



Operational Guidelines
on
Sentinel Surveillance
for
Air Pollution related Illnesses

National Programme on Climate Change and Human Health
Directorate General Health Services
MoHFW
October, 2022



**National Programme
on Climate Change
and Human Health**



**National Centre
for Disease Control**
Government of India

Acknowledgement

The present operational guideline document is an update from the draft Standard Operating Procedure for Air Pollution related Illnesses by the undersigned under National Programme on Climate Change and Human Health (NPCCHH). It was drafted initially by Dr. Nitin Mahajan, the then nodal officer of air pollution and health issues in the programme, under guidance of Dr. Sujeet Singh, Director, NCDC and support from the NPCCHH team of Dr. Aakash Shrivastava, Dr. Shikha Vardhan, Dr. Rameshwar Sorokhaibam, Dr. Akshay Kumar and Dr. Avinash Sunthalia.

The present document is updated from previous draft by the undersigned under the guidance of the Prof. Atul Goel, DG, DGHS, Shri Lav Agarwal, Additional Secretary, MoHFW, Dr. Sujeet Singh, Principal Advisor, NCDC, and Dr. Aakash Shrivastava, Additional Director and Head, NPCCHH (HQ) at NCDC. It has been revised and updated with inclusion of new contents such as the health effects attributed to air pollution in India (ICMR 2019 report), diagrams of structural and functional flow of the present surveillance system, flowchart showing approaches in collection of surveillance data and using of Excel showing simple step by step approaches in analysis and developing graph on the reported cases and air quality data.

One important aspect of the present document is the switching from the ongoing manual approach of surveillance data reporting from sentinel hospital sites to digital approach (Mobile App web based). The digital approach was developed under the Centre of Excellence, TERI (Meena Sehgal, Mahima Utreja) with support from World Bank (Dr. Suresh Mohammed and his team). The mobile application was developed by Indev Consultancy Pvt. Ltd (Mr. Raju Kumar and his team). The technical support was also provided by NPCCHH team and, from TEG members on Air Pollution and Human Health under NPCCHH (HQ) at NCDC. Shri Sunil Bhushan from NIC has been constantly supportive in development of the app and suggested for its operational realizations.

Later, the digital approach of surveillance data reporting and its detailed framework and design in the dashboard were collectively worked out by NPCCHH team and IHIP team so that the surveillance system is integrated with the present IHIP platform which is supported from WHO India (Pavana Murthy, Dr. Shyam Singhal, Raghavendra Kedlaya)

Dr. Siva Prasad, Deputy Assistant Director NPCCHH, NCDC was the main coordinator in developing the present mobile app of the surveillance. He was supported by Dr. Sayana Bhaskaran and Dr. Purvi Patel. Dr. Nivethitha (EIS officer at NCDC) under the supervision of the undersigned prepared the manuals of digital application and dashboard of the surveillance, supported by IHIP team. It was supported in its design and formatting by NPCCHH team, Mr. Avnesh Sharma, Mr. Amit, Mr. Rajkumar, Mr. Deepu Raj.

The programme highly acknowledges the valuable contribution and support from each of the stakeholders in realizing the present document and will greatly be helpful in strengthening the surveillance on air pollution related illnesses in the country under the programme.

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1. INTRODUCTION ON THE SURVEILLANCE OF AIR POLLUTION RELATED ILLNESSES

Air pollution is considered as the single largest environmental health threat globally and it is known to have health effects impacting in various parts of the human body.

A recent ICMR study reported on disease burden, deaths etc. related to air pollution among the Indians showed the following findings as shown below-

- I. 1.7 million Deaths (18% of the total deaths) in India (2019) were attributable to air pollution
 - a. Chronic Obstructive Pulmonary Disease (32.5%)
 - b. Ischaemic heart disease (29.2%)
 - c. Stroke (16.2%)
 - d. Lower respiratory infections (11.2%)
- II. 11.5% of the total DALYs (Disability-Adjusted Life Year) in India (2019) attributable to air pollution are as shown below-
 - a) 39.5% from lung diseases
 - i. COPD (22.7%)
 - ii. Lower respiratory infections (15.5%)
 - iii. Lung cancer (1.3%);
 - b) Other DALYs
 - i. Ischaemic heart disease (24.9%)
 - ii. Stroke (13.7%)
 - iii. Diabetes (5.5%)
 - iv. Neonatal disorders (14.5%)
 - v. Cataract (1.5%)

Considering the health concerns due to exposure to air pollution in the country, 'Air Pollution related Illnesses' is considered a priority health issue under National Programme on Climate Change and Human Health (NPCCHH). One of the main activities identified on the health issue under the programme is conduction of sentinel surveillance on air pollution related illnesses in identified sentinel sites at the city level. This is to understand the relationship of air pollution related illnesses reporting in the sentinel sites to the air quality level in the respective city. This information available at the local level will support in understanding the trend in the air pollution related illnesses occurring in the city with respective to the daily air quality level of the city.

This document describes about standard operating procedure for the conduction of sentinel surveillance on air pollution related illnesses in identified hospitals in the Indian cities under the NPCCHH programme. For this purpose, a structural and functional flow of the present sentinel surveillance system is developed and it consists of briefly of the following as -

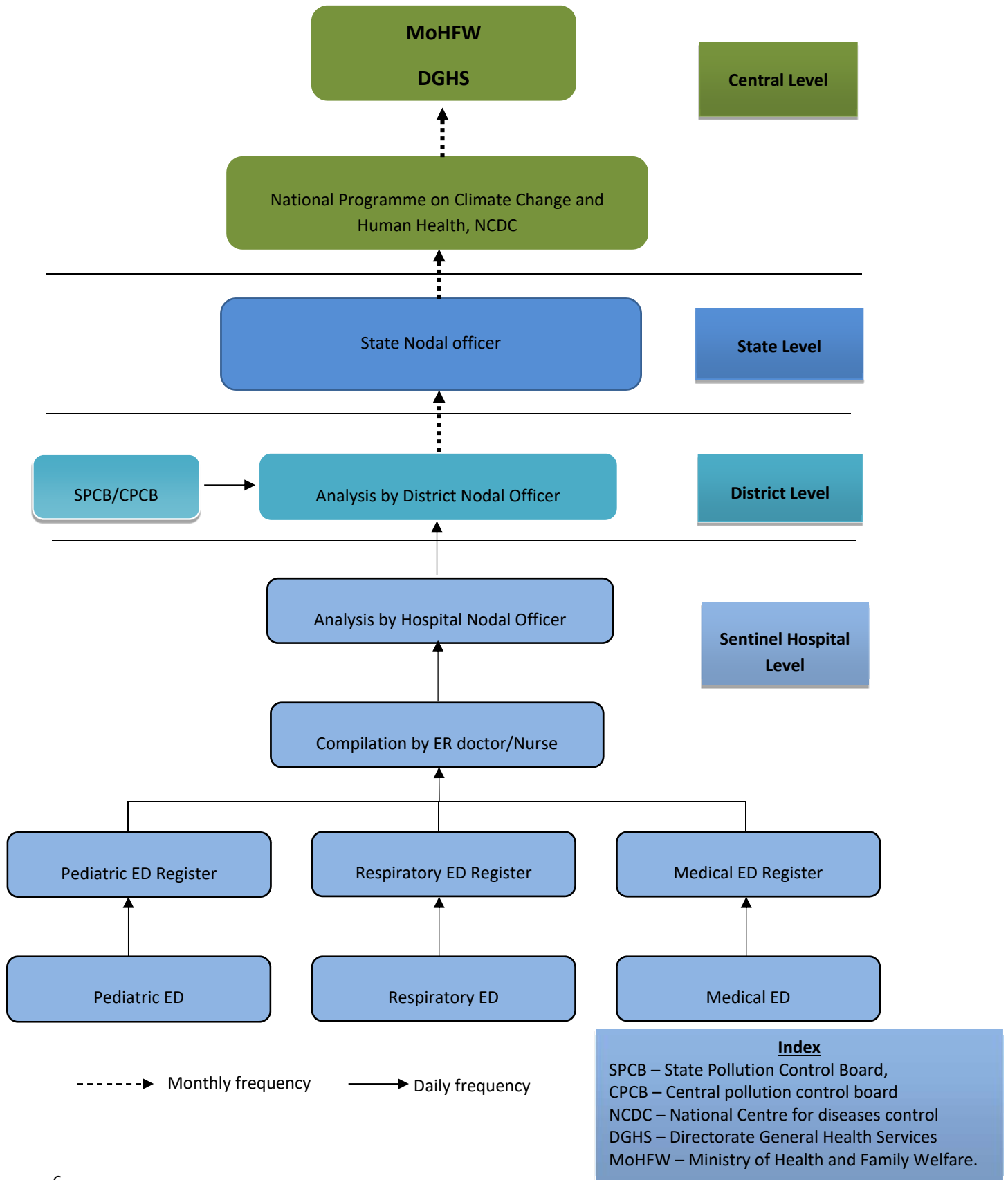
- I.Sentinel hospital (s)in a city are identified in which nodal officers of the hospitals recognize the reported air pollution related illnesses
- II.District level nodal officers under the programme, and analysis conduction and reporting to State Nodal Officer and NPCCHH (HQ) at NCDC.

It describes about its objectives and the standards defined at present. An agreement on the objectives will ensure that priority is given to the information that is being collected by the surveillance system. A standard protocol for the surveillance throughout the country will enable the health professionals to understand the epidemiology of this problem. It will also allow the programme officials and policy makers to easily interpret the data gathered from different parts of the country and act accordingly. This surveillance system does not dramatically alter any of the healthcare network, but an addition to the already existing system.

Who are to use this SOP?

- I. Programme Officials – Central/ State /District Programme Officials
- II. Surveillance Nodal Officers of the Sentinel Hospitals
- III. Those involved in sentinel surveillance on air pollution related illnesses
- IV. Public health professionals
- V. Public Health Institutes
- VI. National health authorities

2. STRUCTURAL AND FUNCTIONAL FLOW OF SURVEILLANCE ON AIR POLLUTION RELATED ILLNESSES NPCCHH



3. OBJECTIVES OF THE SENTINEL SURVEILLANCE ON AIR POLLUTION RELATED ILLNESSES

The general objectives of the surveillance on the subject are as follows-

- I. To get information on the reported health impact level related to air pollution in an area
- II. To take actions based on the information for appropriate control/ intervention measures, allocating health resources, and make case management recommendations.

SPECIFIC OBJECTIVES OF THE SENTINEL SURVEILLANCE

The specific objectives of the surveillance are as follows-

- I. Describe trend of air pollution related illnesses identified like acute respiratory / cardiovascular / cerebrovascular cases reported to air quality in an area*
- II. Generate data to estimate disease burden and help decision-makers prioritize resources/ plan public health interventions.*
- III. Detect unusual and unexpected seasonal health events related to air pollution from the available data.*

4. RATIONALE FOR SENTINEL SURVEILLANCE OF AIR POLLUTION RELATED ILLNESSES

Air pollution is the single largest environmental health threat globally causing impact on health of the people, so, it is necessary to have a surveillance system of data collection in context of air pollution. Air pollution is considered to impact health in various parts of the organ systems, most notably, diseases of respiratory system which results in increased number patient attendance at hospitals. The rise in number of patient flow at hospital from areas where air pollution is an emerging health problem can be correlated with the corresponding air quality level, particularly, air quality index (AQI) of that locality.

An initial phase of establishment of surveillance system of health impact in context of air pollution with a focus on respiratory emergencies having possible cause of air pollution was considered. As a result, acute patients coming to casualty/emergency department with difficulty in acute respiratory symptoms including breathing by any cause having probable relation with the air pollution are taken into considerations. This health data is to be correlated with the air quality level of the area or city. This correlation may help us to interpret the trend of rise/fall of number of patients suffering from acute respiratory illnesses in relation to the rise/fall of air quality level of the locality.

Air quality index is calculated by the central/state pollution control board which has established monitoring station at different parts of state/country. This AQI also gives names of the prominent pollutant for that day and particular locality which is also helpful to correlate the same with patient's data collected from surveillance system. If data of patients suggests rise with corresponding rise in air quality index, suggestions can be given to the policy makers to take corrective steps for lowering the level of air pollutants

5. AIR QUALITY AND ITS SIGNIFICANCE IN THE SURVEILLANCE

Air Quality Index (AQI) is a tool for effective communication of air quality status to people in terms, which are easy to understand. It transforms complex air quality data of various pollutants into a single number (index value), nomenclature and color.

There are six AQI categories, namely Good, Satisfactory, Moderately polluted, Poor, Very Poor, and Severe. Each of these categories is decided based on ambient concentration values of air pollutants and their likely health impacts (known as health breakpoints). AQ sub-index and health breakpoints are evolved for eight pollutants (PM10, PM2.5, NO2, SO2, CO, O3, NH3, and Pb) for which short-term (up to 24-hours) National Ambient Air Quality Standards are prescribed. The worst sub-index determines the overall AQI.

National Network of AQI

- I. Air Quality data from almost 150 cities all over India are uploaded in the Central Pollution Control Board (CPCB) website on real time basis.
- II. State Pollution Control Board (SPCB) of every state has its own network of air quality monitoring stations within cities of the state.
- III. System of Air Quality and Weather Forecasting and Research (SAFAR), Ministry of Earth Science, Govt. of India, Indian Institute of Tropical Meteorology, Pune has established network of air quality monitoring station in the cities like Delhi, Mumbai, Pune, and Ahmedabad.
- IV. The National Clean Air Program (NCAP) identified 132 non-attainment cities/ million plus of India as a medium-term national level strategy to tackle the increasing air pollution problem across the country in a comprehensive manner.
- V. It is planned to strengthen the network of air monitoring systems in the country, and networking them to the central AQI portal, in phased manner.
- VI. Manual stations use AQI calculator and publicize it with minimum time lag, as required for laboratory analysis

AQI categories and health breakpoints for the eight pollutants are as follow:

AQI - 'One Number- One Colour-One Description'

AQI Cat. (Range)	PM ₁₀ 24-hr	PM _{2.5} 24-hr	NO ₂ 24-hr	O ₃ 8-hr	CO 8-hr (mg/m ³)	SO ₂ 24-hr	NH ₃ 24-hr	Pb 24-hr	Associated Health Impacts
Good (0-50)	0-50	0-30	0-40	0-50	0-1.0	0-40	0-200	0-0.5	Minimal Impact
Satisfactory (51-100)	51-100	31-60	41-80	51-100	1.1-2.0	41-80	201-400	0.5 – 1.0	Minor breathing discomfort to sensitive people.
Moderately (101-200)	101-250	61-90	81-180	101-168	2.1- 10	81-380	401-800	1.1- 2.0	Breathing discomfort to lung disease & with heart disease, children, and older adults.
Poor (201-300)	251-350	91-120	181-280	169-208	10-17	381-800	801-1200	2.1- 3.0	Breathing discomfort on prolonged exposure & heart disease
Very poor (301-400)	351-430	121-250	281-400	209-748*	17-34	801-1600	1200-1800	3.1- 3.5	Respiratory illness on prolonged exposure more pronounced in people with lung & heart diseases
Severe (401-500)	430 +	250+	400+	748+*	34+	1600+	1800+	3.5+	Respiratory impact even on healthy people& serious health impacts with lung/heart disease &even during light physical activity.

*Source: CPCB

Limitations of AQI:

- I. For real time AQI, the data is fed directly from the analyzers without scrutiny, thus it may not be for statutory purpose.
- II. The monitoring and subsequent AQI dissemination involves multiple steps including operation of sensors and analyzers, their calibration, data acquisition at local server, transmission to central database using Internet, etc. The functioning of monitoring stations may also get affected due to various technical and operational aspects like long power cuts and maintenance problems. In view of these limitations, it is possible that there may be some disruption in continuous data flow and dissemination. However, in case of breakdowns, necessary actions are initiated immediately for putting the system back into operation within reasonable time.

6. ESTABLISHMENT OF A NETWORK OF SENTINEL SURVEILLANCE OF AIR POLLUTION RELATED ILLNESSES

The surveillance system is for detection of public health risks from air pollution, as well as the prompt risk assessment, notification, and response to these health risks. To this end, a sensitive and flexible surveillance system is needed with an early warning function is necessary.

Public Health importance of this surveillance is to keep a track on the increase in air pollution levels and its impact in the increase in the air pollution related illnesses like respiratory, cardiovascular, and cerebrovascular diseases. The surveillance system should be acceptable to all the stakeholders.

Sentinel Surveillance on diseases related to air pollution may consider on air pollution related illnesses like acute respiratory illnesses, exacerbations of the chronic respiratory conditions etc. This does not mean that acute infectious illnesses like influenza, bacterial and viral respiratory infections need to be excluded. All cases reported on acute respiratory illnesses coming to emergency department are to be considered for inclusion in cases due to Air pollution.

The present ARI Surveillance is a manual method of collection in the prescribed format provided by the NPCCHH (HQ) at NCDC.

Methods for collecting the Surveillance data from the sentinel sites under the programme are considered as follows

- I. Manual method (presently ongoing) – Acute Respiratory Illnesses only
- II. Digital method
 - a. Digital Mobile App web based similar to the Manual method (Switch over)
 - b. Upgraded Digital Mobile App Web based
 - i. Acute Respiratory Illnesses
 - ii. Cardiovascular Diseases
 - iii. Cerebrovascular Diseases

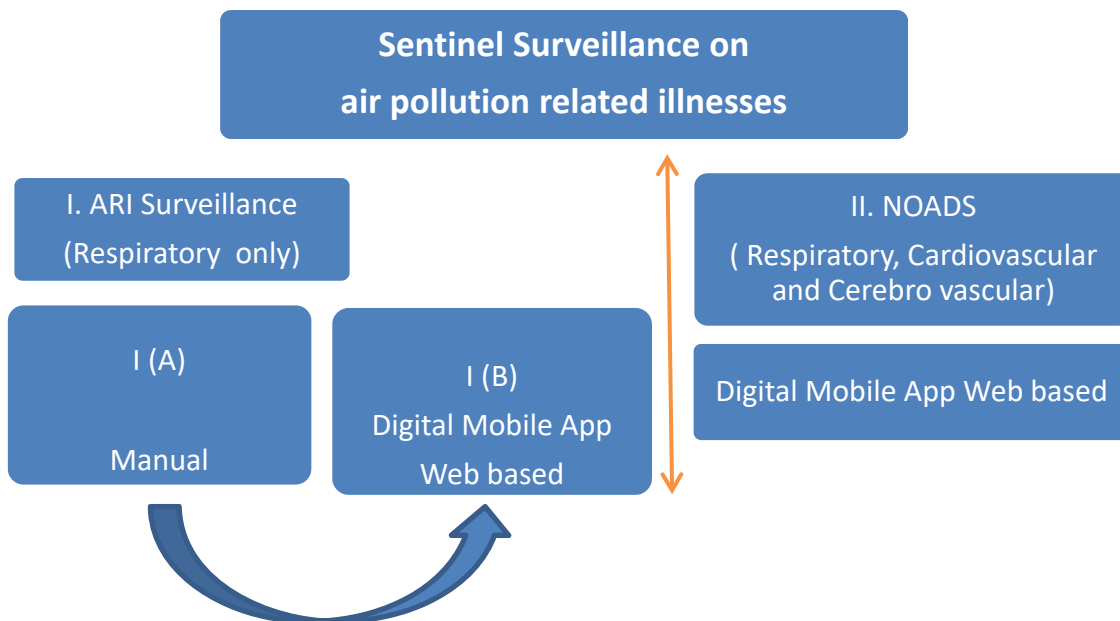
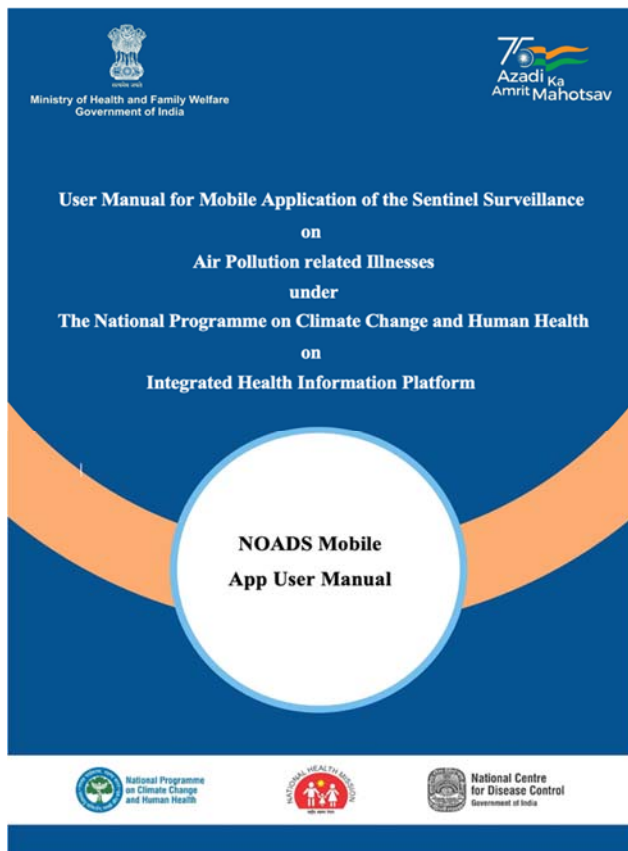
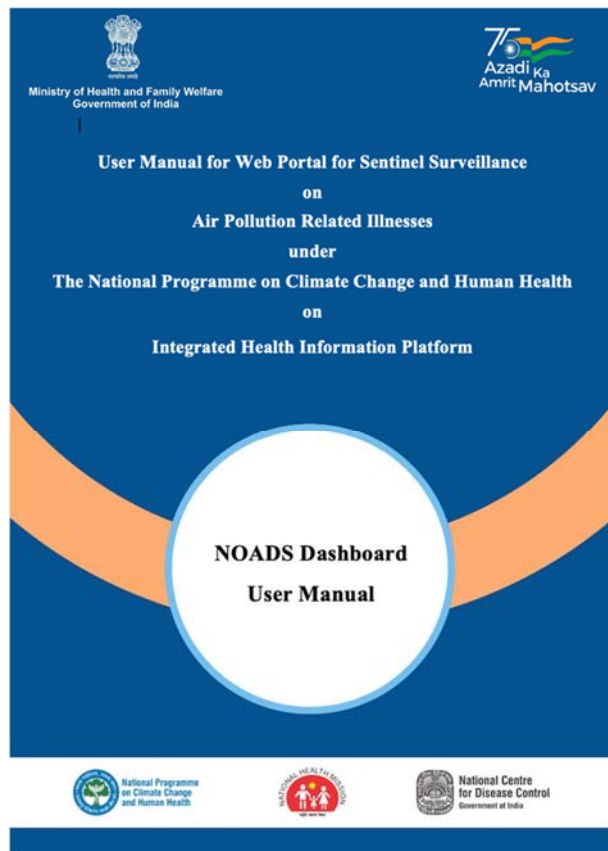


Figure showing types of methods (above) for surveillance data reporting from sentinel hospitals and Manuals (below) for Mobile Application and Dashboard on Air Pollution related Illnesses under NPCCHH. The Manuals are attached as a supplementary booklets of this document.

Supplementary Booklet 1



Supplementary Booklet 2



STEPS IN ESTABLISHING SURVEILLANCE SYSTEM ON AIR POLLUTION RELATED ILLNESSES

I. Selection of City for establishing Surveillance on air pollution related Illnesses

II. Selection of Sentinel Surveillance Hospitals(3-4) within the city identified

III. Identification of Human Resources at the identified Sentinel Surveillance hospital

IV. Data Compilation and Analysis of the surveillance data at the city level

V. Sending reports and feedbacks at district, state, central level and concerned

VI. Public health action based on surveillance data

I. SELECTION OF CITY FOR ESTABLISHING SENTINEL SURVEILLANCE ON AIR POLLUTION RELATED ILLNESSES

The Sentinel Surveillance on Air Pollution related Illnesses is to be started in the **cities having bad air quality** as per the data of Air Quality Index value from Central/State Pollution control board (CPCB/SPCB).

- i. For the state where State Health department must initiate Sentinel Surveillance on Air Pollution related Illnesses in as many as cities possible in the following way:
 - a. Identify most polluted cities using **Central Pollution Control Board Data**.
 - b. While selecting cities within state, cities of which AQI value is listed on central pollution control board or from 132 cities which are identified for National clean air program (NCAP) should be selected on priority as sentinel surveillance sites.
 - c. All the cities having AQI value more than 200 (poor category) are to be included for this ARI surveillance.
 - d. If no city is having AQI above 200 then cities having AQI value between 100 to 200 (Moderately poor) are to be selected for the surveillance.
- ii. For those states of which no city is being listed in CPCB AQI list or NCAP 132 cities, then such state must find out the cities by using data from **state pollution control board or SAFAR** and select the city as sentinel surveillance for air pollution.
- iii. If any state having **no air polluted city** (as per data from CPCB/SPCB/ NCAP list of cities then such state **may select fewer cities for** ARI surveillance. (This can be a check for reference with other air polluted cities)

II. SELECTION OF SENTINEL SURVEILLANCE HOSPITALS WITHIN THE CITY IDENTIFIED:

- i. Find out few hospitals (Public /Private) based on the highest number of patient flow to the emergency department.
- ii. While selecting Sentinel hospitals the Sentinel Surveillance on Air Pollution related Illnesses, preference should be given to **Medical College** if it is located within same city.
- iii. **District/ Civil hospital** is also to be selected as it's the first referral Centre from the primary level health care facilities.
- iv. In addition to medical college and district hospital other public hospital or any major multispecialty hospital or hospital having respiratory emergency department having large patient flow of respiratory emergencies are to be selected for the purpose of ARI surveillance.
- v. It is expected that at least 4-5 sentinel surveillance Hospitals per district may be identified for representativeness of the cases for the Sentinel Surveillance on Air Pollution related Illnesses.

III. IDENTIFICATION OF HUMAN RESOURCE FOR SURVEILLANCE

At State/District level:

- i. The surveillance is to be initiated under the overall supervision of the **State Nodal Officer Climate change (SNO-CC)** of the state. All the communications regarding Sentinel Surveillance on Air Pollution related Illnesses like letters from NCDC and Ministry of Health, reporting formats are shared with the state SNO (CC) of the state.
- ii. SNO should identify the polluted cities first as per the criteria given above and co-ordinate the District Nodal Officer Climate Change (DNO-CC) of the district in which these cities are located to initiate the Sentinel Surveillance on Air Pollution related Illnesses activity.
- iii. SNO/DNO have to co-ordinate with the **health officer of the corporation** of the city for ensuring initiation of the Sentinel Surveillance on Air Pollution related Illnesses within the designated city.
- iv. For the cities selected for surveillance and having Government Medical College, a letter for initiation of ARI surveillance is to be sent from the **Commissioner and Health officer of city to the Dean/Principal** of the Medical College. One copy of letter is also to be sent to Director of Medical Education for necessary action.
- v. In cities where there is no government Medical College then **District hospital or any big Municipal hospital** within the city having high daily footfall of emergencies is to be selected. For this letter is to be issued from Health officer of city.
- vi. SNO have to co-ordinate with the State pollution control board in writing for the daily Air Quality Level of the cities identified for the ARI surveillance. It is to be requested to the SPCB to prepare day wise report of AQI level along with prominent pollutant for that day and send the monthly report at the end of month to the SNOCC.
- vii. SNO must send SPCB monthly AQI report of city to the DNO of the concerned city for analysis purpose.

At Sentinel Surveillance Hospital level (SSH):

- i. At each sentinel hospital level, one **Nodal Officer** for the Sentinel Surveillance on Air Pollution related Illnesses is to be designated by the Dean of Medical College or MS of the District/Municipal hospital.
- ii. Nodal Officer should be preferably selected from the **PSM department** in case of medical college **or Medical Officer who is handling other reporting like HMIS/IDSP** in case of District/ Municipal hospital.
- iii. Nodal officer for Sentinel Surveillance on Air Pollution related Illnesses appointed should co-ordinate with the emergency department for receiving the data.

At Emergency Department of SSH:

- i. At emergency department reporting is to be collected from the **three specialties like Medicine, Pediatric and Respiratory units** as all these are handling the patient independently.
- ii. At each of these specialty sections, the Sentinel Surveillance on Air Pollution related Illnesses **register** is to be maintained for noting daily flow of respiratory emergencies to the section.
- iii. Responsibility of handling of this register will be given to **staff nurse or resident doctor** posted in the specialty unit.
- iv. Staff nurse or Resident doctor should fill up the report before leaving from duty along with the signature in this register.
- v. One fixed time is to be decided by Nodal officer of ARI surveillance for finalization and collection of 24-hour report of the day like 8am of a day to 8am of next day.
- vi. 24-hour report is to be prepared by combining values of all the shift duties within that time frame of 24 hours and the combined report of a day is to be prepared by the resident doctor of particular shift and submit signed copy to the Nodal officer of ARI surveillance.
- vii. Nodal Officer of ARI surveillance should send the report to district level to DNOCC from where it is to be sent to SNOCC.
- viii. At state level all the report from selected districts where polluted cities are located are to be collected and sent to NCDC.

7. ROLES AND RESPONSIBILITIES OF KEY STAKE HOLDERS:

SENTINEL HOSPITALS:

Director/ MS/ Head/CMO

- i. Overall guidance, supervision and monitoring on the surveillance at the hospital level
- ii. Resource mobilizations and capacity building of the involved departments and identified officials/staffs
- iii. Evidence based interventions based on analysis reports received from the district

Nodal Officers:

- i. To oversee that all the surveillance requisites are in place (SOP, Trained/sensitized staffs, reporting formats, Mobile App for reporting the data)
- ii. Monitoring of the reporting of the data to the DNOs (timeliness, completeness)
- iii. Mobile application on surveillance data collection – understanding and modules

DISTRICT LEVEL:

DNO-CC

- i. Availability of SOPs on surveillance of Air pollution related illness
- ii. Availability of city level AQI data from PCB
- iii. Identification of 3-4 sentinel hospitals per city
- iv. Detail information of the key persons from the sentinel hospitals
- v. Capacity building of personnel in the district
- vi. Sharing of reporting formats, SOPs, feedbacks with hospitals
- vii. Monitoring of ARI data from the hospitals for its regular timeliness and completeness.
- viii. Analysis of the surveillance data at the city level
- ix. Reporting of the analyzed data to the State and Centre
- x. Feedback to the hospitals

Data Entry Operator:

- i. Compile the data from different sentinel hospitals
- ii. Assist DNO-CC for follow-up from hospitals on reporting everyday
- iii. Support training/ meetings for the DNO-CC on surveillance related activities

STATE LEVEL

SNO-CC

- i. Availability of the SOP on surveillance of Air pollution related illness
- ii. Identification of DNO-CC, ToTs for the surveillance
- iii. Capacity building of personnel at district level
- iv. Interpreting data sent from districts
- v. Actions based on the reports received from districts
- vi. Reporting to the Centre and feedbacks to the districts

8. CASE DEFINITIONS RELATED TO THE SURVEILLANCE

RESPIRATORY EMERGENCIES TO BE CONSIDERED FOR SURVEILLANCE

Patient coming to the emergency department with any of the below given present or preexisting diseases and presenting with difficulty in breathing should be included as acute respiratory illnesses

1. **Acute lower respiratory tract infections-** used as a synonym for pneumonia, can also be applied to other types of infection including lung abscess and acute bronchitis. Symptoms include shortness of breath, weakness, fever, coughing and fatigue.
2. **Acute upper respiratory tract infection-** is an illness caused by an acute infection, which involves the upper respiratory tract, including the nose, sinuses, pharynx, or larynx. This commonly includes nasal obstruction, sore throat, tonsillitis, pharyngitis, laryngitis, sinusitis, otitis media, and the common cold.
3. **Influenza** - is an infectious disease caused by an influenza virus. The most common symptoms include: high fever, runny nose, sore throat, muscle pains, headache, coughing, sneezing, and feeling tired.
4. **Pneumonia (Viral/Bacterial):** Pneumonia is an infection that inflames the air sacs in one or both lungs. The air sacs may fill with fluid or pus (purulent material), causing cough with phlegm or pus, fever, chills, and difficulty breathing.
5. **Chronic disease of respiratory tract:** Chronic respiratory diseases (CRDs) are diseases of the airways and other structures of the lung. Some of the most common are chronic obstructive pulmonary disease (COPD), asthma, occupational lung diseases and pulmonary hypertension
6. **Asthma** – Asthma is a condition in which your airways narrow and swell and produce extra mucus. This can make breathing difficult and trigger coughing, wheezing and shortness of breath.
7. **Exacerbation of obstructive lung disease-** Acute exacerbation of COPD is a sudden worsening of COPD symptoms (shortness of breath, quantity and color of phlegm) that typically lasts for several days. It may be triggered by an infection with bacteria or viruses or by environmental pollutants.
8. **Acute respiratory distress syndrome (ARDS)-** is a type of respiratory failure characterized by rapid onset of widespread inflammation in the lungs. Symptoms include shortness of breath, rapid breathing, and bluish skin coloration.
9. **Epiglottitis:** Epiglottitis is a bacterial infection of the epiglottis and surrounding tissues. It may block the windpipe (trachea) and be fatal. The main symptoms are severe sore throat and noisy, difficult breathing.
10. **Bronchiectasis:** It is a disease in which there is permanent enlargement of parts of the airways of the lung. Symptoms typically include a chronic cough with mucus production Other symptoms include shortness of breath, coughing up blood, and chest pain

Diseases considered to be excluded for the surveillance reporting (Exclusive Criteria)-

- 1. Cancer of trachea, Bronchus, and lung**
- 2. Inhalation injury**
- 3. Pneumothorax**
- 4. Fibrosis**
- 5. Massive hemoptysis**
- 6. Pulmonary Edema**
- 7. Drug Overdose**
- 8. Respiratory failure due to**
- 9. Acute neuromuscular disorder**
- 10. ARF in pregnancy**
- 11. Heart failure**

9. DATA COMPILATION AND ANALYSIS OF THE SURVEILLANCE DATA

This is the process that is being followed in the present. The application-based surveillance that will be implemented in the future will skip all these steps as it is a real time updating of the cases. Please refer to the NOADS app manual/NOADS dashboard manual for reference.

- i. At each district level city wise report of ARI surveillance is to be compiled in the formats like Annexure A & B
- ii. DNO-CC must collect the day wise AQI report for particular month from SNO-CC after end of each month. DNO-CC can directly approach the SPCB for receiving this data of AQI if they want.
- iii. At district level day wise acute emergency illness cases are to be analyzed as per calculation mentioned in Annexure C and analysis graph of ARI cases proportion with respect to AQI is to be prepared as per Annexure D.
- iv. Monthly report for city in the form of Annexure A, B, C& D is to be prepared at district level and same is to be sent to state level office.
- v. From state level this report of ARI surveillance for the all the identified cities within state is to be sent to NCDC.
- vi. From NCDC state wise analysis report is submitted to the DGHS and MOHFW office.

10. PUBLIC HEALTH ACTIONS BASED ON SURVEILLANCE ANALYSIS

Public health authorities to take more appropriate public health interventions like IEC dissemination, health advisories, hospital preparedness, allocating health resources etc.

11. FORMATS FOR THE SURVEILLANCE USED AT VARIOUS LEVELS

The surveillance reporting is to be collected in the standard formats designed by the NCDC which are as follows (Hospitals and District levels):

- i. Data Collection at the Hospital level (Daily)
- ii. Data Collection at the Hospital level (Monthly)
- iii. District level Analysis of Surveillance Data reported
- iv. Data analysis of the surveillance data with air quality (Graph)

12. ANNEXURE A (HOSPITAL LEVEL)

(DAILY REPORTING OF ARI DATA FORMAT BY NODAL OFFICERS OF THE HOSPITALS)							
CASES OF ACUTE RESPIRATORY ILLNESSES REPORTING TO EMERGENCY DEPARTMENTS (ED) OF SENTINEL HOSPITALS							
NAME OF THE HOSPITAL:							
Name of the city & district:				Name of the state:			
Date of compiling Report:		Date of cases visit to Emergency		Reporting Period (24 hrs)		Specify usual time: 08:00hrs morning to 08:00hrs next morning or as per hospital considerations	
	<i>Total Number of Emergencies Reported to ED</i>	<i>Total Number of Acute Respiratory illness* cases reported to ED (* check list of ARI overleaf)</i>	<i>Cases of Acute Respiratory illnesses reported to ED and requiring nebulisation</i>	<i>Cases of Respiratory Illnesses requiring admission</i>	<i>Cases of Respiratory Illnesses requiring Non-invasive ventilation</i>	<i>Cases of Respiratory Illnesses Requiring Invasive Ventilation</i>	NAME AND SIGN OF OIC*
	<i>Internal Medicine ED</i>						
	<i>Respiratory Medicine ED</i>						
	<i>Paediatrics ED</i>						
	<i>Total No. of cases (in ED)</i> <i>Name and Sign of hospital Nodal Officer</i>						

To be daily filled by the nodal officers of concerned emergency unit and to be further compiled together by nodal officer of the hospital to send to district nodal officer – climate change and be copied to state nodal officer – climate change and NCDC at npcchh@gmail.com, dailvaricases@gmail.com and to be retained in hospital for necessary checks.

* OIC is nodal officer responsible for reporting for concerned department – internal medicine /respiratory medicine /paediatrics

This report is to be sent by each specialty department to Nodal Officer for surveillance of hospital.

- i. In this reporting format Name of reporting unit is to be mentioned as specialty like medicine, pediatric or respiratory emergency department etc.
- ii. In name of hospital head, enter name of sentinel surveillance hospital along with city name
- iii. Date should be the one when this report is sent to Nodal officer of the hospital
- iv. Reporting period will be of 24 hours as per the combination of all the shifts of the emergency department. E.g. 8am of previous day to 8am of next day.

Doctor of each specialty must fill this format under mentioned heads as given below:

i. Total Number of Emergencies Reported to ED-

- a. Here all kind of emergencies attended by the treating physician like from accidents, medical related, poisoning, burns including respiratory emergencies etc. are to be entered. This will give the total count of emergencies at the emergency department.

ii. Total Number of Acute Respiratory illness cases reported to ED –

- a. Here all the emergencies of due to respiratory illnesses are to be included. This should include both infectious and non-infectious origin. This value will be a part of total emergency reported to ED.

iii. Cases of Acute Respiratory illnesses reported to ED and requiring nebulisation.

- a. Here all the respiratory emergencies attended by the doctor and required nebulization at the same time in emergency department are to be entered. This value will be the part of total of all respiratory emergencies and its value should not be higher than point no. 2.

iv. Cases of acute respiratory illnesses requiring hospital admission.

- a. Here out of all emergencies attended by the doctor i.e. point no 2 those who are admitted are to be entered.

v. Cases of acute respiratory illnesses requiring non-invasive ventilation.

- a. Some respiratory emergencies which are admitted require need of Ventilation. In this head, all those admitted and put on non-invasive ventilator are to be entered. This will be part of point no 5.

vi. Cases of acute respiratory illnesses requiring invasive ventilation: Those patients who are kept on invasive ventilator are to be entered in this head. This value is also part of point no.

13. ANNEXURE B (HOSPITAL LEVEL)

# (MONTHLY COMPILED ARI SURVEILLANCE DATE-WISE DATA BY NODAL OFFICERS OF THE HOSPITAL)						
ACUTE RESPIRATORY ILLNESS CASES REPORTING TO EMERGENCY DEPARTMENT (ED) OF SENTINEL HOSPITAL						
DETAILS OF NODAL OFFICER OF HOSPITAL						
NAME:			DESIGNATION:			
DEPARTMENT: MOBILE NO.			EMAILID:			
NAME OF THE STATE:	NAME OF THE CITY		NAME OF THE HOSPITAL:		Date Of Forwarding Report:	
(1)	(2)	(3)	(4)	(5)	(6)	(7)
DATE	total number of emergencies reported to ED	total number of acute respiratory illness cases reported to ED	cases of respiratory illnesses requiring nebulization	cases of respiratory illnesses requiring admission	cases of respiratory illnesses requiring non-invasive ventilation	cases of respiratory illnesses requiring invasive ventilation
Total no. of cases (ED) / month						
Sign of hospital nodal officer						

To be sent every first day of the Month by Nodal Officer of sentinel hospital to District Nodal Officer – Climate Change and be copied to State Nodal Officer – Climate Change and NCDC at npcchh@gmail.com. A copy to be retained by the hospital for necessary check

14. ANNEXURE C (DISTRICT LEVEL)

### (Analysis of ARI cases from the Sentinel Hospital by District Nodal Officer-CC)													
Analysis of Acute Respiratory illness cases reported to Emergency Department in Sentinel Hospital													
DETAILS OF THE DISTRICT NODAL OFFICER-CC:													
NAME:										DISTRICT & STATE:			
MOBILE NO. EMAIL ID: SIGNATURE:													
	1	2	3	4	5	6	7	8	9	10	11	12	13
Date	<i>Total Number of Emergencies Reported to Emergency Dept. (ED)</i>	<i>Total Number of Acute Respiratory illness cases reported to ED (ARI)</i>	<i>Cases of Respiratory illnesses requiring nebulization (N)</i>	<i>Cases of Respiratory illnesses requiring admission (Admin)</i>	<i>Cases of Respiratory illnesses requiring Non-invasive ventilation (NIV)</i>	<i>Cases of Respiratory illnesses requiring invasive ventilation (IV)</i>	<i>ED(ARI) /ED %</i>	<i>N/E D (ARI) %</i>	<i>Adm in/ED(ARI) %</i>	<i>NIV/ED (ARI) %</i>	<i>IV/E D (ARI) %</i>	<i>IV/admin %</i>	<i>AQI</i>
Total per month													

to be sent before every 5th day of the month by district nodal officer - cc to state nodal officer – cc and be copied to NCDC at npcchh@gmail.com. A copy to be retained by DNO-CC for necessary check. a copy to be sent to respective city hospitals as a feedback.

Surveillance Data Analysis Report.

Following proportions are to be calculated from data of Annexure A.

For easy understanding, the analysis is explained with one day entry given below as an example:

Date	Total Number of Emergencies Reported to ED	Total Number of Acute Respiratory illness* cases reported to ED	Cases of Acute Respiratory illnesses reported to ED and requiring nebulisation	Cases of Respiratory Illnesses requiring admission	Cases of Respiratory Illnesses requiring Non-invasive ventilation	<i>cases of respiratory illnesses requiring invasive ventilation</i>
1.09.22	100	70	30	20	10	10

1. **ED(ARI)/ED %** = This will give proportion of acute respiratory illness emergency cases out of the total emergency cases reported at emergency department of the hospital. Calculation is given below

$$\text{ED(ARI)/ED \%} = 70/100 * 100 = 70\%$$

2. **N/ED(ARI)%** = Number of patients given nebulization out of the total number of respiratory illness cases reported at the emergency department of the hospital. Calculation is given below

$$\text{N/ED(ARI) \%} = 30/70 * 100 = 43\%$$

3. **Admit/ ED(ARI)%** = Number of patients admitted in the hospital out of the total number of respiratory illness cases reported at the emergency department of the hospital.

$$\text{Admit/ ED(ARI)\%} = 20/70 * 100 = 28.5\%$$

4. **NIV/ED(ARI)%** = Number of patients required non-invasive ventilation support in the hospital out of the total number of respiratory illness cases reported at the emergency department of the hospital.

$$\text{NIV/ED(ARI)\%} = 10/70 * 100 = 14\%$$

5. **IV/ED(ARI)%** = Number of patients required invasive ventilation support in the hospital out of the total number of respiratory illness cases reported at the emergency department of the hospital.

$$\text{IV/ED(ARI)\%} = 10/70 * 100 = 14\%$$

6. **IV/Admit%** = Number of patients required invasive ventilation support out of the total number of respiratory illness cases reported at emergency department and admitted in the hospital.

$$\text{IV/Admit\%} = 10/20 * 100 = 50\%$$

15. ANNEXURE D-ANALYSIS OF THE SURVEILLANCE DATA WITH AIR QUALITY

Analysis graph shows the relationship between the ARI cases (proportion) reported from the emergency department of the sentinel site with respect to daily city level AQI value. Graph is to be prepared between proportion of ARI cases attending emergency department on primary y axis and variable of air quality index on secondary y axis with the dates on x axis.

For this purpose of analysis, an excel sheet will be required with steps (9) shown as below-

Steps for preparing graph:

1. Select data of date, AQI and proportion of ARI cases attending ED
2. Click on the insert option
3. Select combined chart option
4. Select clustered column – line on secondary axis
5. Click on “Primary Horizontal” under “Axis titles for naming the Date axis
6. Click on “Primary Vertical” under “Axis titles for naming the Proportion of ARI cases axis
7. Click on “Secondary Vertical” under “Axis titles for naming the AQI axis
8. Click on “Chart title” under “Add chart element” for changing the title of the graph
9. Click on “Legend” under “Add chart element” for editing the legends

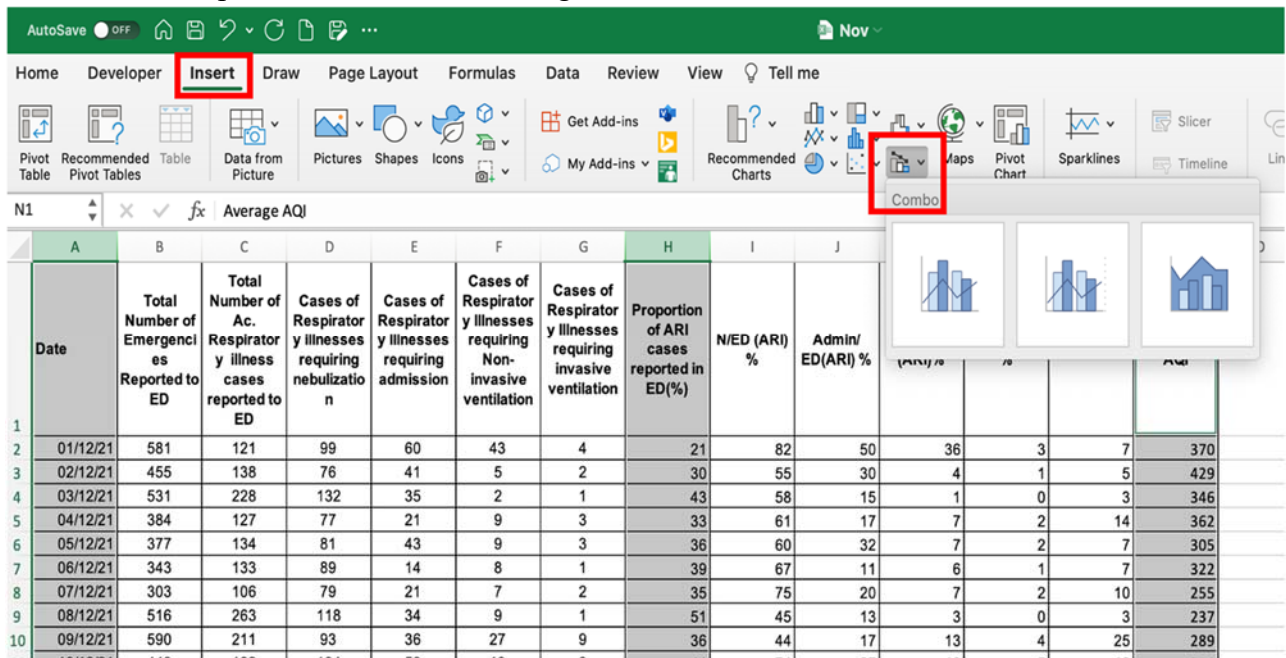
Step 1:

Click column A, Column H and Column N using Control + left click

	A	B	C	D	E	F	G	H	I	J	K	L	M	N
	Date	Total Number of Emergencies Reported to ED	Total Number of Ac. Respiratory illness cases reported to ED	Cases of Respiratory illnesses requiring nebulization	Cases of Respiratory illnesses requiring admission	Cases of Respiratory illnesses requiring Non-invasive ventilation	Cases of Respiratory illnesses requiring invasive ventilation	Proportion of ARI cases reported in ED(%)	N/ED (ARI) %	Admin/ED(ARI) %	NIV/ED (ARI)%	IV/ED(ARI) %	IV/Admin %	Average AQI
1														
2	01/12/22	581	121	99	60	43	4	21	82	50	36	3	7	370
3	02/12/22	455	138	76	41	5	2	30	55	30	4	1	5	429
4	03/12/22	531	228	132	35	2	1	43	58	15	1	0	3	346
5	04/12/22	384	127	77	21	9	3	33	61	17	7	2	14	362
6	05/12/22	377	134	81	43	9	3	36	60	32	7	2	7	305
7	06/12/22	343	133	89	14	8	1	39	67	11	6	1	7	322
8	07/12/22	303	106	79	21	7	2	35	75	20	7	2	10	255
9	08/12/22	516	263	118	34	9	1	51	45	13	3	0	3	237
10	09/12/22	590	211	93	36	27	9	36	44	17	13	4	25	289
11	10/12/22	449	182	134	50	19	9	41	74	27	10	5	18	314
12	11/12/22	372	90	66	40	12	5	24	73	44	13	6	13	281
13	12/12/22	372	122	77	29	8	2	33	63	24	7	2	7	254
14	13/12/22	526	162	112	24	11	2	31	69	15	7	1	8	331
15	14/12/22	511	181	129	25	15	2	35	71	14	8	1	8	367
16	15/12/22	467	117	91	39	13	1	25	78	33	11	1	3	363
17	16/12/22	483	128	85	32	10	5	27	66	25	8	4	16	368
18	17/12/22	344	84	56	26	5	2	24	67	31	6	2	8	329
19	18/12/22	321	96	46	12	1	0	30	48	13	1	0	0	291
20	19/12/22	355	125	57	31	12	3	35	46	25	10	2	10	271
21	20/12/22	412	153	86	17	11	4	37	56	11	7	3	24	332
22	21/12/22	392	148	92	36	8	3	38	62	24	5	2	8	402
23	22/12/22	412	148	99	35	10	2	36	67	24	7	1	6	407

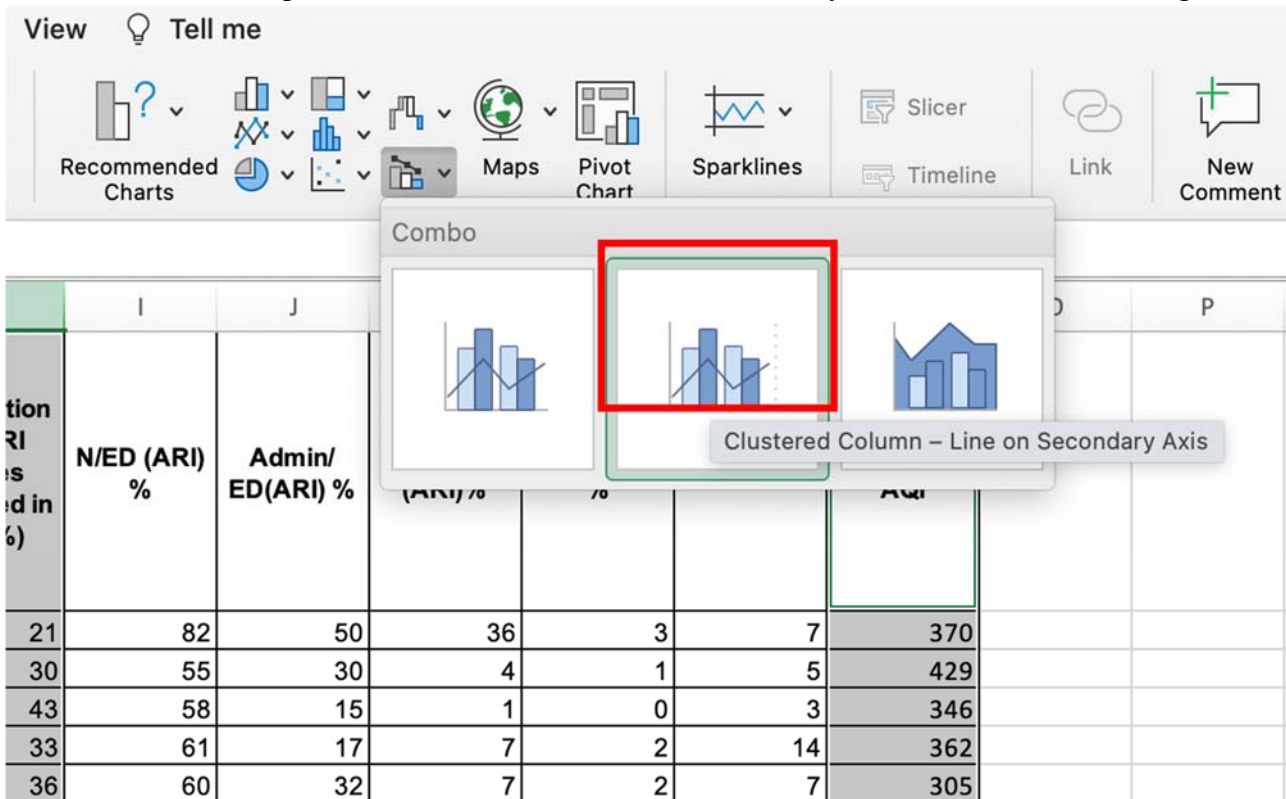
Step 2:

Click on insert option as shown in below fig



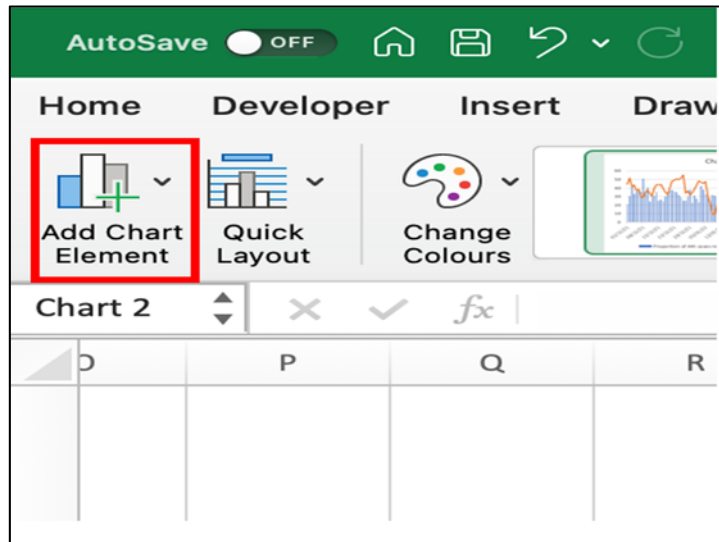
Step 3:

Click on the second option- clustered column – line on secondary axis as shown in below fig



Step 4:

Click on “Add chart element” as shown in Fig



Step 5 - 9

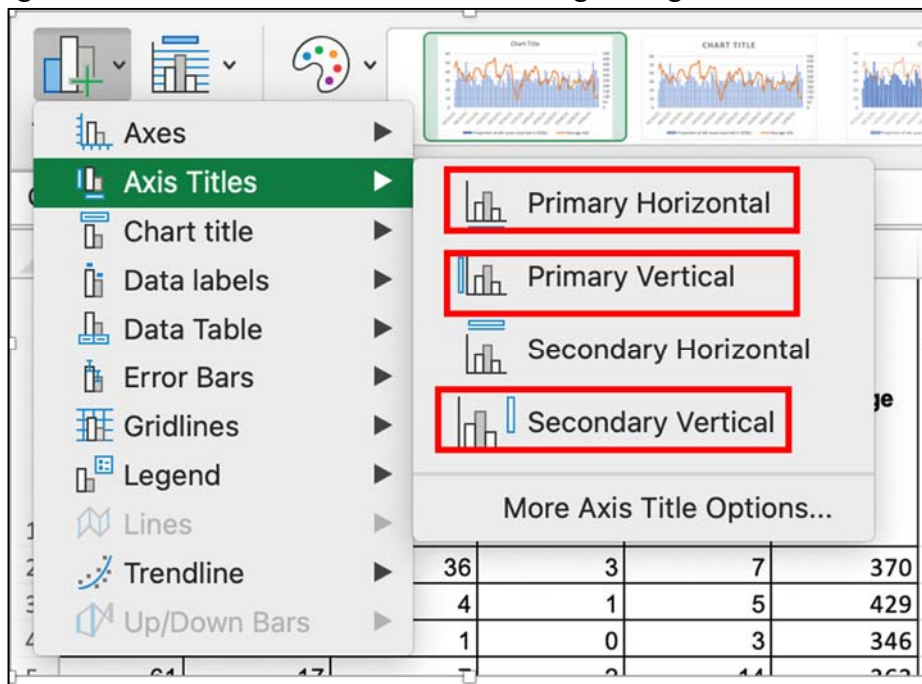
Click on “Primary Horizontal” under “Axis titles for naming the Date axis

Click on “Primary Vertical” under “Axis titles for naming the Proportion of ARI cases axis

Click on “Secondary Vertical” under “Axis titles for naming the AQI axis

Click on “Chart title” under “Add chart element” for changing the title of the graph

Click on “Legend” under “Add chart element” for editing the legends



16. ANNEXURE E (CALCULATION OF AQI)

Calculation of AQI:

- a. The Sub-indices for individual pollutants at a monitoring location are calculated using its 24-hourly average concentration value (8-hourly in case of CO and O₃) and health breakpoint concentration range. Based on the measured ambient concentrations of a pollutant, sub-index is calculated, which is a linear function of concentration (e.g., the sub-index for PM_{2.5} will be 51 at concentration 31 $\mu\text{g}/\text{m}^3$, 100 at concentration 60 $\mu\text{g}/\text{m}^3$, and 75 at concentration of 45 $\mu\text{g}/\text{m}^3$). The worst sub-index is the AQI for that location.
- b. All locations do not monitor the eight pollutants. Overall AQI is calculated only if data are available for minimum three pollutants out of which one should necessarily be either PM_{2.5} or PM₁₀. Else, data are considered insufficient for calculating AQI. Similarly, a minimum of 16 hours' data is considered necessary for calculating sub index.
- c. The sub-indices for monitored pollutants are calculated and disseminated, even if data are inadequate for determining AQI. The Individual pollutant-wise sub-index will provide air quality status for that pollutant.
- d. The web-based system is designed to provide AQI on real time basis. It is an automated system that captures data from continuous monitoring stations without human intervention and displays AQI based on running average values (e.g., AQI at 6am on a day will incorporate data from 6am on previous day to the current day).
- e. For manual monitoring stations, an AQI calculator is developed wherein data can be fed manually to get AQI value.

This operational guideline on Sentinel Surveillance of Air Pollution related Illnesses is developed under the NPCCHH programme at NCDC, Directorate General Health Services, MoHFW.

The document is meant to support the relevant stakeholders in understanding and operationalizing the surveillance system on air pollution related illnesses under the programme including at the sentinel hospitals and the programme officials involved in it.

This will benefit the Central, State and District Programme officials and Surveillance Nodal Officers and other officials and staffs involving in the Sentinel Hospitals. The document will also help to those public health professionals interested in understanding how the sentinel surveillance on air pollution related illnesses is conducting in a sentinel hospital, its functioning mechanisms in the city and its reporting requirements in the state and central level and the actions suggested as a part of the surveillance mechanisms under NPCCHH.



**National Programme
on Climate Change
and Human Health**



**National Centre
for Disease Control**
Government of India