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Pollution Hazard Caused by Anti-Disease Drugs in Hospital Environments Near Chennai

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Abstract: This work focuses on the effect of various possible air pollutants emitted in hospital environments due to usage of anti-disease drugs to counteract various human disorders. Quantitative pollution survey was conducted for the area consisting of tuberculosis related hospitals and pharmaceutical areas near Chennai. In general, all these drugs may have adverse bad effects on the well health of human community. These anti-disease drugs could be thus named as toxic polluting gases. Healthcare workers and nurses in hospitals are directly inhaling these toxic polluting gases at a slower rate and could possibly suffer with various health complexities. Experimental statistical survey was done to observe the severity of pollution around the place. Time bound study and observation was conducted to know the pollution effect. Pollution survey was conducted for the time period of four consecutive months from January 2019 to April 2019 in three thoracic units each with three selected sites as general ward, special ward and common area. Air quality index (AQI) was calculated and remedial measures were suggested.

Index Terms: Tuberculosis, Pharmaceutical, Anti-disease drug, Thoracic, Toxic, Pollution

I. INTRODUCTION

Hospital and pharmaceutical environments are places of higher importance in terms of need for anti-pollution measures. In this work, a survey based on quantitative measurement of pollutant level is done on such environments near Chennai. A thorough discussion on the drugs causing pollution, tablets, their compositions and characteristics were discussed through literature study. Finally a pollution survey was conducted and based on the results, remedial measures were suggested. Out of most of the medicines in thoracic sector, clarithromycin is a popular and important drug.

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1.1 Thoracic zones and Air sampling

In this current research, three places were chosen as sampling sites. They were general ward, special ward and common area as shown in figure 1. A four month period air pollution study from January 2019 to April 2019 was conducted with the help of pollution equipment known as High Volume Air Sampler [6].

In the due course of the study, the importance of more number of trees surrounding the sampling areas was realized. On the other hand, pharmaceutical wastes and its disposal depended entirely on their own specific methodologies of the particular pharmacies and hospitals indicating lack of correct government guidelines.

Figure 1. Sites of pollution study showing general ward on left, special ward in middle and common area on the right side

1.2 High Volume Air Sampler

High volume air sampler is shown in the figure 2 below which was used in this study for air pollution survey [9] at the selected sampling sites. It is a productive 400x400x680, single-phase 25 kg, product-sized product-size air flow unit with a frequency of 50 Hz 230 VAC, with an electronic powered unit of 0.9 to 1.7 mm per minute.

Figure 2. High Volume Air Sampler

1.3 Air Quality Index

Air Quality Index (AQI) is the measurement of the proportion of the environmental pollutant concentration to domestic pollutant norms. There was no critical endeavor, mainly because of the manner in which the NAC Monitoring program was started in 1984, of establishing and using AQI in India[13]. Despite the NEERI scheme, in 1978 and Bombay, Nagpur started observing in 10 metropolitan regions. Even before 1978, no effort was made to use AQI to understand information and open telecoms. Agharkar (1982) examined available AQIs and considered the status of Bombay town and its rural regions with regard to air quality. Although numerous specialist papers proposing specific records were presented globally, there was no attempt to use an Index in India. A continuous Air Quality Index study in India includes the methodology for predicting air quality and calls the framework SAFAR that relates to the Air Quality-Weather Forecasting and Research System [14]. The following Table 2 demonstrates the categorization of the distinct air quality kinds, such as clean air, satisfactory, moderate, poor, very poor and severe pollution depending on their APIs as shown in the table 1 and the equation for the same is given in equation 1 below.

Table 1. Category of air quality.

Type	AQI
Clean air	0-50
Satisfactory	51-100
Moderate pollution	101-250
Poor	251-300
Very poor	301-400
Severe	401-500

$$AQI = \frac{\text{Polluting gas quantity in } \mu g/m^3 \text{ for (Industrial estate + Residential area + School zone)}}{3} \quad \text{—— (1)}$$

1.4 Consequences of inhaling Pollutant gases

Availability of diseases are plenty in the world out of which Tuberculosis (TB) is one of the world's top ten major causes, ranking higher than HIV. Billions of people suffer from this disease all over the world even in this modern arena. For instance, a total of 1,600,000 TB of fatalities were reported in the year of 2017. In that same year, there were approximately 234,000 deaths of people due to TB, including children. Individuals with both TB and HIV are medically classified and termed as HIV-dead. It was estimated that there were 10.0 million fresh affected people of TB in the discussed year. TB is capable of affecting all nations and age groups, especially 90% are adults aged more than 15 years in which 64% are males and 9% are HIV affected people. 72% of this effect could be attributed the African region. In the World Health Organization (WHO) European region and America, only 6% of cases were reported for TB, each. Global statistics on TB indicate an estimated 1,000,000 effects in the last year. Effects of TB in Indian population are more important similar to its effect in China, US, South Africa and in Nigeria. An estimated quantity of one million ten thousand children suffered from TB in 2017. The global control measures of TB and efforts to end TB are becoming an growing issue utilizing drug resistant TB.

II. SURVEY RESULTS & DISCUSSION

The Primary cause of pollution in the regions selected for sampling research could be termed as the drug clarithromycin compared to the other common ones used in thoracic areas. As mentioned earlier, the survey was conducted in three thoracic units. In each unit three different zones were chosen as general ward, special ward and common area. There was a significant concern here about the concentrations of chemicals released from the drug. These concentrations of pollution not only pose a health hazard, but also have a adversely impact on the environment. In the course of various periods of 4 consecutive months beginning between January 2019 and April 2019, high-volume air sampler was used to find out how much of a pollutant in micrograms was available per unit cube meter from the air from Table 2 below. For a specific month, a research study was conducted first in order to take account of the severity of the medicinal drug. Generally in areas such as the general ward, the special ward and common area, the effect could be felt comparatively more than the unutilized areas in the hospitals. In comparison, the wards have a slightly greater concentration of air pollution. This is because, usually, these places are much closer to the drugs possibly releasing harmful chemical wastes.

Table 2. Observed values of pollutant levels

Thoracic unit	Sampling area	Jan 2019 ($\mu g/m^3$)	Feb 2019 ($\mu g/m^3$)	Mar 2019 ($\mu g/m^3$)	Apr 2019 ($\mu g/m^3$)
Thoracic unit-1	General ward	120	128	131	122
	Special ward	110	116	121	115
	Common area	100	107	113	106
Thoracic unit-2	General ward	123	129	130	125
	Special ward	111	118	120	117
	Common area	104	105	111	106
Thoracic unit-3	General ward	121	128	132	121
	Special ward	113	115	123	117
	Common area	107	106	109	105

The pollutant gasses had been evaluated at concentrations of micro grams per cubic meter. The table above obviously shows the entire testing detail. The chemical content that is the level of pollutant for the four-month sampling research is demonstrated below in figure 3 for thoracic unit-1 first followed by the other units below in separate diagrams.

In order to identify the existing pollution situation that occurred every day in a locality that affects the population and the environment, directly or indirectly, this experimental study was conducted for the recent last four months starting from January 2019 to April 2019.

For the general ward, special ward and common areas in January 2019, the observed values were found to be120 µg/m^3, 110 µg / m^3 and 100 µg / m^3. The values for the month of February 2019 were 128 µg/m^3 , 116 µg/m^3 and 107 µg/m^3. The values for the month of March 2019 were 131 µg/m^3, 121 µg/m^3 and 113 µg/m^3. And finally for the month of April 2019, it was observed to be 122 µg/m^3, 115 µg/m^3 and 106 µg/m^3. By comparison, it was very obvious that the first month has a lesser pollution than the remaining three months.

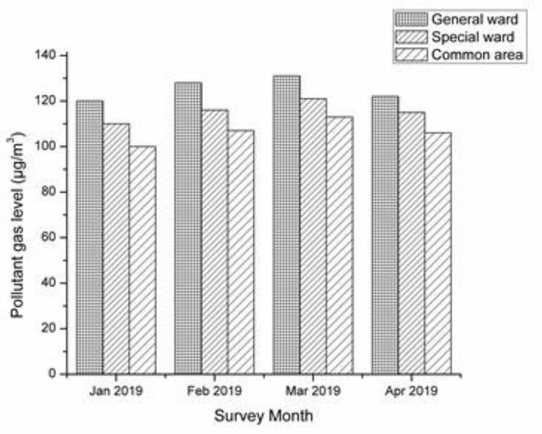

Figure 3. Thoracic unit-1

The pollution concentration for the 4 sample periods from January 2019 to April 2019 for thoracic unit-2 was shown in figure 4. In January 2019, the general ward, special ward and common area respectively had faced a pollutant values of 123 µg/m^3, 111 µg/m^3 and 104 µg/m^3. The values recorded for February 2019 for these areas were 129 µg/m^3, 118 µg/m^3 and 105 µg/m^3. The values were 130 µg/m^3, 120 µg/m^3 and 111 µg/m^3 respectively, for the month of March 2019 in the same manner. The 125 µg/m^3 values of 117 µg/m^3 and 106 µg/m^3 respectively were finally noted for the month of April 2019. Here also, a comparative increase in pollution was observed for the last two months than the first two months.

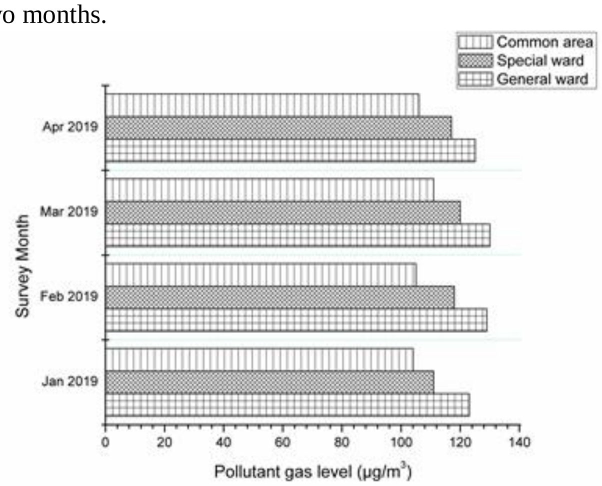

Figure 4. Thoracic unit-2

For the case of thoracic unit-3, in January 2019, the pollutant level values observed for general ward, special ward and common area respectively were 121 µg/m^3, 113 µg/m^3 and107µg/m^3. The values recorded for February 2019 for these areas were 128 µg/m^3, 115 µg/m^3 and 106 µg/m^3. The values were 132 µg/m^3, 123 µg/m^3 and 109 µg/m^3 respectively, for the month of March 2019. Finally for the month of April 2019, the values were found to be 121µg/m^3,117 µg/m^3 and 105 µg/m^3 respectively. A comparative increase in pollution was observed for the last two months than the first two months and this is illustrated in figure 5.

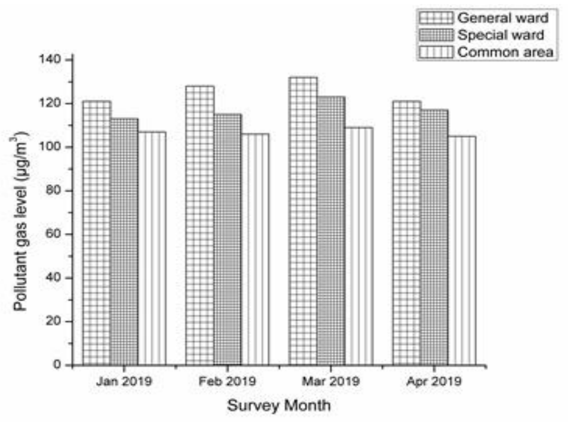

Figure 5. Thoracic unit-3

In general, it has been found that the concentrations of the different pollutant gasses are found to be moderate through the study. Each moment the concentration values were recorded, further numerical tests were performed to ensure the values. The values showing neurotoxicity concentrations and pollutions that happen because of the thoracic drugs especially clarithromycin. The three statistics discussed above are therefore all precise and obviously illustrate the ideal state of the situation. In the methodology section, the effects and consequences of inhaling these dangerous pollutant gasses were lucidly discussed. Accuracy and thorough calculation are very important in every experimental examination of this type. In most of these instances diseases are less identifiable or, in the worst cases, are not at all identifiable as the illness and disease caused in humans by the inhalation of these gasses at extreme levels are alarming. A prolonged inhalation of these gasses for many years, such as 20-30 years, could also lead to death on certain occasions. These gasses often affect mostly the lungs, eyes and unconsciousness on certain occasions. Such a survey is very important and necessary not only for the pharmaceutical industry / hospitals but for many hospital units that emit harmful gases. During the study, it was observed that there was a comparative increase in pollution over the last two months as compared to the first two months. Air quality index (AQI) is an important measure in pollution studies.

In the methodology section the importance of an air quality index was well described. Based on equation (1) for AQI, the following calculation was done for various pollutants. Table 3 shows the calculated AQI values. According to the index value of air quality, air quality was more strongly polluted in the last two months of the pollution survey, in comparison to the remaining months, as shown in figure 6.

The higher the AQI, the more contamination is present in the surrounding environment, in overall. There are also a range of diseases that result from air pollution. Every year, around 8 000 people in Chennai experience diseases such as breathing problems. Consequently, a lower value of AQI is always welcome for the society and the overall environment surrounding.

Table 3. Calculated AQI values

Thoracic unit	Jan 2019 (μg/m^3)	Feb 2019 (μg/m^3)	Mar 2019 (μg/m^3)	Apr 2019 (μg/m^3)
Thoracic unit-1	110	117	121.66	114.33
Thoracic unit-2	112.66	117.33	120.33	116
Thoracic unit-3	113.66	116.33	121.33	114.33

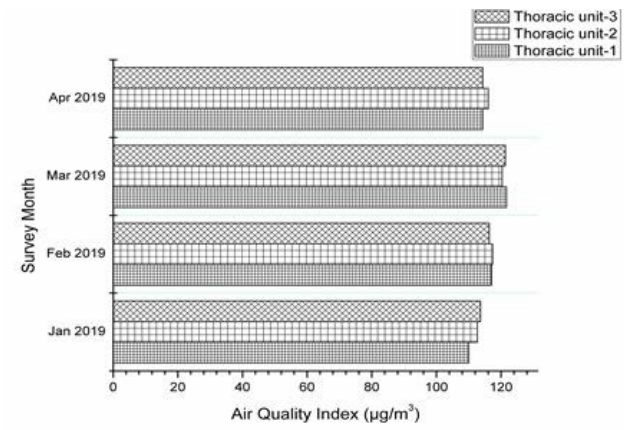

Figure 6. AQI values for the surveyed months

III. 3 CONCLUSION AND RECOMMENDATIONS

The manufacture and use of many pharmaceutical drugs is an essential act in the society for counteracting diseases. In areas of frequent usage, this may lead to environmental degradation due to emissions of important amounts of gaseous and chemical contaminants and also through inappropriate use of waste disposal. In this work, a place near Chennai with many pharmaceutical industries and TB hospitals are operating was chosen as sampling area and an experimental study was carried out for air pollution survey. The primary drug materials are products of higher usage such as clarithromycin and improperly disposed of medicines. The following points were noted and suggestions were made during the moment constrained experimental investigation.

- Measurable amounts of air pollutant levels could be observable in the chosen areas of study. The level of different air pollutants in the ambient air was noticeable during the sampling period of four months.
- The three sites for quantitative pollution survey were chosen through a study on the past history of the entire area and from the frequency of more usage of medicinal drugs. All these three sites have been turned into air pollution sites, according to the Air Quality Index (AQI) values measured. On the whole, the greater the AQI, the more contamination is. Thus, reduced AQIs benefit human health and the environment.
- It was observed from the pollution survey results for the four sampling months that the last two months showed more severe pollution from the medicinal drug compared to the first two months. This could be attributed to more frequent usage of the drugs in the corresponding months and also to the climatic changes that were occurring in these months.
- Remedial measures could be suggestible like supplying of better quality drug products. In this way, the gaseous and chemical pollutants could be decreased.
- In this work, life cycle assessment for a drug like clarithromycin was discussed based on a literature study. Use of high quality drugs and manufacture of medicines should take ecological and health considerations into account as a whole. Greenbelt development can be an efficient mitigation system for the medical industry.
- Facilities for protection can be developed with the incorporation of suitable filter material via adequate research and development; and more environmental awareness programs can be organized for hospital staff, workers of pharmaceutical industries or chemical industry employees.
- Without effective air quality management systems, the concentrations of air pollutants will increase in the future. Therefore it is highly necessary to develop and enforce of air quality standards and future research in the usage of protective facial masks for the healthcare workers and general public in any medicinal areas that are using anti-thoracic drugs. This will definitely improve the human health, environment and the well-being of the society in overall.

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