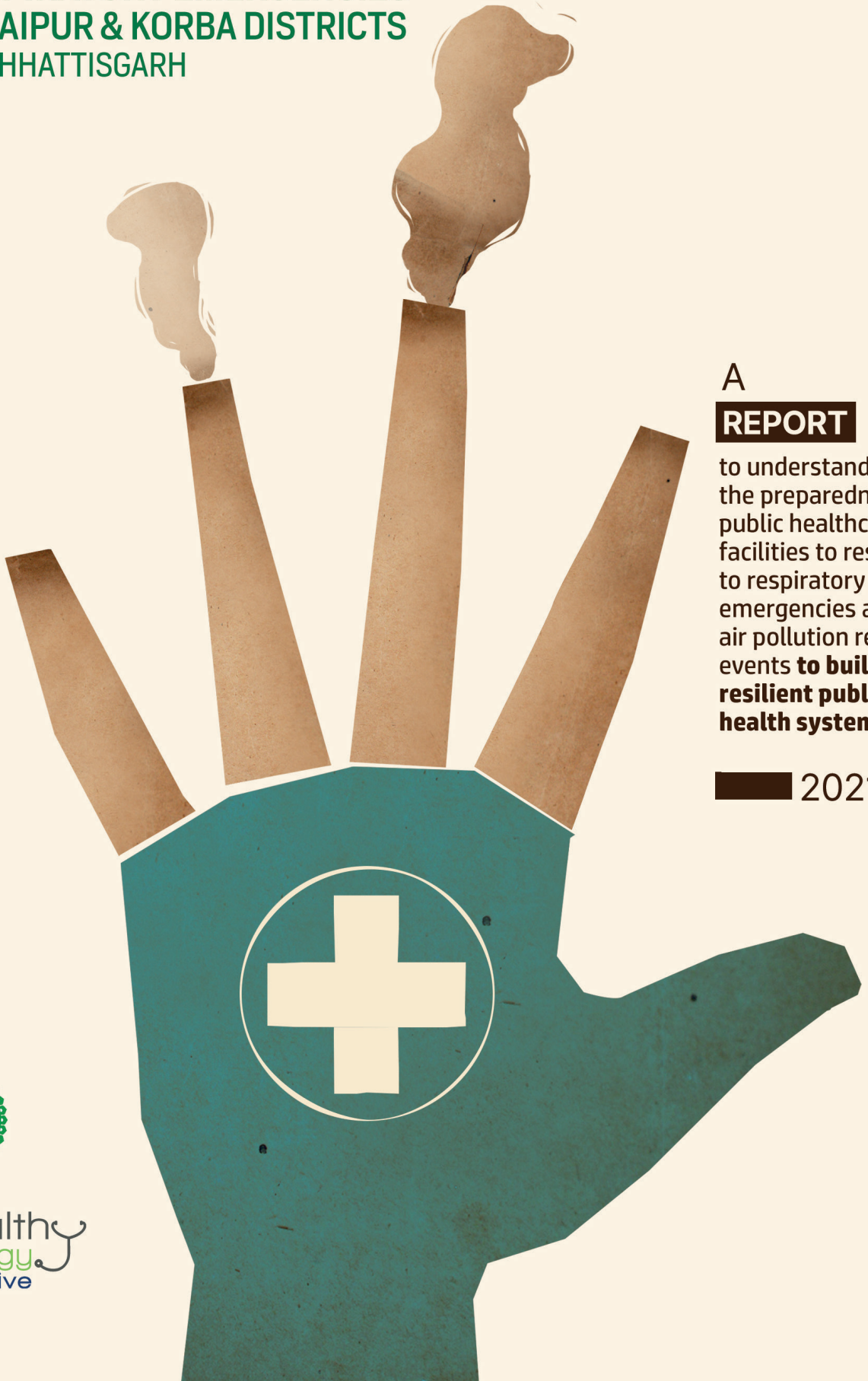
PUBLIC HEALTH PREPAREDNESS

TO TREAT PATIENTS FOR RESPIRATORY EMERGENCIES IN RAIPUR & KORBA DISTRICTS OF CHHATTISGARH



A

REPORT

to understand the preparedness of public healthcare facilities to respond to respiratory emergencies and air pollution related events **to build a resilient public health system**

2021

State Health Resource Centre Chhattisgarh

healthy energy initiative

LIST OF **CONTRIBUTORS**

This report was developed by State Health Resource Center, Chhattisgarh and we would like to thank:

Dr. Samir Garg, Executive Director,
State Health Resource Center, Raipur (SHRC)

Punita Kumar, Program Associate,
State Health Resource Center, Raipur (SHRC)

Interns at SHRC

Anirudh Bhargav & Animesh Panda

Healthy Energy Initiative, India

Shweta Narayan, Nitha Thankam George, Dr Gajapriya G, Pooja Kumar, Dr. Vishvaja Sambath

We would also like to thank our external advisors for their feedback and valuable comments that have strengthened the report:

Dr. Prabir Chatterjee, former Executive Director, SHRC

Dr. Kamlesh Jain, State Nodal Officer of National Program of Climate Change and Human Health, Directorate of Health and Family Welfare, Government of Chhattisgarh

Dr. Ravindra Khaiwal, Nodal Faculty, Centre of Excellence Department of Community Medicine & School of Public Health, PGIMER Chandigarh

CONTENTS

EXECUTIVE SUMMARY

Chhattisgarh is a state with rich natural resources and serves the entire nation with more than 17% of the coal reserves and about 15% of the steel production. With more than 156 mineral-based industries in the state, Chhattisgarh is also one of the worst affected due to air pollution.

Air pollution is a public health emergency, according to the World Health Organization, every day around 93% of the world's children under the age of 15 years (1.8 billion children) breathe air that is so polluted it puts their health and development at serious risk. Health workers from the pollution impacted communities in Chhattisgarh report that they see more and more cases of premature births, low birth weights, and stillbirths in their communities, something that was unheard of a few years ago.

In addition, the shortage of hospital beds and oxygen and the subsequent loss of lives during the deadly second wave of COVID-19 in India exposed the weakness of the country's health systems. Learning from this episode and seeing the link between health impacts of air pollution and COVID vulnerability of the populations, the State Health Resource Centre, Chhattisgarh, began a process of assessment of the health infrastructure preparedness for air pollution vulnerability in the State.

The mitigation measures to air pollution at the hospital/ health center level play an important role in addressing the impact of air pollution on health. The health sector needs to be equipped with adequate resources in terms of manpower, diagnostic tools, availability of drugs, etc. to manage the higher patient load at times of air pollution-related emergencies. Therefore, it becomes crucial to know the level of preparedness of the healthcare facilities to respond to any air pollution-related events. This knowledge will also help the policymakers frame policies that help mitigate the air pollution-related health crisis and build a resilient healthcare system.

A total of fifty-six public health facilities were surveyed in this study, out of which 31 were from Raipur and 25 from Korba. Out of the 56 facilities, three were tertiary care centers i.e., one medical College and two district hospitals, the remaining fifty-three (53) were Urban and Rural Community Health Centers, Primary Health Centers, and Urban Primary Health centers.

The respondents in the survey included Medical superintendents, Civil surgeons, Block Medical Officers, Medical Officers, Assistant Medical officers, Rural Medical assistants. They shared about the availability of drugs to handle respiratory emergencies, the availability of human resources in association with respiratory health, and awareness programs or training of the staff and community on respiratory illnesses.

FINDINGS

The assessment found major gaps in health services provided by the health centers in severe air pollution impacted regions. Some of the key findings from the assessment are:

- There is a need for trained health professionals at the primary and secondary levels of health facilities to attend to respiratory emergencies.
- There is a need for suitable respiratory diagnostic tools at primary and secondary health care facilities.
- There is a need for a spirometer for lung function tests at District Hospital Raipur.
- There is a need for trained spirometer technicians or staff at District Hospital Korba.
- There is a need for respiratory emergency drugs in all health facilities, especially at primary and secondary levels.
- Health workers need to anticipate respiratory emergencies and make planned interventions including various community awareness programs.
- There is a good follow-up system by public health facilities in place for the patients in general.
- Most follow-ups of the patients are done by health facilities through home visits and telephone.

RECOMMENDATIONS

- Primary and secondary public health facilities need to be prepared for respiratory emergencies with trained health professionals for treatment intervention. It is important to have specialist doctors at the CHC and below hospitals, as these facilities cater to most of the population. The state health department should train the general doctors on emergency care for respiratory illness to take care of emergencies and refer the patient to a specialist once the emergency is tackled.
- Appropriate diagnostic tools like spirometers must be procured immediately at district and PHC levels, in addition, the available paramedic staff should be adequately trained to handle the equipment. Health facilities should also be equipped with appropriate medicines to tackle respiratory emergencies.
- Given the need for trained health professionals in the health department, the technical capacities of the existing health professionals need to be strengthened through capacity-building training. They could be stratified as – Human Resource Training on – diagnostic tools (Spirometer, ECG reading) - Training for Diagnosis, and line of treatment to utilize the health facility for respiratory emergencies. This could lead to improving the preventive action for respiratory illnesses through screening and surveillance and addressing follow-up treatment.
- Training for the medical practitioners on 'Diagnosis and Line of treatment' for respiratory emergencies and illness at the primary and secondary level should be provided every quarter. IEC materials for health professionals and hospital staff should be provided and regularly updated.
- ASHAs services should also be utilized to spread awareness on ambulance services for Acute Respiratory Illnesses as people are not aware of it. Training ASHA workers as messengers on air pollution and health are essential.
- The State should establish Surveillance on illnesses due to air pollution to help understand the health problems in the area in a better manner.
- There should be a timely issue of alerts/warnings on health risk factors related to the air quality level (AQI) and weather conditions like temperature, humidity, etc., obtained from IMD/Pollution Control Boards to the health professionals and the common people.
- Patients should be encouraged to visit the public health facility to avail treatment and drugs through 'community outreach programs' if required for a longer period (for example 'Asthma').
- IEC materials for the communities should be provided within the health centers and at important locations within the communities – like a place of worship, schools, colleges, bus stops, and markets.
- The State should undertake programs to sensitize leadership and government officials - Since the districts face the acute issue of air pollution, local and state administrations should be actively involved to seek the alternative for mitigating the possible causes of air pollution. A graded health action plan like the one for Delhi and NCR can be replicated in these districts, including the implementation of suggestions highlighted in the 'Health Sector Preparedness for Air Pollution- Minimizing the health Impacts' released by the Ministry of Health and Family Welfare.
- A similar health infrastructure assessment should be conducted in all the districts of Chhattisgarh, especially in the regions more vulnerable to air pollution.

1. INTRODUCTION

1.1. GLOBAL SITUATION ANALYSIS

Non-Communicable Diseases (NCD) accounted for seven of the top ten causes of death globally in 2019 causing the death of 41 million people. These seven factors were responsible for 44% of all deaths, or 80% of the top ten. However, NCDs accounted for 74 percent of global deaths in 2019. Over the next 20 years, NCDs are expected to cost the global economy $ 47 trillion, or 75 percent of global GDP.

Chronic Respiratory Disease (CRD) is one of the four most popular NCDs worldwide. Asthma, chronic obstructive pulmonary disease (COPD), occupational lung disorders, sleep apnea syndrome, and pulmonary hypertension are all examples of CRDs. The burden of preventable CRDs has a significant negative impact on the quality of life and disability of those affected, with women, children, and the elderly being particularly vulnerable. CRDs have a strong and growing global Disability Adjusted Life Years (DALYs). For instance, consider the global mortality rate. COPD deaths rose by nearly 11% between 1990 and 2015, and if current trends persist, it will be the third leading cause of death globally by 2025. (1)

Air pollution is a public health emergency, globally, air pollution causes seven million premature deaths each year , that's 13 deaths every minute. It is a silent pandemic. According to the World Health Organization, every day around 93% of the world's children under the age of 15 years (1.8 billion children) breathe air that is so polluted it puts their health and development at serious risk . Health workers from the pollution impacted communities report that they see more and more cases of premature births, low birth weights, and stillbirths in their communities, something that was unheard of a few years ago.

1.2. SITUATION ANALYSIS OF INDIA

Every year, nearly 5.8 million people in India die from NCDs (heart and lung diseases, stroke, cancer, and diabetes) according to the World Health Organization (WHO). This means that 1 in every 4 Indians is at risk of dying from an NCD before reaching the age of 70.

According to the Ministry of Health and Family Welfare (MOHFW), Government of India (GOI) report "India: Health of the Nation's States," NCDs have increased their contribution from 30% of total disease burden-'disability-adjusted life years (DALYs) in 1990 to 55% in 2016, as well as the proportion of deaths due to NCDs (among all deaths) from 37% to 55%. This demonstrates a rapid epidemiological change in the disease burden on NCDs. (2)

Chronic respiratory diseases now account for 6.4 percent of total DALYs in India, up from 4.5 percent (95 percent UI 4.0-4.9) in 1990 to 6.4 (5.8-7.0) in 2016. In 2016, India accounted for 32.0 percent of global DALYs due to chronic respiratory disease. (3)

1.3. SITUATION ANALYSIS OF KORBA AND RAIPUR

Korba, a city in Chhattisgarh ranks 5th in the '**critically polluted area**' category according to a study by Central Pollution Control Board (CPCB) in 2017. The region is a hub of coal mines and power plants. Many coal-based thermal power plants like the National Thermal Power Corporation and Chhattisgarh State Electricity Board among others are located in Korba making it a power hub not only for the State of Chhattisgarh but for North and Central India.

Raipur the capital city of the State of Chhattisgarh is the 7th most polluted city in the world according to the WHO reports of 2016. The city has grown with scant regard for industrial zoning as a result is surrounded by sponge iron factories and brick kilns, with most of these industries in a residential area. Both Korba and Raipur have also been listed in the 122 non-attainment cities by Central Pollution Control Board under the National Clean Air Program (NCAP).

According to the World Health Organization (WHO), 37 Indian cities are among the top 100 cities in the world with the worst PM10 pollution, with Delhi, Raipur, Gwalior, and Lucknow among the top ten (WHO, 2014). (3)

1.4. AIR POLLUTION AND COVID VULNERABILITY

Emerging research is indicating that people affected by air pollution are more vulnerable to the risks and complexities of COVID-19. The latest study (4) from Harvard University's TH Chan School of Public Health has found a correlation between air pollution and COVID-19 deaths in the US. "The results of this paper suggest that long-term exposure to air pollution increases vulnerability to experiencing the most severe Covid-19 outcomes." Earlier, a paper published by the Italian Society of Environmental Medicine (5) suggests that "the rapid increase of contagion rates that has affected some areas of Northern Italy could be tied to atmospheric particulate pollution acting as a carrier and booster there". A recent study has also estimated that fossil fuel-related emissions contributed to as high as 22% of COVID-19 mortality in South Asia (6).

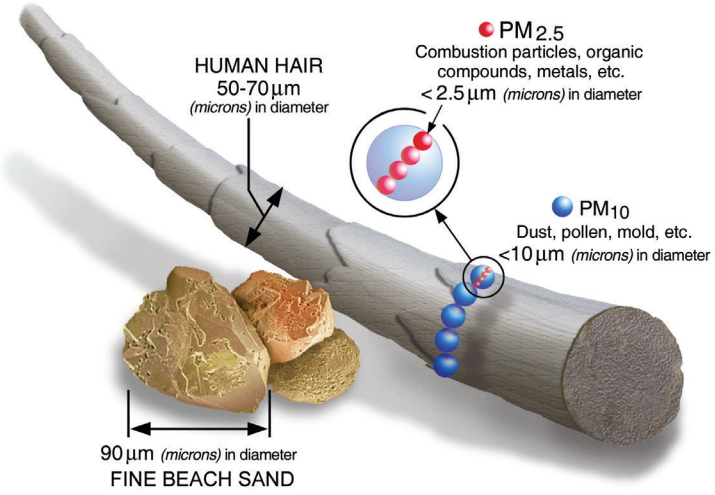
1.4. IMPACT ON HEALTH

In India, air pollution claimed the lives of 167 million people (95 percent confidence interval: 142–192) in 2019, accounting for 178% (158–195) of the country's total deaths. The majority of these deaths were caused by air pollution in the environment (098 million [077–119]) and the home (061 million [039–086]). From 1990 to 2019, the death rate due to household air pollution decreased by 642% (522–742), while the death rate due to atmospheric particulate matter pollution increased by 1153% (283–3444) and the death rate due to ambient ozone pollution increased by 1392% (965–1958). (7)

Total premature mortality due to pollution from coal-fired TPPs is projected to increase by 2-3 times by 2030, from 186,500 to 229,500 per year. By 2030, the number of asthma cases linked to coal-fired TPP pollution will have risen to 42.7 million.

The public health effects, according to the Lancet report, will be serious. Sulfur dioxide (SO_2) and nitrogen oxides (NO_x) are released during coal combustion, resulting in the production of fine particulate matter ($PM_{2.5}$, or particles smaller than 2.5 m in diameter) and ozone. $PM_{2.5}$ raises the risk of respiratory and cardiovascular disease-related premature death. It is the world's most dangerous air pollutant to human health. (8) Surface ozone is also a major concern for public health and ecosystems. (9) The type of coal combusted, the type of boiler used, and the pollution controls in place can all affect SO_2 and NO_x emissions at a coal plant. (10)

Particulate matter is made up of small particles smaller than 2.5 micrometers ($PM_{2.5}$) and larger particles up to I0 micrometers, (PM_{10}) and it is generated by coal combustion. Smaller particles (less than $PM_{2.5}$) penetrate further into the airways than PM_{10} and are thus thought to pose a greater risk to human health.



The US Environmental Protection Agency concluded in a study reviewing over 40 studies on the health effects of exposure to small particulate matter ($PM_{2.5}$) that PM is likely to cause respiratory problems, the development of asthma, and a decline in lung function in children. According to the findings, an improvement in PM of I0 µg/m' is correlated with a 1% to 3.4 percent decrease in FEV1 ***(FEV1 is the amount of air you can force from your lungs in one second. It's measured during a spirometry test, also known as a pulmonary function test, which involves forcefully breathing out into a mouthpiece connected to a spirometer machine.)*** a lung function indicator, in asthmatic children.

It also found that exposure to $PM_{2.5}$ increases emergency room visits and hospital admissions for respiratory-related symptoms including infections and COPD. (11) Epidemiological data from Australia and New Zealand, Mexico, Canada, and Europe shows that these respiratory health effects are seen in populations exposed to PM all over the world. Aside from respiratory illnesses, poor work power, cancer, and cardiovascular complications are all normal. (12)(13)

Pollution from fine particulates and sulfur oxide has been linked to all-cause, lung cancer, and cardiopulmonary mortality. Each 10- µg/m^3 rise in fine particulate air pollution was associated with a 4%, 6%, and 8% increase in mortality from all causes, including cardiopulmonary disease, and lung cancer, respectively. (14)

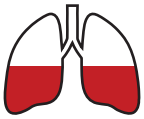
SHORT TERM IMPACT

- Headache
- Nausea
- Cough
- Breathlessness
- Dry Skin
- Acne
- Allergic Reactions
- Hairfall
- Poor Hair Texture
- Irritation in Eyes
- Nose & Throat

29% of deaths from **LUNG CANCER**

24% of deaths from **STROKE**

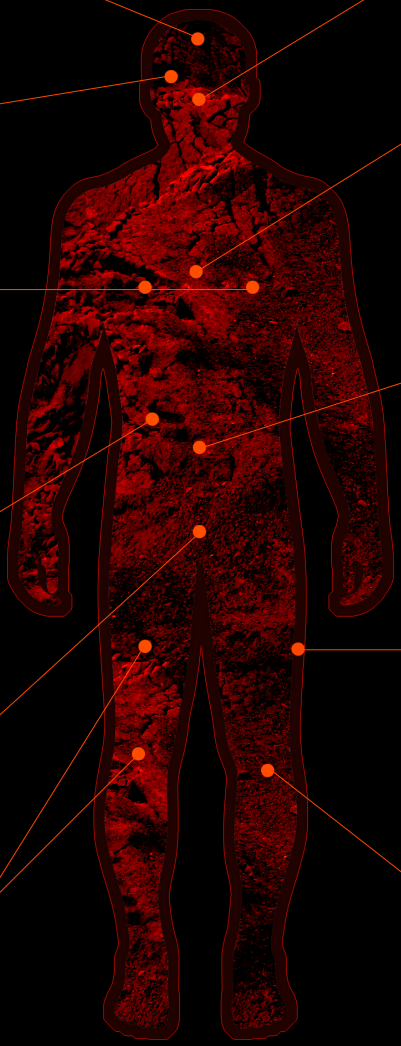
25% of deaths from **HEART DISEASE**



43% of deaths from **LUNG DISEASE**

LONG TERM IMPACT

Organs Affected by Air Pollution



Brain

Stroke, Dementia, Parkinson's Disease, Poor Mental Health

Eyes

Conjunctivitis, Dry Eye Diseases, Blepharitis, Cataracts

Lungs

Chronic Obstructive Pulmonary Disease, Asthma, Lung Cancer, Chronic Laryngitis, Acute and Chronic Bronchitis

Liver and Pancreas

Hepatic Steatosis, Hepatocellular Carcinoma, Type I and Type II Diabetes

Urogenital

Bladder Cancer, Kidney Cancer, Prostate Hyperplasia

Bone and Joints

Osteoporosis, Factures, Rheumatic Diseases

Nose

Allergic Rhinitis (Hayfever)

Heart

Ischaemic Heart Disease, Hypertension, Congestive Heart Failure, Arrhythmias

Gastrointestinal

Gastric Cancer, Colorectal Cancer, Inflammatory Bowel Disease, Crohn's Disease, Appendicitis

SKIN

Atopic Skin Disease, Skin Aging, Urticaria, Dermographism, Seborrhea, Acne

BLOOD

Leukaemia, Intravascular Coagulation, Anaemia, Sickle Cell Pain Crises

Effects in all parts of the body

Metabolic Syndrome, Obesity

The following are some of the possible negative health effects associated with inhalable coal dust:

Respiratory Effect

Contaminants from coal combustion include particulate matter (PM), sulfur dioxide (SO_2), and nitrogen oxides such as NO_2, which cause harm to the airways and lungs by cell damage caused by oxidizing molecules in pollutants. Inflammation, cytotoxicity, and cell death result as a result of this.

The Cardiovascular Effect

Cardiovascular effect of coal-fired power plants is largely due to particulate matter emissions, which contribute to the global burden of cardiovascular disease. Particles with a diameter of fewer than 2.5 microns ($PM_{2.5}$) have been related to cardiovascular disease and death. Cardiovascular injury is caused by the same mechanism as respiratory injury: oxidative stress caused by oxidizing molecules in toxins causes inflammation and cytotoxicity.

Adverse effects of inhalable coal dust.

Possible adverse health effects associated with inhalable coal dust include:

Extra thoracic Region: Nasal Cancer, Sinusitis, Buccal and lip cancer Pharyngeal and laryngeal cancer, Gastric Cancer, (Throat and Eye Irritation)

Tracheobronchial Region: Chronic bronchitis, Chronic obstructive airways disease and loss of FEV1b, Alveolar Region, Coal Workers Pneumoconiosis (CWP), Silicosis, Emphysema Tuberculosis, Caplan's Syndrome. (13)

Asthma

Asthma is a long-term condition affecting children and adults. The air passages in the lungs become narrow due to inflammation and tightening of the muscles around the small airways. This causes asthma symptoms: cough, wheeze, shortness of breath, and chest tightness. Apart from many one of the factors triggering asthma is exposure to a range of environmental allergens and irritants that are also thought to increase the risk of asthma, including indoor and outdoor air pollution, house dust mites, molds, and occupational exposure to chemicals, fumes, or dust. (15) Asthma is not a curable condition, but management techniques focus on keeping the disease under control and lowering the associated morbidity and mortality. To effectively treat asthma, it may be necessary to consider not only guideline-based clinical approaches but also socio-environmental risk factors. To manage the disease in developing countries, all hospitals must provide sufficient public health facilities and services, as well as have standard treatment. (16)

1.6. IMPACT ON ECONOMY DUE TO AIR POLLUTION

In India, economic losses resulting from premature deaths and morbidity due to air pollution totaled US$288 billion (214–374) and $80 billion (59–103), respectively, in 2019. This cumulative loss of $368 billion (274%–477% of India's GDP) amounted to 136 percent of the country's GDP (GDP). The economic loss as a percentage of state GDP varied 32 times between states, ranging from 067 percent (047–091 percent) to 215 percent (160–277 percent), with the lowest per-capita GDP states of Uttar Pradesh, Bihar, Rajasthan, Madhya Pradesh, and Chhattisgarh suffering the most. In 2019, Delhi had the highest per-capita economic loss from air pollution, followed by Haryana, with a 54-fold difference across all states. (17)

Additional health effects from coal-based pollution were quantified in the report, including a high number of heart attacks, emergency room visits, hospital admissions, and missed workdays. The study estimates that the monetary cost of these health consequences is between Rs. 16,000 and Rs. 23,000 crores per year. (18)

2.
RATIONALE FOR THE STUDY

Chhattisgarh is a state with rich natural resources and serves the entire nation with more than 17% of the coal reserves and about 15% of the steel production. With more than 156 mineral-based industries in the state, Chhattisgarh is also one of the worst affected due to air pollution.

Among COVID-19 patients, relatively greater proportions of patients with COPD received mechanical ventilation and intensive critical care. COPD is an independent risk factor for all-cause mortality in COVID-19 patients in Korea (16). Attention to local action is necessary for communities where there are hazards and make the population more vulnerable to impacts of pollution resulting from man-made disasters, industrialization, unplanned development, fossil fuel-based activities, etc. Chhattisgarh is a state with rich natural resources, serves the entire nation with more than 17% of the coal reserves and about 15% of the steel production. Due to rapid industrialization and the shifting needs of the state, there is a need to assess the vulnerabilities and be prepared for the state to manage and mitigate the needs of the pollution-impacted communities.

With rapidly rising coal-based industrialization in the state, air pollution is an inevitable threat for the residents of Chhattisgarh. In addition to industrial activities, climate change is also found to be associated with aggravating air pollution and resulting in various health hazards. People seek healthcare services from health facilities for managing the impacts and hence, the health sector has to be well prepared for managing crises. Several studies have shown that the rise in ambient air pollution is related to increased hospital emergency admission rates. A positive association has been found between environmental PM_{10} and ozone concentrations and the daily number of emergency room visits due to asthma and acute respiratory diseases, even with levels lower than the Mexican standard levels. Also, a synergic effect between PM_{10} and O_3 was found.

In addition, the shortage of hospital beds and oxygen and the subsequent loss of lives during the deadly second wave of COVID-19 in India exposed the weakness of the country's health systems. Learning from this episode and seeing the link between the health impacts of air pollution and COVID vulnerability of the populations, a process of assessment of the health infrastructure preparedness for air pollution vulnerability becomes necessary.

The mitigation measures to air pollution at the hospital/ health center level play an important role in addressing the impact of air pollution on health. The health sector needs to be equipped with adequate resources in terms of manpower, diagnostic tools, availability of drugs, etc. to manage the higher patient load at times of air pollution-related emergencies. Therefore, it becomes crucial to know the level of preparedness of the healthcare facilities to respond to any air pollution-related events. This knowledge will also help the policymakers frame policies that help mitigate the air pollution-related health crisis and build a resilient healthcare system.

3.
AIM

To assess the Public Health Facility preparedness to treat patients for respiratory emergencies in Raipur and Korba Districts of Chhattisgarh.

4.
OBJECTIVE

- ☑ To assess the availability of human resources in association to treat respiratory emergencies.
- ☑ To assess the availability of diagnostic tools to handle respiratory emergencies.
- ☑ To assess the availability of drugs to handle respiratory emergencies.
- ☑ To assess community awareness programs or training of the staff and community on respiratory emergencies and illnesses.

5. METHODOLOGY

- The cross-sectional assessment of the public health facility was conducted in the Raipur and Korba Districts of Chhattisgarh. As per convenience, two districts have been chosen: Raipur and Korba. (The cities have thermal power plants, so the likelihood of respiratory illnesses is inevitably higher.)
- The data was collected over 3 months from March 2021 to May 2021.
- List of public health facilities (Urban and Rural) from selected districts are drawn from health. nic. in [website under Department of Health & Family Welfare, Govt of Chhattisgarh].
- Data was collected from Dr. B.R.Ambedkar Medical College and hospital; District hospitals (2), Community Health center Six (6).
- Primary Health Center (47) was randomly selected.
- Data was collected in a pre-framed semi-structured questionnaire with 65 questions capturing information related to human resource availability, capacity building, equipment availability, drug availability, referral and follow-up, and awareness of emergency helplines after the pilot testing of the questionnaire. (see Annexure 1 for a detailed questionnaire).
- Data was collected in Kobo collect the application – Kobo collects an Android-based Mobile Application tool to collect Answers with a GPS location tracker from the respondents.
- The data collected were compiled and analyzed in STATA and Microsoft Excel 2013. Descriptive analysis was done and proportions were identified for the study variables.

6.
RESULT AND **DISCUSSIONS**

A total of fifty-six public health facilities were surveyed in this study, out of which 31 were from Raipur and 25 from Korba.

Out of the 56 facilities, three were tertiary care centers i.e., one medical College and two district hospitals, the remaining fifty-three (53) were Urban and Rural Community Health Centers, Primary Health Centers, and Urban Primary Health centers.

The respondents in the survey included Medical superintendents, Civil surgeons, Block Medical Officers, Medical Officers, Assistant Medical officers, Rural Medical assistants. They shared about the availability of drugs to handle respiratory emergencies and the availability of human resources in association with respiratory health and awareness programs or training of the staff and community on respiratory illnesses.

Table 1: Details and Respondents of the Public Health Facility Surveyed

Type of Public Health Facility	Respondents	No of Public Health Facility		
		Raipur	Korba	Total
PHC + UPHC	RMA, MO, AMO	25	22	47
CHC	BMO	4	2	6
DH	Civil Surgeon	1	1	2
Medical College & Hospital	Medical Superintendent	1	0	1
TOTAL		**31**	**25**	**56**

6.1. HUMAN RESOURCES, EQUIPMENT, AND DIAGNOSTIC FACILITIES AT PUBLIC HEALTH FACILITIES FOR RESPIRATORY EMERGENCY

Table 2: Human Resources at Public Health Facilities for Respiratory Emergencies

Human Resources at the Facility	Medical College (N=1)	District Hospital (N=2)	CHC N=6	PHC N=47	Total N=56
Doctor with MD (General Medicine)	1	2	0	6	**9**
ECG Technician	1	2	1	0	**4**
Radiographer (X-RAY Technician)	1	2	4	5	**12**
Spirometry (PFT) Technician	1	0	0	0	**1**
LAB Technician	1	2	6	36	**45**

The study looked at the different types of human resources needed to tackle patients with problems due to air pollution, this included – Doctors with MD (General Medicine), ECG technicians, Radiographers (X-RAY technicians), Spirometry (PFT) technicians, and Lab technicians.

The study found that all these personnel was available at the Medical College. At district hospitals Doctors with MD (General Medicine), ECG technicians, Radiographers (X-RAY technicians) and Lab technicians were available but there were no Spirometry (PFT) technicians.

At the CHC level, none of them had had a Doctor with MD (General Medicine) and Spirometry (PFT) technician; all of them had lab technicians, 4 out of 6 CHCs had a radiographer (X-Ray technician) and only 1 out of the 6 CHCs had an ECG technician.

36 out of the 47 PHCs surveyed had lab technicians. Only 6 out of the 47 PHCs had a Doctor with MD (General Medicine), only 5 out of the 47 PHCs had a Radiographer (X-RAY technician, none of the PHCs had an ECG technician or a spirometry (PFT) technician.

Overall, the data in Table 2 indicate the lack of trained health professionals at primary and secondary healthcare facilities to respond to patients suffering from adverse health conditions due to air pollution.

Table 3: Equipment at the Public Health Facility for Respiratory Emergency

Equipment	Medical College (N=1)	District Hospital (N=2)	CHC N=6	PHC N=47	Total N=56
Oxygen Cylinder	1	2	6	44	**53**
Ventilators	1	2	1	N/A	**4**
Nebulizers	1	2	6	46	**55**
Spirometer	1	1	0	0	**1**
Spacer	1	1	0	4	**6**
Pulse Oximeter	1	2	6	45	**54**
Tracheostomy Kit	1	2	2	1	**6**
AMBU Bag	1	2	6	43	**52**
IEC Material	0	0	2	5	**7**

The study looked at the availability of various equipment critical in responding to the care of patients affected by air pollution. These included – oxygen cylinders, ventilators, nebulizers, spirometers, spacers, pulse oximeters, tracheostomy kits, AMBU bags, and IEC materials for staff.

The study found that the medical college has all the equipment listed in the survey except for IEC materials.

While both the district hospitals surveyed had oxygen cylinders, ventilators, nebulizers, pulse oximeters, tracheostomy kits, AMBU bags only one of the two had spirometers, spacers. Neither of the district hospitals had IEC materials for the staff.

All the 6 CHCs surveyed had oxygen cylinders, nebulizers, pulse oximeters, and AMBU bags. 2 out of the 6 CHCs surveyed had tracheostomy kits and IEC material and only 1 out of 6 had ventilators.

46 out of 47 PHCs surveyed in the region had nebulizers, 45 out of 47 had pulse oximeters, 44 out of 47 had oxygen cylinders, 43 out of 47 had AMBU bags. 5 out of 47 PHCs had IEC materials and 4 had spacers and only 1 PHC tracheostomy kit. While the ventilators data was not available, none of the PHCs in the region had spirometry available at their centers.

Table 4: Availability of Diagnostics at Public Health Facility

Diagnostic Availability	Medical College (N=1)	District Hospital (N=2)	CHC N=6	PHC N=47	Total N=56
Blood Test	1	2	6	44	**53**
X-ray Chest	1	2	4	4	**11**
ECG	1	2	1	0	**4**
ECHO	1	0	0	0	**1**
PFT (Spirometer)	1	1	0	0	**1**
Sputum CB NAAT/ True NAT	1	2	2	24	**29**

Data about the availability of diagnostic facilities indicate once again that the medical college and District hospitals are better equipped than the CHCs and PHCS. All diagnostic facilities – blood tests, chest X-rays, ECG, ECHO, PFT, and sputum CB were available at the medical college.

District hospitals were equipped with blood tests, chest X-rays, ECG, and sputum tests. Only one out of the two district hospitals had the facility for PFT tests, and none have a facility for ECHO tests.

At the CHC level, all centers had facilities for blood tests, 4 out of 6 had chest x-ray facilities. 2 out of 6 had sputum CB tests and 1 has ECG. None of the CHCs had ECHO or PFT test facilities.

Similarly, 44 out of 47 PHCs surveyed had facilities for blood tests, 24 out of 47 had facilities for sputum CB and 4 out of 47 had facilities for a chest x-ray. None of the PHCs had facilities for ECG, ECHO, and PFT.

Implications

CHC/PHC/UPHC are the centers for screening, referrals, and follow-ups for long-term treatment. This data indicated that these centers lack adequate equipment and specialized technicians to be able to screen the patients early.

It is essential to build the technical capacities within the existing staff to meet out the gap to not only address the preventive action for air pollution-related respiratory illnesses but also to address respiratory emergencies. Early detection of respiratory illnesses under the preventive action can provide timely care, early referral, and improve the prospects of early detection for compensation in case of silicosis/occupational health hazards.

Another important observation that emerges from the data in Tables 2 and 3 is concerning the Spirometry machines and technicians. According to the survey, there is a spirometry machine available in one of the two district hospitals. However, the data also reveals that none of the trained staff to handle spirometry machines are available at the district hospital. Thus, it is likely that the machine currently at the district hospital is either sitting idle or subjected to improper use, perhaps leading to an inappropriate diagnosis. This not only increases the health burden of respiratory health illnesses at the medical college level but also pushes the patients for quality care to private health care facilities which are far more expensive and unaffordable to many.

The data finally also indicates that there is very little awareness material (IEC) available at the health centers to educate patients and staff about the health impacts of air pollution and methods that people can adapt to protect themselves from the dangers of air pollution.

6.2. AVAILABILITY OF DRUGS AT PUBLIC HEALTH FACILITY

Air pollution affects the lungs and heart health, it is important to know what medicines are being prescribed at various health center levels to provide relief to the patients affected by the adverse health impacts of air pollution. The Respiratory emergency drugs in the survey were selected according to the Essential Drug List (EDL) Chhattisgarh 2020.

Table 5: Availability of Drugs of Respiratory Emergency at Public Health Facility

Respiratory Emergency	Medical College (N=1)	District Hospital (N=2)	CHC N=6	PHC N=47	Total N=56
Salbutamol	1	2	5	42	**50**
Prednisolone	1	2	3	31	**37**
Hydrocortisone	1	2	6	44	**53**
Epinephrine	1	2	5	29	**37**
Rotahaler	1	2	4	8	**15**
Rotacaps	1	2	4	7	**14**

Cardiovascular Emergency	Medical College (N=1)	District Hospital (N=2)	CHC N=6	PHC N=47	Total N=56
Enalapril	1	2	5	30	**38**
Telmisartan	1	2	5	17	**25**
Amlodipine	1	2	6	43	**52**
Diuretics	1	2	6	34	**43**
Aspirin	1	2	5	18	**26**

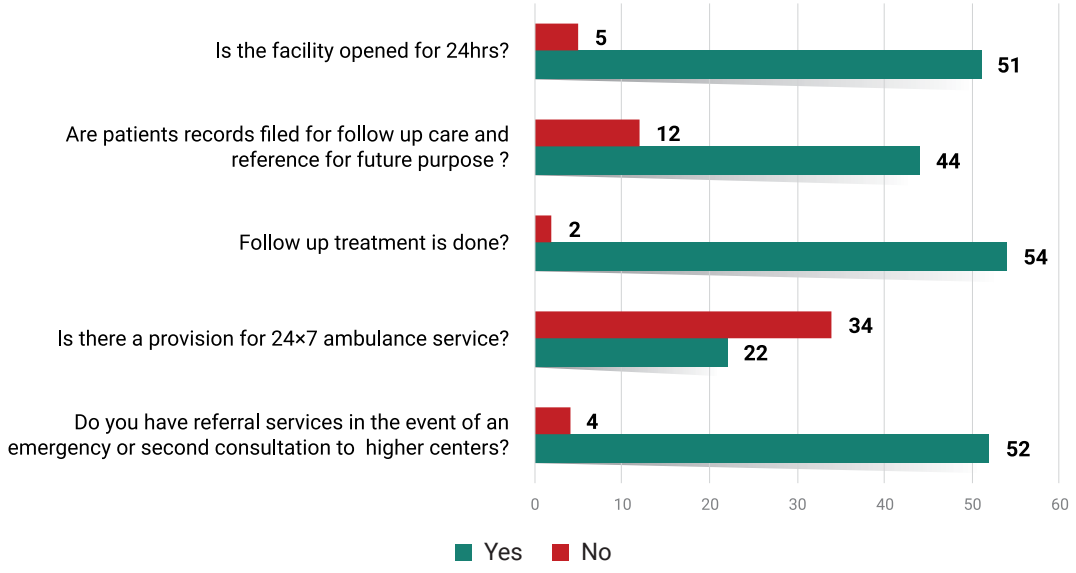
Data from the survey in Table 5 indicates that drugs related to managing respiratory emergencies are mostly available in all health facilities especially primary and secondary levels where most of the patients first report. However, critical drugs like Rotahaler and Rotacap, inhalers, and also respiratory emergency drugs that ought to be available for severe cases, are not widely available. The study found that Rotahaler was available in only 4 out of 6 CHCs and 8 out of 47 PHCs. Similarly, Rotacap was only available in 4 out 6 CHCs and 7 out of 47 PHCs.

One possible reason for the lack of availability of respiratory drugs at CHC and PHC levels could be that the health professional at this level may require training to make a diagnosis of respiratory illnesses and prescribe the line of treatment. This also links back to the unavailability of trained Doctors (MD, General Medicine) at the levels of CHCs and PHCs.

6.3. EMERGENCY, AMBULANCE, FOLLOW UP TREATMENT, AND TRAINING OF THE HEALTH PROFESSIONALS

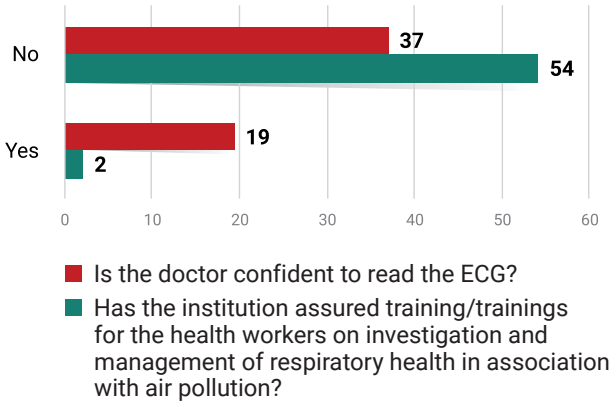
The majority of the health facilities remain open round the clock and most of them are maintaining patients records for follow-up care and reference for the future. Health facilities have a good follow-up and referral system in line. The follow-ups are done in two ways, by home visits, and by telephone. However, around thirty-four (34) health facilities reported the non-availability of ambulance services for respiratory emergencies. This may pose a challenge in delivering speedy assistance to patients.

Graph 1: Ambulance and Follow Up Treatment



The health professionals have expressed the need for the training and they expect the investigation and management of respiratory health (See graph 2). All the health facilities function round the clock hence providing support to the people in case of an emergency. Table 5 it is indicated that most of the public health facilities have most of the respiratory emergency drugs available as per the Chhattisgarh Essential Drug List. To complement the usage of the respiratory drugs available at the CHC and PHC levels, it is indeed necessary to have qualified health professionals preferably MD Medicine at the health centers. Though these postings may be a challenge for the health department perhaps due to the remoteness of the regions. It is important that adequate training is provided to the existing health staff to handle patients affected by air pollution.

Graph 2: Building Capacity of the Health Workers on Respiratory Health

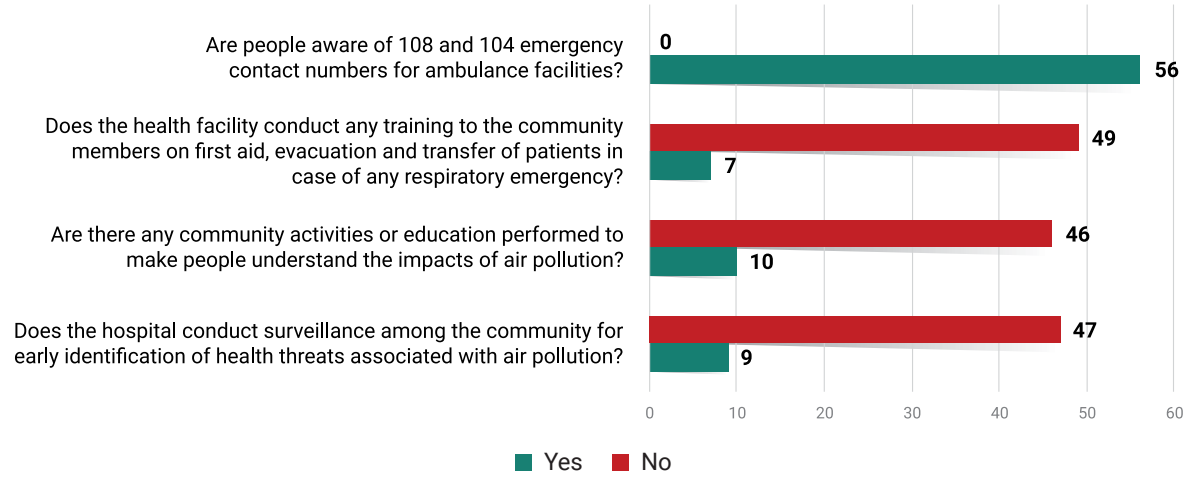


According to the WHO document on '*Clinical management of severe acute respiratory infection (SARI) when COVID-19 disease is suspected Interim guidance 13 March 2020*', Primary Health Centers are capable of handling emergencies related to Acute Respiratory Infection (ARI) and Severe Acute Respiratory Infection (SARI) with guidance, supportive management, trained human resources and availability of appropriate drugs. To address this, training on diagnosis and line of treatment for ARI and SARI to the health professionals at the primary level could strengthen the capacity and technical knowledge of the existing staff to observe better results on the existing 'Health and Wellness Center' apart from screening and surveillance which are the most important key role of the primary care.

Communities should be promoted to visit the public health facility for a continuous supply of respiratory drugs which are needed in the long run for non-communicable diseases including patients with respiratory illnesses, the asthmatic patients can avail of inhalers for longer and continuous treatment.

Follow-up is an important part of the treatment for ARI and SARI. Follow-ups are being done regularly by the health center through ANM/MPW/Mitanins. Follow-ups are done through home visits and telephone which is a good initiative and should be promoted. Primary and secondary health facilities' referrals should be considered at the tertiary level to process speedy compensations for occupational hazards.

Graph 3: Sensitization/Training & Education/Surveillance by Public Health Facility in the Communities



Communities are aware of 24×7 ambulance 108 and 104 but are not sure whether the ambulance service can also be utilized for respiratory emergencies. Seven (7) facilities have reported conducting training of the community members on first aid and transfer of the patients in case of any respiratory emergency; all these are primary health care facilities. Health professionals also expressed the need for training and training materials on the respective topic as they share Air pollution is one of the leading issues throughout the year. Nine (9) health centers are under active surveillance, one (1) is CHC, and eight (8) are PHC.

One of the possible reasons why communities are not using ambulatory services for respiratory emergencies is perhaps that they may not know that ambulances could be used for respiratory emergencies. This can also be interpreted that people lack to address respiratory emergencies as an immediate health need, hence making a delayed intentional choice to reach out to the health facility delaying the treatment. This behavioral risk factor for health can increase the health burden of respiratory illnesses also pushing the communities towards poor health quality, eventually leading to a vicious cycle of poor socio-economic conditions.

This has been noticed during the COVID-19 pandemic when people hesitated to go to the health facility unless they felt breathless hence many people required Intensive Care in the Intensive Care Unit (ICU). The PHCs and CHC 's could be the most relevant centers for the High Dependency Unit (HDU) and could be promoted for this to improve quality care for respiratory emergencies, treatment, and palliative care. Health professionals expressed the need for training and training materials on 'Air pollution' as it is one of the leading issues throughout the year indicating that they require much knowledge and materials to identify the suspects for early intervention. There are Nine (9) health centers are involved in active surveillance, one (1) is CHC, and eight (8) are PHC. More awareness and sensitization of the communities is needed in the communities for respiratory emergencies. Major reduction in the burden of respiratory illnesses will come from the interventions made in the communities and providing a continuous line of treatment through the public health facility.

7.
FINDINGS

The assessment found major gaps in health services provided by the health centres in severe air pollution impacted regions. Some of the key findings from the assessment are:

- ☑ There is a need for trained health professionals at the primary and secondary levels of health facilities to attend to respiratory emergencies.
- ☑ There is a need for suitable respiratory diagnostic tools at primary and secondary health care facilities.
- ☑ There is a need for a spirometer for lung function tests at District Hospital Raipur.
- ☑ There is a need for trained spirometer technicians or staff at District Hospital Korba.
- ☑ There is a need for respiratory emergency drugs in all health facilities, especially at primary and secondary levels.
- ☑ Health workers need to anticipate respiratory emergencies and make planned interventions including various community awareness programs.
- ☑ There is a good follow-up system by public health facilities in place for the patients in general.
- ☑ Most follow-ups of the patients are done by health facilities through home visits and telephone.

8. RECOMMENDATIONS

- Primary and secondary public health facilities need to be prepared for respiratory emergencies with trained health professionals for treatment intervention. It is important to have specialist doctors at the CHC and below hospitals, as these facilities cater to most of the population. The state health department should train the general doctors in emergency care for respiratory illness to take care of emergencies and refer the patient to the specialist once the emergency is tackled.
- Appropriate diagnostic tools like spirometers must be procured immediately at district and PHC levels, in addition, the available paramedic staff should be adequately trained to handle the equipment. Health facilities should also be equipped with appropriate medicines to tackle respiratory emergencies.
- Given the need for trained health professionals in the health department, the technical capacities of the existing health professionals need to be strengthened through capacity-building training. They could be stratified as – Human Resource Training on – diagnostic tools (Spirometer, ECG reading) - Training for Diagnosis, and line of treatment to utilize the health facility for respiratory emergencies. This could lead to improving the preventive action for respiratory illnesses through screening and surveillance and addressing follow-up treatment.
- Training for the medical practitioners on 'Diagnosis and Line of treatment' for respiratory emergencies and illness at the primary and secondary level should be provided every quarter. IEC materials for health professionals and hospital staff should be provided and regularly updated.
- ASHAs services should also be utilized to spread awareness on ambulance services for Acute Respiratory Illnesses as people are not aware of it. Training ASHA workers as messengers on air pollution and health are essential.
- The State should establish Surveillance on illnesses due to air pollution to help understand the health problems in the area in a better manner.
- There should be a timely issue of alerts/warnings on health risk factors related to the air quality level (AQI) and weather conditions like temperature, humidity, etc., obtained from IMD/Pollution Control Boards to the health professionals and the common people.
- Patients should be encouraged to visit the public health facility to avail treatment and drugs through 'community outreach programs' if required for a longer period (for example 'Asthma').
- IEC materials for the communities should be provided within the health centers and at important locations within the communities – like a place of worship, schools, colleges, bus stops, and markets.
- The State should undertake programs to sensitize leadership and government officials - Since the districts face the acute issue of air pollution, local and state administrations should be actively involved to seek the alternative for mitigating the possible causes of air pollution. A graded health action plan like the one for Delhi and NCR can be replicated in these districts, including the implementation of suggestions highlighted in the 'Health Sector Preparedness for Air Pollution- Minimizing the health Impacts' released by the Ministry of Health and Family Welfare.
- A similar health infrastructure assessment should be conducted in all the districts of Chhattisgarh, especially in the regions more vulnerable to air pollution.

9.
CONCLUSION

To initiate the process of treatment with quality care from the primary level is one of the prime responsibilities of the public health system. Primary and Secondary Public health facilities are not prepared to meet the respiratory emergencies and illnesses; hence the public health facilities need to be prepared to address the health burden of respiratory emergencies and illnesses with trained health professionals/diagnostic tools and respiratory drugs. Along with respiratory emergencies and follow-up treatment it is also needed to improve the preventive action for respiratory illnesses through screening and surveillance. It is only when the public health facility is well prepared, the suspects can be identified for preventive action and patients would be able to receive quality the public health facility with more accessibility.

Community sensitization is needed to understand respiratory emergencies and availing the drugs from public health facilities for the long run to continue the treatment. This could reduce the out-of-pocket expense of the patient. The Health System will also have a constant and consistent flow of respiratory drugs. Interventions in primary and secondary health care centers and communities could make a remarkable positive impact in the districts with Acute Respiratory Infections (ARI).

REFERENCES

1. *https://doi.org/10.1371/journal.pone.0247700*
2. *https://www.nhp.gov.in/healthlyliving/ncd2019#:~:text=In%20India%2C%20nearly%205.8%20million,reach%20the%20age%20of%2070.*
3. *https://doi.org/10.1016/S2214-109X(18)30409-1*
4. *https://www.nytimes.com/2020/04/07/climate/air-pollution-coronavirus-covid.html*
5. *http://www.simaonlus.it/wpsima/wp-content/uploads/2020/03/COVID19_Position-Paper_Relazione-circa-l%E2%80%99effetto-dell%E2%80%99inquinamento-da-particolato-atmosferico-e-la-diffusione-di-virus-nella-popolazione.pdf*
6. *Andrea Pozzer, Francesca Dominici, Andy Haines, Christian Witt, Thomas Münzel, Jos Lelieveld, Regional and global contributions of air pollution to the risk of death from COVID-19, Cardiovascular Research, Volume 116, Issue 14, 1 December 2020, Pages 2247–2253, https://doi.org/10.1093/cvr/cvaa288*
7. *https://shsrc.org/wp-content/uploads/2020/04/Korba-Study-SHRC-2020.pdf*
8. *http://www.indiaairquality.info/wp-content/uploads/docs/Air%20Pollution%20from%20India%20Coal%20TPPs%20-%20LowRes.pdf*
9. *https://www.sciencedirect.com/science/article/pii/S2542519620302989*
10. *http://www.indiaairquality.info/wp-content/uploads/docs/Air%20Pollution%20from%20India%20Coal%20TPPs%20-%20LowRes.pdf*
11. *Outdoor Air Pollution and COPD-Related Emergency Department Visits, Hospital Admissions, and Mortality: A Meta-Analysis, Rebecca DeVries, David Kriebel 1, Susan Sama 1, PMID: 27564008 DOI: 10.1080/15412555.2016.1216956, https://pubmed.ncbi.nlm.nih.gov/27564008/*
12. *https://www.who.int/healthinfo/global_burden_disease/GlobalHealthRisks_report_full.pdf*
13. *Forouzanfar, M. H.Global, regional, and national comparative risk assessment of 79 behavioral, environmental and occupational, and metabolic risks or clusters of risks, 1990–2015: a systematic analysis for the Global Burden of Disease Study 2015 Lancet 2016, 388 (10053) 1659– 1724 DOI: 10.1016/S0140-6736(16)31679-8*
14. *Lung cancer, cardiopulmonary mortality, and long-term exposure to fine particulate air pollution, C Arden Pope 3rd 1, Richard T Burnett, Michael J Thun, Eugenia E Calle, Daniel Krewski, Kazuhiko Ito, George D Thurston, PMID: 11879110 PMCID: PMC4037163 DOI: 10.1001/jama.287.9.1132, https://pubmed.ncbi.nlm.nih.gov/11879110/*
15. *https://www.who.int/news-room/fact-sheets/detail/asthma*
16. *Ainsworth, E. A. Rice production in a changing climate: a meta-analysis of responses to elevated carbon dioxide and elevated ozone concentration Glob. Change Biol. 2008, 14 (7) 1642– 1650 DOI: 10.1111/j.1365-2486.2008.01594.x, https://onlinelibrary.wiley.com/doi/abs/10.1111/j.1365-2486.2008.01594.x*
17. *https://cornettscorner.com/wp-content/uploads/2021/03/coal-dust-health-effects.pdf*
18. *https://www.researchgate.net/figure/Availability-of-basic-equipment-for-asthma-care_tbl1_47700434*

ANNEXURE

Rapid Assessment of Health Facility Readiness To Treat Patients for Respiratory Health

Date

yyyy-mm-dd hh:mm

Respondent

Designation

Name of Health Facility

Setting of Health Facility

- ◯ Urban
- ◯ Rural

Type of Health Facility

- ◯ Medical College
- ◯ Distrcit Hospital
- ◯ Community Health Center
- ◯ Primary Health Center

Do the health facility have human resources for managing Respiratory health?

- ☐ Doctor with MD (General Medicine)
- ☐ ECG Technician
- ☐ Radiographer (X Ray Technician)
- ☐ Pulmonary Function (Spirometry Technician)
- ☐ Lab Tecnician
- ☐ None

Is the Doctor Confident to read the ECG

- ◯ Yes
- ◯ No

Has the institution assured training/trainings for the health workers on investigation and management of respiratory health in association with air pollution?

- ◯ Yes
- ◯ No

How frequent are those training sessions?

_____

Which basic equipment are there in health facility for managing pulmonary illness in associated to air pollution ?

- [ ] Oxygen cylinder
- [ ] Ventilators
- [ ] Nebulizers
- [ ] Spirometer
- [ ] Spacer
- [ ] Pulse oximeter
- [ ] Health education material
- [ ] AMBU bag
- [ ] Tracheostomy Kits

Are these diagnostics tests available in the health facility?

- [ ] Blood Test
- [ ] X-ray chest
- [ ] ECG
- [ ] ECHO
- [ ] Pulmonary Function Test (Spirometry)
- [ ] Sputum CB NAAT/ True NAT
- [ ] Other

Others specify

_____

The health facility has following drugs for respiratory emergency?

- [ ] Salbutamol Inhaler
- [ ] Beclomethasone Inhaler
- [ ] Prednisolone
- [ ] Hydrocortisone injection
- [ ] Epinephrine injectable
- [ ] Rotahaler
- [ ] Rotacaps

Does the health facility conduct any training to the community members on first aid, evacuation and transfer of patients in case of any respiratory emergency?

- ◯ Yes
- ◯ No

How frequent are those trainings ?

- ◯ Quarterly
- ◯ Half Yearly
- ◯ Annually
- ◯ Once

Are there any community activities or education performed to make people understand the impacts of air pollution?

- ◯ Yes
- ◯ No

19. Does the hospital conduct surveillance among the community for early identification of health threats associated with air pollution?

- ◯ Yes
- ◯ No

Ils the health facility openened for 24 hours?

- ◯ Yes
- ◯ No

Are people aware of 108 and 104 emergency contact numbers for ambulance facilities?

- ◯ Yes
- ◯ No

Point and shoot! Use the camera to take a photo

Click here to upload file. (< 5MB)

Record your current location

latitude (x.y °)

longitude (x.y °)

altitude (m)

accuracy (m)

i https://www.who.int/health-topics/air-pollution#tab=tab_1

ii https://www.who.int/news/item/29-10-2018-more-than-90-of-the-worlds-children-breathe-toxic-air-every-day