correlation with cardiovascular diseases, among

**Past experience on inter-sectoral matters, such as tobacco control, has shown that sustained advocacy from a unified health sector has the potential to drive transformational change in policy and public opinion.**

others. Developing and integrating material on environmental exposures into the medical curriculum, and supplementing the knowledge of current practitioners through short-term training programmes and continuing medical education credits, for example, would go a long way in addressing the knowledge-action gap with both physicians and their patients.

Medical associations can be powerful vehicles for raising awareness and can also become credible translators of scientific information to policymakers and to the public in general. Once the medical fraternity is itself more aware of the problem at hand and the mitigation measures, they can be advocates of change and engage the media as well as with the government and policymakers to influence decision making for cleaner, healthy air for all. Raising awareness on the impact of air pollution on health at an individual and community level can empower citizens to take action as well as continue to demand their right to clean air through legislative procedures and make clean air a national advocacy issue.

## 6.2. Data collection in hospital-based settings

A primary source of expanding the evidence base for health effects of air pollution is an adequate health information system. In India, healthcare providers are both private and public, therefore health outcome data sources are also from both these settings. Public sources for data include government-managed databases, population-based surveys and Health Management Information System (HMIS). Private sources primarily include hospital-based patient records and private diagnostic centers.

Avenues of health data outside government and private health records, as suggested by experts, include longitudinal cohorts in research studies, records from private practitioners, insurance claims, emergency ambulance calls. Potential future sources to collect primary data can include data collected from activity trackers and wearable devices. There is a strong need to develop and integrate health information systems and a comprehensive sentinel surveillance system (urban and rural) for regularly collecting health and environment data.

There is a need for expanding the health outcomes and indicators that are covered under various surveys, databases and registries. The overall health profile of India reflects a rise in chronic diseases but there is still a gap in adequate documentation on these conditions. For instance, the HMIS portal focuses heavily on MCH reporting, while there is little to no data on chronic diseases and health outcomes. Extension of HMIS beyond MCH reporting may provide a rigorous evidence base to design policy and monitor performance and quality of health services related to air pollution-related disease burden. While the national (NCD) programme has initiated some screening, there is no mechanism for follow-up and


**There is a strong need to develop and integrate health information systems and a comprehensive sentinel surveillance system (urban and rural) for regularly collecting health and environment data.**

treatment over time. An integrated system should be designed to track the health impacts of household energy use and ensure better patient care and follow-up.

In addition to this, even for data which is reported, delays in making this publicly available poses a barrier to informing policy-making and designing interventions. One of the biggest challenges which remains is that hospital-based data is not easy to source and access; even when government hospitals provide access, private hospitals may be reluctant. Lack of a system to access and analyse hospital-based information is a barrier.

## 6.3. Need for more long-term context-specific evidence base

The need for epidemiological evidence on the health impacts of air pollution cannot be stressed enough. A strong evidence base is essential in setting up of regulatory standards for pollution levels across the country. It also plays a key role in defining national and state health priorities and thereafter the allocation of funds to health related programmes.

There is therefore a need for studies on the long-term effects of exposure to air pollution. Though time series and cross-sectional studies provided some of the most consistent evidence of serious acute health effects of air pollution in North America, Europe and to some extent in Asia, chronic health effects estimates can only be generated through long-term observation of large population-based cohort or panel studies. Several long-term studies have been conducted in North America and Europe, the results of which provide a great wealth of evidence on long-term health effects but at relatively lower spectrum of exposures (below 50µg/m3 of PM2.5). This consequently means that comparative risk assessment may have underestimated the health burden for regions such as India and China which have higher exposures. As of now, only a handful of air pollution studies are ongoing in India and there is a need for long-term studies linking exposures to incidences of chronic cardiovascular and respiratory diseases.

**As of now, only a handful of studies are ongoing in India and there is a need for long-term studies linking air pollution exposures to incidences of chronic cardiovascular and respiratory diseases.**

## 6.4. Increasing monitoring and visualization of information for dissemination among the public

An efficient air quality management plan for any city necessarily requires adequate and appropriate air quality data along with source apportionment and emission inventory studies. Data sources for ambient air pollution levels in India includes a mix of government-run monitoring networks as well as private low-cost monitoring networks. The Central Pollution Control Board's NAMP is a nation-wide ambient air quality monitoring network. It can be considered a primary data source, used widely by experts as well.

NAMP is a primary source of ambient air quality data in India and has 703 stations, covering 264 cities/towns in 29 states and 5 UTs. $SO_2$, $NO_2$ and PM2.5 are monitored for 24 hours, twice a week, by the Central Pollution Control

Boards, State Pollution Control Boards, Pollution Control Committees and National Environmental Engineering Research Institute. Additionally, the geographical spread of NAMP stations covers more urban than rural areas. In effect, rural areas are under-monitored for ambient air quality. Air quality management then needs to take this into consideration as source contributions cannot be deduced. Although ozone is listed as a regulated pollutant, its monitoring is extremely limited in a few cities and is currently not reported under NAMP.

Further, CPCB also displays real-time pollutant levels on its portal and display boards installed at monitoring stations for public viewing. CPCB, however, limits access to industrial stack emissions database and pollutants data from monitoring stations installed within various major industries.

Efforts need to be made to disseminate air-pollution related information, especially for communities and vulnerable groups . The Ministry of Health and Family Welfare (MoHFW) can, through its network of health workers and primary health centres, disseminate information on air pollution as well as on inter-sectoral programmes or schemes which can reduce the burden of environmental exposures. Data should be made available in the public domain to raise levels of awareness and understanding of air pollution.

## 6.5. Role of Health Community in Creating Awareness

Health sector has been in the forefront for many behavioral change initiatives, for instance, tobacco use. The inadequacy in capacity to understand, prevent, and relate environmental health factors like air pollution and climate change to impacts on health needs urgent redressal. The health sector also needs to be in the forefront in building awareness and sensitizing the community about the effects on health of deteriorating regional air quality.

Doctors are the first point of contact for the community at large during air pollution episodes (crop burning, fire-cracker burning during winter, increased and sustained pollution levels due to winter inversion effect, etc.) and thus are expected to be aware of these issues not just for medical practice but also lend their knowledge and communicative capabilities to educate their communities and advocate for environmental issues of concern. In the current scenario, where public health is directly impacted from the closely linked environmental issues of air pollution and climate change, the responsibility of clear and precise health messaging coming from healthcare professionals has added value. Recent examples of health sector voices joining the larger community in advocacy and mass sensitization for environmental issues like air pollution and climate change will hopefully play a huge role in bringing about policy changes. This must be continued and amplified in the coming years through continued capacity-building of healthcare professionals as well.

**The inadequacy in capacity to understand, prevent, and relate environmental health factors like air pollution and climate change to impacts on health needs urgent redressal.**

# 7. Recommendations

This study sought to explore and establish for the first time, through a qualitative study and interview-based approach, the current status of knowledge, awareness and practice of health care professionals with regard to air pollution and its impacts on health. Findings from this work point to a less than adequate and appropriate level of awareness, often limited to certain domain specialists. The linkages between exposure to harmful levels of air pollutants and their myriad effects on different aspects of human health – respiratory, cardiovascular, neurocognitive development, pregnancy outcomes etc is not fully understood across all health sector practitioners. This gap in knowledge and awareness can have serious impacts on the way the disease burden due to air pollution is dealt with across healthcare in India. In light of the findings in the current study and the urgent need to build capacity to address the increasing burden of air pollution related diseases across all sections of the Indian population, the following recommendations are proposed:

**The linkages between exposure to harmful levels of air pollutants and their myriad effects on different aspects of human health is not fully understood across all health sector practitioners.**

i. The current curriculum for medical, nursing and allied healthcare professionals must be revisited and a substantial allocation for teaching of environmental health related topics like air pollution –related disease burden must be incorporated. Besides air pollution, related topics of climate change and their impacts on human health must be addressed. Undergraduate and post-graduate training must account for the relevant courses and trainings to equip future healthcare practitioners to address the growing burden of air-pollution related morbidity and mortality.

ii. The current health and allied professionals have several national and regional networks, often defined by domain specialization that meet

at regular intervals throughout the year at workshop and conferences. A strong push must be made for air pollution and health impacts discussions to be included in such fora.

iii. Short-term trainings and continuing medical education formats can also be used to build capacity for existing practitioners in all disciplines.

iv. Additional innovative platforms including e-courses, regular webinars, newsletters and medical print media can also be leveraged to enhance knowledge and awareness about air pollution.

v. In clinical practice, environmental history taking must become the norm. A WHO pediatric environmental history taking form (Green page) has been advocated, but is rarely used in practice. Appropriate history-taking and relating it to presenting signs and symptoms can help address many air pollution related illnesses in a timely manner. (https://www.who.int/ceh/capacity/paedenvhistory/en/)

vi. Clinical and epidemiological research through contextual studies in India for air pollution and its health effects must be encouraged to enhance the evidence base for use in effective policy-making. Appropriate research funding must also be made available to facilitate this through national agencies like the Indian Council for Medical Research and Department of Science and Technology, besides other funding agencies.

vii. The healthcare community must be empowered with information regarding air quality in their regional context through innovative methods such as mobile technology, radio, television and social media so they can use this information in preventive and curative care and in their daily interaction with patients.

viii. A unified and empowered health sector voice as advocates for environmental health issues can be leveraged to bring about changes in policy-making with a health-centric focus.

ix. Enhancing communication by healthcare providers about air pollution through all media can play a huge role in making communities aware about air pollution and its health effects, using appropriate personal protection and behavioral change to adapt to changing air quality in their region.

x. Integration of training in environmental exposure science, public health and core medical/nursing training to encourage transdisciplinary knowledge and a cadre of professionals who can holistically address the growing burden of air pollution and its effects on health is imperative.

**A strong push must be made for air pollution and health impacts discussions to be included in to be included in medical associations chapters, workshops and conferences.**

# 8. Conclusion

With the deteriorating air quality across large parts of India and the growing burden of morbidity and mortality from air pollution, it is increasingly important to build our health care capacities to address the changing disease profile. While recognizing the gaps that currently exist in our medical training in India, we provide recommendations to incorporate changes in the medical training for future under-graduate and post-graduate levels while proposing other strategies for current practitioners as well through conferences, workshops and virtual platforms. A sea change in our capacity building must be brought about with immediate effect to ensure that the knowledge, attitude, awareness and practice of healthcare practitioners in handling the growing burden of air-pollution related diseases in India is ensured.

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