

# **MANUAL ON HEALTH IMPACT ASSESSMENT of AIR POLLUTION**

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# BACKGROUND

- On the ground of Malé Declaration the Regional Center on Health Impact Assessment has been established in Dhaka to provide a common platform to coordinate among the identified national level technical centers for the implementation of health impact assessment activities and to develop capacity within member countries for the intended assessment.
- As a part of major activities, the Regional Center intends to develop this particular manual on air pollution health impact study that will be used for training of professionals. The manual points out different sources and of air pollutants with associated health impacts, different epidemiological study designs for investigating health impacts attributable to air pollution and provides example of a study conducted in Bangladesh.

# OBJECTIVE OF THE MANUAL

This manual will enable trainees:

- To recognize air pollution as a growing health concern
- To identify major air pollutants and their sources
- To identify different health impacts caused by air pollution
- To learn about epidemiological study designs that can be used for assessing health impact of air pollution

# MAJOR CONTENT

## **Part-A: Background of Air pollution**

- Introduction to air pollution
- Causes of air pollution
- Major air pollutants and their sources
- Air pollution in regional countries
- Air pollution in Bangladesh
- Health impacts of air pollution

## **Part-B: How to conduct health impact study**

- Planning of the study
- Study protocol development
- Epidemiological study designs for health impact assessment

## **Part-C: Study conducted in Bangladesh**

- Example of study conducted in Bangladesh

# **Part-A:**

# **Background of Air Pollution**

# INTRODUCTION

- Air pollution has been considered as a major environmental risk to health since last few decades. In developing countries the price of rapid growth is all too often noxious airborne pollution, which annually contributes to a disturbing number of avoidable deaths.
- WHO reports that in 2012 around 7 million people died - one in eight of total global deaths – as a result of air pollution exposure.
- The situation is worse in developing countries in Asia. ‘More than half of the burden from air pollution on human health is borne by people in developing countries’.
- Emerging economy has enabled the rapid growth of industrial units and subsequent emission of untreated gaseous pollutant is making the situation worse.

# AIR POLLUTION

- Air pollution is contamination of the indoor or outdoor environment by any chemical, physical or biological agent that modifies the natural characteristics of the atmosphere (WHO).
- Air pollution can be explained as the deterioration of air by noxious gases and minute particles of solid and liquid matter, (particulates) in concentrations that endanger health.
- Air pollution is the presence of substances in the ambient atmosphere, generally resulting mainly from the activity of man in sufficient concentration, present for sufficient time which interfere with human health, comfort or damage to property or injurious to vegetation and animals

# CAUSES OF AIR POLLUTION

1. Burning of Fossil Fuels
2. Agricultural activities:
3. Exhaust from factories and industries
4. Mining operations
5. Indoor air pollution



# MAJOR AIR POLLUTANTS

- Carbon monoxide (CO)
- Sulphur oxides (SO<sub>x</sub>)
- Suspended particulate matter (SPM)
- Black carbon
- Nitrogen oxides (NO<sub>x</sub>) and derivatives
- Heavy metal
- Hydrocarbons
- Ground level ozone

# SOURCES of AIR POLLUTANTS

Pollutant	Sources
<b>Carbon Monoxide (CO)</b>	Motor vehicle exhaust, kerosene or wood burning stoves.
<b>Sulfur Dioxide (SO<sub>2</sub>)</b>	Coal-fired power plants, brick kilns, petroleum refineries, sulfuric acid manufacture, and smelting sulfur containing ores.
<b>Nitrogen Dioxide (NO<sub>2</sub>)</b>	Motor vehicles, power plants, and other industrial, commercial, and residential sources that burn fuels (e.g. diesel generators).
<b>Ozone (O<sub>3</sub>)</b>	Vehicle exhaust and certain other fumes. Formed from other air pollutants in the presence of sunlight.
<b>Lead (Pb)</b>	Metal refineries, lead smelters, battery manufacturers, iron and steel producers.
<b>Particulate Matter (PM)</b>	Diesel engines, power plants, brick kilns, industries, windblown and road dust, wood stoves.

# AIR POLLUTION IN REGIONAL COUNTRIES

- Majority of the world's population lives in areas where levels of ambient air pollution exceed WHO standard. More than 1200 million people may be exposed to excessive levels of sulphur dioxide, more than 1400 million people may be exposed to excessive levels of suspended solids.
- The annual Global Burden of Disease (GBD) report ranked air pollution for the first time in the world's top 10 list of killer diseases, with 1.2 million deaths a year in east Asia and China, and 712,000 in south Asia, including India.

# AIR POLLUTION IN REGIONAL COUNTRIES

- According to the WHO, air pollution has worsened in Asian cities in recent years and presents a threat to human health. In many cities the levels of fine particulate matter - a key pollutant in terms of its impact on human health - are exceeding the critical limit (as defined by the WHO), specifically in densely populated, fast-growing and less developed countries like China, India, Pakistan and Bangladesh.
- Over the last few years, China has been in the news for heavy pollution in its cities with the skies being completely blanketed by smog. India and Pakistan, however, have the dubious distinction of having the most polluted cities in the region.

# AIR POLLUTION IN BANGLADESH

Bangladesh has been observing a significant growth in the industrial sector since its inception. Industries are mainly concentrated in major urban areas like Dhaka, the seaport cities like Chittagong and Khulna, the inland port city Narayanganj, and other divisional towns. Naturally, the air pollution problem is more acute in these areas. Apart from unplanned industrial development in these areas, the severity of the pollution is increased mainly due to exhausts from vehicles.

# AIR POLLUTION IN BANGLADESH

- About 6.5 million people in four large cities of Bangladesh suffer due to air pollution each year. The “air pollution” kills nearly 1.5 million Bangladeshis each year in Dhaka 2001 and Bangladesh could save between \$200 million to \$800 million per year. These amounts translate to about 0.7% to 3.0% of the gross national product if air pollution is reduced in just four major cities of Bangladesh. Large number of children, homeless street children, local streetwalkers, and rickshaw pullers in the city of Dhaka pose a definite threat to the air pollution.

Pollutant	Averaging Time	WHO Standards	US Standards	Bangladesh Standards	Ambient Concentration in Dhaka	Major <a href="#">Source</a>	Health Problems
CO Carbon monoxide	1 hour	30 mg/m <sup>3</sup>	9 ppm 10 mg/m <sup>3</sup>		11 ppm (instantaneous average)	Automobile	Hinders O <sub>2</sub> transport from blood into tissues, Cardiac
	8 hour	10 mg/m <sup>3</sup>	35 ppm 40 mg/m <sup>3</sup>				
Pb Lead	24 hour	0.5-1. ug/m <sup>3</sup>			4.63 ug/m <sup>3</sup>	Leaded fuel	Hindered neurological development of children and risk of high blood pressures, heart attack for adults
	Quarterly		1.5 ug/m <sup>3</sup>				
NO <sub>2</sub> Nitrogen dioxide	Annual		0.053 ppm 100 ug/m <sup>3</sup>	80 ug/m <sup>3</sup> (Residential) 100 ug/m <sup>3</sup> (Commercial)	41.8 ug/m <sup>3</sup>		Respiratory problems and chest pain
	24 hour	150 ug/m <sup>3</sup>			0.063 ppm 119 ug/m <sup>3</sup>		
O <sub>3</sub> Ozone	1 hour	150 - 200 ug/m <sup>3</sup>	0.12 ppm 235 ug/m <sup>3</sup>				Respiratory, asthma, eye irritation, heart attack
PM <sub>10</sub> /TSP/SPM	Annual	60-90 ug/m <sup>3</sup>	50 ug/m <sup>3</sup>	200 ug/m <sup>3</sup> (Residential) 400 ug/m <sup>3</sup> (Commercial)	1245-1601 ug/m <sup>3</sup> (Commercial) 445 ug/m <sup>3</sup> (Residential)		Respiratory, cardiovascular and lung disease, bronchitis
	24 hour	150-230 ug/m <sup>3</sup>	150 ug/m <sup>3</sup>				
SO <sub>2</sub> Sulfur dioxide	Annual	40-60 ug/m <sup>3</sup>	0.03 ppm 80 ug/m <sup>3</sup>	80 ug/m <sup>3</sup> (Residential) 100 ug/m <sup>3</sup>	472.9 ug/m <sup>3</sup> (Commercial) 63.5 ug/m <sup>3</sup>		Respiratory, chest pain, premature mortality.

# HEALTH IMPACT OF AIR POLLUTION

- Air pollution is a significant risk factor for multiple health conditions including respiratory infections, heart disease, and lung cancer, according to the WHO.
- The health effects caused by air pollution may include difficulty in breathing, wheezing, coughing and aggravation of existing respiratory and cardiac conditions. These effects can result in increased medication use, increased doctor or emergency room visits, more hospital admissions and premature death.



# HEALTH IMPACT OF AIR POLLUTION

Included in the assessment is a breakdown of deaths attributed to specific diseases, underlining that the vast majority of air pollution deaths are due to cardiovascular diseases as follows:

## **Outdoor air pollution-caused deaths – breakdown by disease:**

- 40% – ischaemic heart disease;
- 40% – stroke;
- 11% – chronic obstructive pulmonary disease (COPD);
- 6% - lung cancer; and
- 3% – acute lower respiratory infections in children.

## **Indoor air pollution-caused deaths – breakdown by disease:**

- 34% - stroke;
- 26% - ischaemic heart disease;
- 22% - COPD;
- 12% - acute lower respiratory infections in children; and
- 6% - lung cancer.

# HEALTH IMPACT OF AIR POLLUTION

- Regionally, low- and middle-income countries in the WHO South-East Asia and Western Pacific Regions had the largest air pollution-related burden in 2012, with a total of 3.3 million deaths linked to indoor air pollution and 2.6 million deaths related to outdoor air pollution.

# HEALTH IMPACT OF AIR POLLUTION

- **Immediate effects:** sudden increase in air pollution has often been associated with immediate increase in the mortality and morbidity especially due to respiratory diseases. cardiopulmonary hospitalizations, emergency department or outpatient visits
- **Delayed effects: due to irritants and carcinogens**
  - **Bronchial Asthma**
  - **Chronic bronchitis,**
  - **Empyesma**
  - **Conjunctivitis, irritation to eyes, Dermatitis etc.**
  - **Lung cancer,**

# HEALTH IMPACT OF AIR POLLUTION

## Other Effects of Air Pollution

### Immune System; Allergies

Allergic Asthma, Allergic Rhinoconjunctivitis  
Extrinsic Allergic Alveolitis / Hypersensitivity

### Central Nervous System

Toxic Damage of Nerve Cells  
Mental retardation

### Carcinogenic Effects

Lung Cancer, Leukemia

### Reproductive effects

Infant mortality, Low weight birth

# HEALTH IMPACT OF AIR POLLUTION

- Effects on children
- Around the world, children living in cities with high exposure to air pollutants are at increased risk of developing asthma, pneumonia and other lower respiratory infections. Because children are outdoors more and have higher minute ventilation they are more susceptible to the dangers of air pollution. Risks of low initial birth weight are also heightened in such cities.
- The World Health Organization reports that the greatest concentrations of particulates are found in countries with low economic world power and high poverty and population growth rates.

# **Part-B: How to conduct health impact study**

# Epidemiological study designs for health impact assessment

- *Cross-Sectional Studies*
- *Time-series analyses*
- *Cohort Studies*
- *Case-Control Studies*
- *Intervention Studies*
- *Ecological studies*
- *Occupational Studies*

# Part-C:

## Study Conducted in Bangladesh

- Title of the Study: “Assessment of Impact of Air Pollution among School Children in Selected Schools of Dhaka City, Bangladesh”
- Step by step methods and procedures of the study conducted are described in the manual as an example of health impact study.



THANK YOU