Federal University Wukari General Studies Journal
Division of General Studies,
Federal University Wukari
Journal homepage: https://journal.quantapub.com/index.php/fuwgestj

# Assessment of the Patterns of Respiratory Conditions across Selected Health Institutions in Lagos State, Nigeria

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## Abstract

*Respiratory diseases are among the leading causes of morbidity and mortality globally, with urban and industrialized settings like Lagos State, Nigeria, being particularly vulnerable due to high levels of air pollution, overcrowding, and inequitable access to healthcare. Despite the growing burden, comprehensive data on institutional patterns of respiratory conditions across Lagos remains sparse, limiting effective public health response. This study assessed patterns of respiratory conditions using hospital-based records from selected general hospitals, Lagos State University Teaching Hospital (LASUTH), and Primary Healthcare Centers (PHCs) across Lagos from 2016 to 2021. Monthly respiratory symptom and disease were collected from hospitals and supplemented by structured questionnaires administered to residents in proximity to industrial estates. Data analysis involved mapping of respiratory cases across the industrial locations and descriptive statistics. A total of 82,481 cases were recorded in PHCs from 2016 to 2021, with asthma (40,909) and pneumonia (41,572) dominating. Higher counts were recorded during the dry season across all facilities. Ikorodu General Hospital reported 22,177 cases, with Upper Respiratory Tract Infections (URTI) accounting for over 50%. LASUTH recorded 521 severe cases, with pulmonary tuberculosis and COPD being most common. Under-5 children were the most affected group, primarily due to physiological vulnerability and indoor air pollution. The study revealed a significant burden of respiratory diseases in Lagos State, with distinct spatial and seasonal patterns linked to environmental pollution and socioeconomic disparities. Dry seasons and proximity to industrial estates were associated with increased respiratory morbidity. Data gaps, disparities in healthcare infrastructure, and lack of standardized record-keeping were critical limitations in effectively addressing respiratory health disparities across the industrial locations. Strengthen and harmonize health data systems across institutions to allow for real-time surveillance of respiratory conditions, air quality monitoring and control policies in high-risk industrial areas and pprioritize healthcare infrastructure development in under-resourced PHCs and secondary hospitals are recommended.*

**Keywords:** Respiratory diseases, Hospital-based morbidity, Industrial estates, Public health, urban health

## Introduction

Respiratory diseases constitute a significant public health burden worldwide, with increasing incidence and mortality observed in both developing and developed nations. Lagos State, as Nigeria's most populous and industrialized region, faces complex health challenges due to rapid urbanization, high population density, vehicular emissions, industrial pollutants, and poor housing conditions. These factors contribute to a high prevalence of respiratory illnesses including asthma, chronic obstructive pulmonary disease (COPD), bronchitis, and pneumonia (Adeyemi *et al.,* 2021). Understanding the patterns of respiratory morbidity and mortality across health institutions in Lagos is essential for effective health planning and intervention. In Lagos State, the burden of respiratory morbidity and mortality is growing at an alarming rate. Despite the increasing hospital admissions and reported fatalities from respiratory-related conditions, there is a dearth of comprehensive, institution-based data that accurately captures the spatial and temporal patterns of these health outcomes. This data gap impedes informed decision-making by health authorities and policymakers, limiting the effectiveness of public health interventions. The urban environment of Lagos is characterized by heavy traffic congestion, industrial emissions, and frequent exposure to airborne pollutants such as particulate matter ($PM_{2.5}$ and $PM_{10}$), nitrogen dioxide ($NO_2$), sulfur dioxide ($SO_2$), and volatile organic compounds (Akinfolarin *et al.,* 2018). These pollutants are well-established risk factors for respiratory illnesses (WHO, 2017). Vulnerable populations, including children, the elderly, and individuals with pre-existing conditions, are disproportionately affected, yet many cases remain underdiagnosed or unreported due to inequities in access to healthcare facilities and diagnostic services (Ezeh *et al.*, 2019).

Respiratory diseases such as pneumonia, bronchial asthma, tuberculosis, COPD, and acute respiratory infections represent leading causes of hospital admissions and deaths in Lagos State. Despite the significant burden posed by these conditions, there is a glaring lack of comprehensive institutional data that outlines their distribution and outcomes across public and private health facilities. This information gap complicates the task of identifying high-risk zones, allocating resources effectively, and implementing disease prevention strategies (Onwujekwe *et al.,* 2019). The state's urban configuration and population density make it a hotspot for environmental health challenges. High volumes of vehicular emissions, industrial discharges, and open waste burning contribute to elevated levels of ambient air pollutants such as $PM_{2.5,}$ $PM_{10,}$ $NO_2$, $SO_2$, and carbon monoxide. These pollutants have been directly linked to the onset and exacerbation of respiratory illnesses (Akinfolarin *et al.,* 2018; WHO, 2017). Yet, little is known about how these exposures translate into actual patterns of morbidity and mortality within health institutions. A critical challenge is the disparity in healthcare access and diagnostic capabilities among health institutions. Tertiary facilities like Lagos University Teaching Hospital (LUTH) have better resources and trained personnel for managing respiratory diseases, whereas primary and secondary healthcare centers often lack basic diagnostic equipment such as spirometers and x-ray machines. This inequality leads to underreporting and delayed diagnosis, resulting in higher mortality rates at lower-tier institutions (Adebayo *et al.,* 2020). Moreover, socioeconomic inequalities exacerbate respiratory health outcomes. People in low-income communities are more likely to use biomass for cooking and heating, live in overcrowded spaces, and experience chronic exposure to indoor pollutants (Nriagu *et al.,* 2016). The lack of standardized reporting systems across health institutions through manual recordkeeping, which increases the risk of data loss, duplication, and inaccuracy. Where digital systems are used, they are often not harmonized across institutions, making it difficult to track patient histories or monitor disease trends in real-time (Onwujekwe *et al.,* 2019). These system inefficiencies impede evidence-based health planning and surveillance. Also noteworthy is the lack of gender- and age-disaggregated data on respiratory morbidity and mortality. Children under five and the elderly are especially vulnerable to air pollution and respiratory diseases. However, in the absence of specific institutional records capturing demographic variation, it is difficult to prioritize interventions for these at-risk groups (Ezeh *et al.,* 2019).

Compounding the issue is the inconsistent record-keeping and reporting practices across public and private health institutions in Lagos. Without standardized surveillance and monitoring frameworks, it is difficult to compare data across institutions or assess trends over time. Moreover, the absence of integrated health information systems contributes to fragmented datasets that are insufficient for understanding disease distribution or informing resource allocation

(Onwujekwe *et al.,* 2019). Socioeconomic disparities further exacerbate the problem. Populations in low-income neighborhoods often live in overcrowded and poorly ventilated environments, increasing their exposure to indoor air pollution from biomass fuels and tobacco smoke (Nriagu *et al.,* 2016). Despite these known risks, health records in many institutions do not routinely capture environmental or occupational exposure histories, limiting the ability to establish causal relationships. The health infrastructure in Lagos is under significant strain due to population pressure and limited resources. Many secondary and tertiary institutions are overwhelmed by patient loads, leading to delays in diagnosis and treatment. In such settings, respiratory complications are often mismanaged or escalate to fatal outcomes, especially in cases where facilities lack specialized respiratory care units or intensive care services (Adebayo *et al.,* 2020). The lack of spatially-disaggregated, standardized, and systematically-collected data on respiratory diseases across health institutions in Lagos poses a serious challenge to public health. There is an urgent need for detailed epidemiological assessment that examines the institutional patterns of respiratory morbidity and mortality. Such research can support evidence-based policy formulation, enhance the allocation of health resources, and ultimately reduce the disease burden among Lagos residents.

## 2.0. Materials and Methods

### 2.1. Study Area

Lagos State is situated in South Western Nigeria at latitudes $6^0$22'N and $6^0$52'N and longitudes $2^0$42'E and $3^0$42'E. It is bounded to the west by the Republic of Benin, on the southern boundary by a 180 km long Atlantic coastline and the northern and eastern boundaries by Ogun State. Lagos state has a landmass of 3,671km$^2$ of which over 35% (787 km$^2$) of this are defined by lagoons, creeks and islands (Soladoye & Ajibade 2014; PWC, 2015; NBS 2011). Lagos state has 20 local government areas of which sixteen are metropolitan densely populated areas. The Climate of Nigeria is balkanized into three climate types which are the tropical rainforest, montane or highland and the tropical savanna climates (Ileoje, 2001; Eludoyin, *et al* 2013). The coastal landscape of Lagos state is bifurcated into five geomorphological sub units, which are; coastal creeks and lagoons, abandoned beach ridge complex, swamp flats, active barrier beach complex and forested river floodplain (Adegoke *et al.* 1980). The topography is flat slightly above mean sea level (Oluwole *et al.* 1994) and defined by swamp forest of the coastal belt with fresh water, and dry lowland rain forest with patches of vegetation in their natural state. These wetland vegetation is caused by the double maxima rainfall pattern of the region (Adelana *et al.* 2005; Odjugbo, 2010). The geology of Lagos state is made up of the tertiary and quaternary sediments which comprises of the Benin formation (Miocene to recent), recent littoral alluvium and lagoon/coastal plain sands of the Dahomey basin (where the sea bed steeply slopes away from shore and stratigraphically consist of Abeokuta and Imo groups and Ilaro Formation) (Soladoye & Ajibade 2014). The Dahomey basin spreads through southeastern Ghana in the west, through southern Togo and southern Benin Republic to southwest Nigeria, the basin is bounded to the west by faults and marked by the Benin hinge line at its eastern limit (Yusuf & Abiye, 2019).

Lagos state accounts for over 60% of the industrial and commercial activities in Nigeria and financially solvent with the capacity of generating over 75% of its revenues independent of federal allocation (LBS, 2015; Ajayi 2007, 2011; SWIFT 2017). According to the Lagos Bureau of Statistics (2015) report on revenue generation, Lagos state had a gross domestic product (GDP) of over 80 billion dollars in 2010 accounting for 36% of Nigeria's GDP and among the largest economy in Africa. Lagos State has a projected population of 21 million in 2021 according to the 2006 NPC projection making it the seventh fastest growing city in the world and the third largest city in Africa (Longe, 2011; Salau, 2016; NPC 2006). It has a population growth rate of 3.2% and projected to be over 30 million by 2025 (PWC, 2015). Over 80% of the population are domiciled on 37% of the metropolitan landmass where all economic activities are concentrated and driven by a skilled work force of over 45% with a literacy rate of 92% (Ojeh *et al* 2016; PWC, 2015). The industrial estates in Lagos are Ikeja, Agidingbi, Amuwo Odofin, Apapa, Gbagada, Iganmu, Ijora, Ilupeju, Matori, Ogba, Oregun, Oshodi/Isolo/Ilasamaja, Surulere, Odogunya, and Yaba. (Ajayi, 2007, 2011; Etim, 2012; Ojiodu *et al*, 2013; Mashi *et al*, 2014). Some of these estates are both active and dormant in industrial activities including Ikeja/Ogba, Oshodi/Ilupeju.

**Table 1: Study area**

| S/n | Industrial estate | Year of est. | Active industrial firm | Size (Ha) | Estate area | Estate type | Industrial nature |
|---|---|---|---|---|---|---|---|
| **1** | Ikeja/Ogba | 1959 | 75 | 180 | Mainland | IR | FBT, FM, C&P, DIP, PPP, TW, EE, WH WWG, MVP, CCT, EE, and P. |
| **2** | Oshodi/Ilupeju | 1962 | 57 | 330 | Mainland | IR | FBT, DIP, PPP, C&P, CP& IT, TW, WWG, MVP, WH and P. |
| **3** | Surulere | 1957 | 39 | 25 | Mainland | IR | FBT, WH, M&S, C, PPP, TW, DIP, E/P, EE, NMMP and MV |
| **4** | Apapa | 1957 | 31 | 100 | Coastal | IR | FBT, C&P, M&S, PPP, OMC, WH, CCT and TW |
| **5** | Odogunya | 1976 | 52 | 1582.27 | Mainland | IR | FBT, C&P, DIP, M&S, PPP, TW, EE, WH, FM, FW and E/P |
| **6** | Alausa (control) | 1996 | 0 | 1 | Mainland | GR | LASEPA premises, Government buildings, offices and residential areas |

Source: (Fagbohunka, 2014; MAN, 2014; LBS, 2016; Field Survey, 2021)

Note: IR: Industrial/Residential
GR: Government/Residential
Ha: Hectares
WH: Warehousing
M&S: Metals Iron and Steels Fabrication
C&P: Chemicals and Pharmaceuticals
CP&IT: Computer Parts and Information Technology Equipment
DIP: Domestic/ Industrial Plastics and Nylons
FBT: Food, Beverages, Biscuits and Tobacco
PPP: Paper and Pulp Products
MVP: Motor Vehicle Assembly and Parts
NMMP: Non -Metallic Mineral Products
EE: Electrical and Electronics Products
TW: Textile and Wearing Apparels
WWG: Wood and Wood Goods
CCT: Cement, Clay and Tiles
OMC: Oil Marketing Companies
E/P: Energy/Power
FM: Foam Manufacturing
P: Publishing
C: Carpets
FW: Foot Wears

**2.2. Data Collected**

**2.3. Respiratory Incidence Data**

Monthly respiratory records were collated from General hospitals in Apapa, Randle, Ikorodu, Oshodi/Isolo, Lagos State University Teaching Hospital (LASUTH), and Lagos State Primary Health Care Board, Yaba for morbidities (e.g., lung cancer, asthma and pneumonia etc.) due to increased industrial air pollution levels on residents. Monthly incidence of respiratory symptoms (e.g. coughing, decreased lung function, bronchitis, irritation of the eyes, nose and throat, flu, cold, headaches, dizziness, restlessness, needles feeling, sweating, tiredness, increased heart rate, asphyxia, convulsions, chest tightness, and shortness of breath) and diseases (e.g. lung cancer, asthma and pneumonia) was collated simultaneously for twelve months spanning through the wet and dry seasons during which field readings for pollutants levels and meteorological conditions were investigated.

The information elicited are hospital visits and hospital admissions for incidence of respiratory symptoms (e.g. coughing, decreased lung function, bronchitis, irritation of the eyes, nose and throat, flu, cold, headaches, dizziness, restlessness, needles feeling, sweating, tiredness, increased heart rate, asphyxia, convulsions, chest tightness, and shortness of breath) and diseases (e.g. lung cancer, asthma and pneumonia) for the highly vulnerable groups which are; infants and children (5 years and below), working age (less than 65years) and the elderly (above 65 years). Random sampling was used to administer structured questionnaires on residents within and in proximity to the industrial estates to elicit information on their perceived respiratory health effects caused by increased industrial air pollution levels.

**3.0. Results and Discussion**

**3.1. Pattern of hospital based respiratory conditions across the state**

Total morbidity cases from 2018 to 2021 (Fig. 2) in primary health care centers across the 20 LGAs in Lagos state was 82,481. From the available records, Asthma cases recorded a total of 40,909 and pneumonia cases was 41572. An annual downward trend in Asthma and Pneumonia was observed between 2018 to 2021 across all PHCs in Lagos State. Asthma and Pneumonia cases varied between the wet and dry season with upward trends observed during the dry season than the wet season across the state from 2018 to 2021 (Fig. 3). The general and teaching hospital-based records across the study area varied in terms of respiratory conditions, and number of cases between 2016 to 2021 (Fig. 4 to Fig. 9). A total of 22,177 cases were found at Ikorodu General hospital with 23 respiratory conditions (Fig. 4). Upper respiratory tract infection (URTI) accounted for 52.07% (11,547), Broncho-pneumonia 11.11% (2,463), Asthma 6.83% (1,515), Acute tonsilitis and Aspiration pneumonia (4.70% (1042) and 4.82% (1070), Pneumonia 3.68% (816) and Acute bronchitis, Bacteria pneumonia and Respiratory distress accounted for 1.58% (350), 1.78% (394) and 1.10% (243). Other respiratory conditions like COPD 0.25% (56), Rhinitis 0.24% (53), Pleural effusion 0.20 (44) etc. accounted for less than 1% of the total cases.

At General hospital, Apapa, 3565 cases were found with 18 respiratory conditions (Fig. 5). Upper respiratory tract infection (URTI) accounted for 55.1% (1,964), Asthma 15.79% (563), Acute bronchitis 5.58% (199), Lobar pneumonia 5.39% (192), Broncho pneumonia 3.96% (141), Pneumonia 2.92% (104), Acute tonsilitis 2.33% (83), Acute nasopharyngitis 2.19% (78%), Coryza 2.89% (103) and Bacteria pneumonia 1.29% (46). Other respiratory conditions like Acute sinusitis 0.17% (6), Emphysema 0.65% (23) etc. accounted for less than 1% of the total cases.

At Randale General hospital, Surulere, 10,082 cases were found with 21 respiratory conditions (Fig. 6). Upper respiratory tract infection (URTI) accounted for 21.02% (2,119), Acute bronchitis 17.08% (1,722), Asthma 13.47% (1,358), Acute bronchiolitis 8.55% (862), Broncho pneumonia 9.63% (971), Pneumonia 7.96% (803), Respiratory distress 4.81% (485), Bacteria pneumonia 2.07% (209), Acute sinusitis 1.43% (144), Lower respiratory tract infection (LRTI) 1.26% (127) and Viral pneumonia 1.47% (148). Other respiratory conditions like Acute laryngitis 0.13% (13), Emphysema 0.34% (34) etc. accounted for less than 1% of the total cases.

At Oshodi/Isolo general hospital, 8552 cases were found with 17 respiratory conditions (Fig. 7). Upper respiratory tract infection accounted for 38.26% (3,272), Broncho pneumonia 25.06% (2,143), Acute bronchitis 17.35% (1,484), Asthma 6.28% (537), Acute tonsilitis 3.13% (268), Bacteria pneumonia 2.12% (181), Pharyngitis 2.22% (190), Rhinitis 1.68% (144) and Acute sinusitis 1.06% (91). Other respiratory conditions like Adenoids 0.74% (63), Aspiration pneumonia 0.28% (24) etc. accounted for less than 1% of the total cases. At the Lagos State University Teaching Hospital (LASUTH), 521 cases were found with 18 respiratory conditions (Fig. 8). Pulmonary tuberculosis accounted for 26.30% (137), Asthma 25.91% (135), COPD 20.73% (108),

Pneumonia 12.67% (66), Sarcoidosis pulmonary fibrosis and TB bronchiectasis 2.11% (11 each), Bronchial asthma 1.54% (8), Bronchitis 1.73% (9) and Koch Disease 1.15% (6). Other respiratory conditions like Pulmonary edema 0.96% (5), Lung abscess 0.38% (2), lung disease 0.96% (5) etc. accounted for less than 1% of the total cases. The respiratory conditions across general and teaching hospitals (Fig. 9) in the study area between 2016 to 2021 revealed more hospital based respiratory conditions in the dry season than the wet season. Monthly hospital based respiratory conditions also varied between 2020 to 2021 (Fig. 10). The dry season revealed higher hospital based respiratory conditions than the wet season during the period of study (Fig. 11 and Fig. 12).

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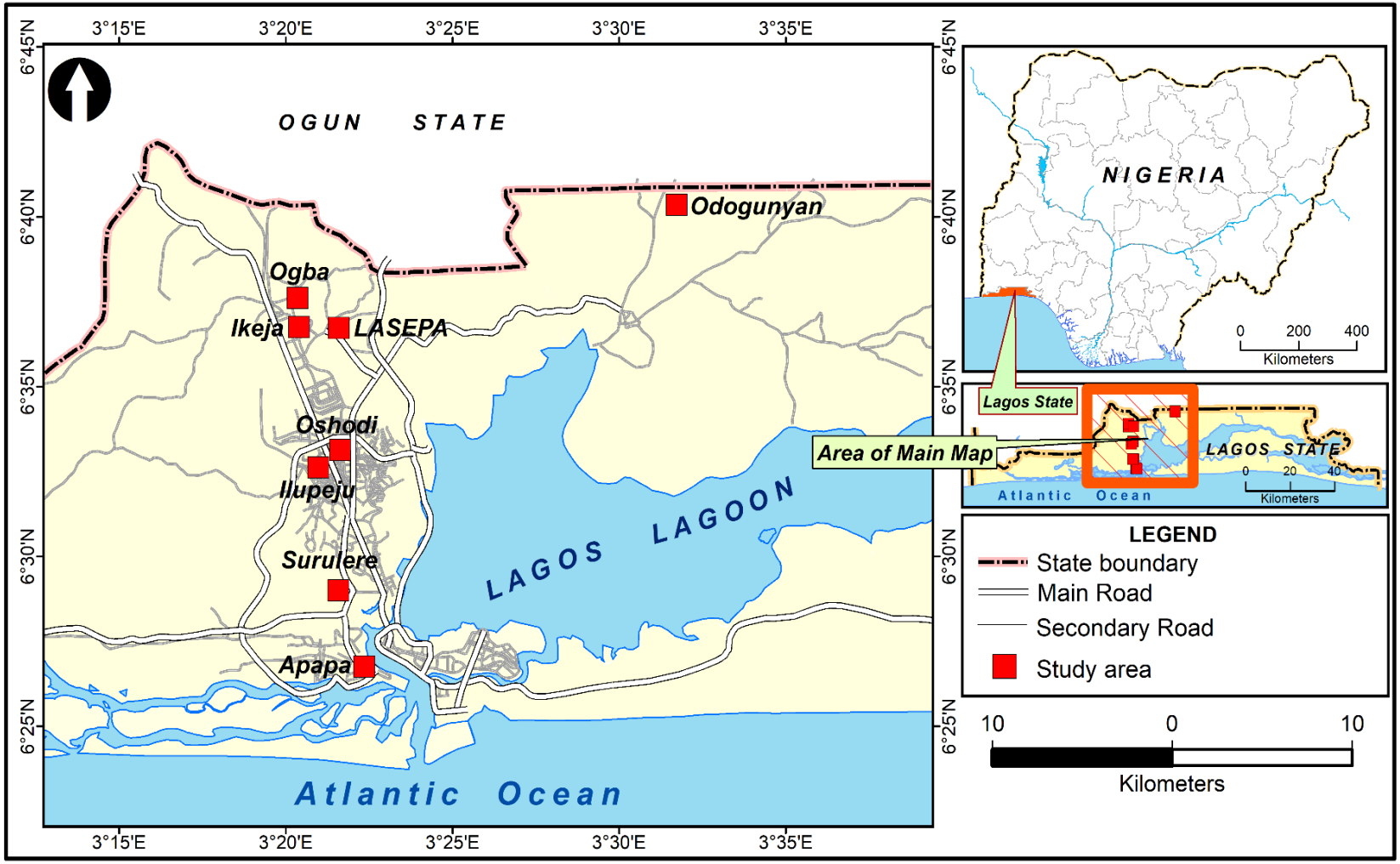


Fig. 1. Study area showing the Industrial Locations

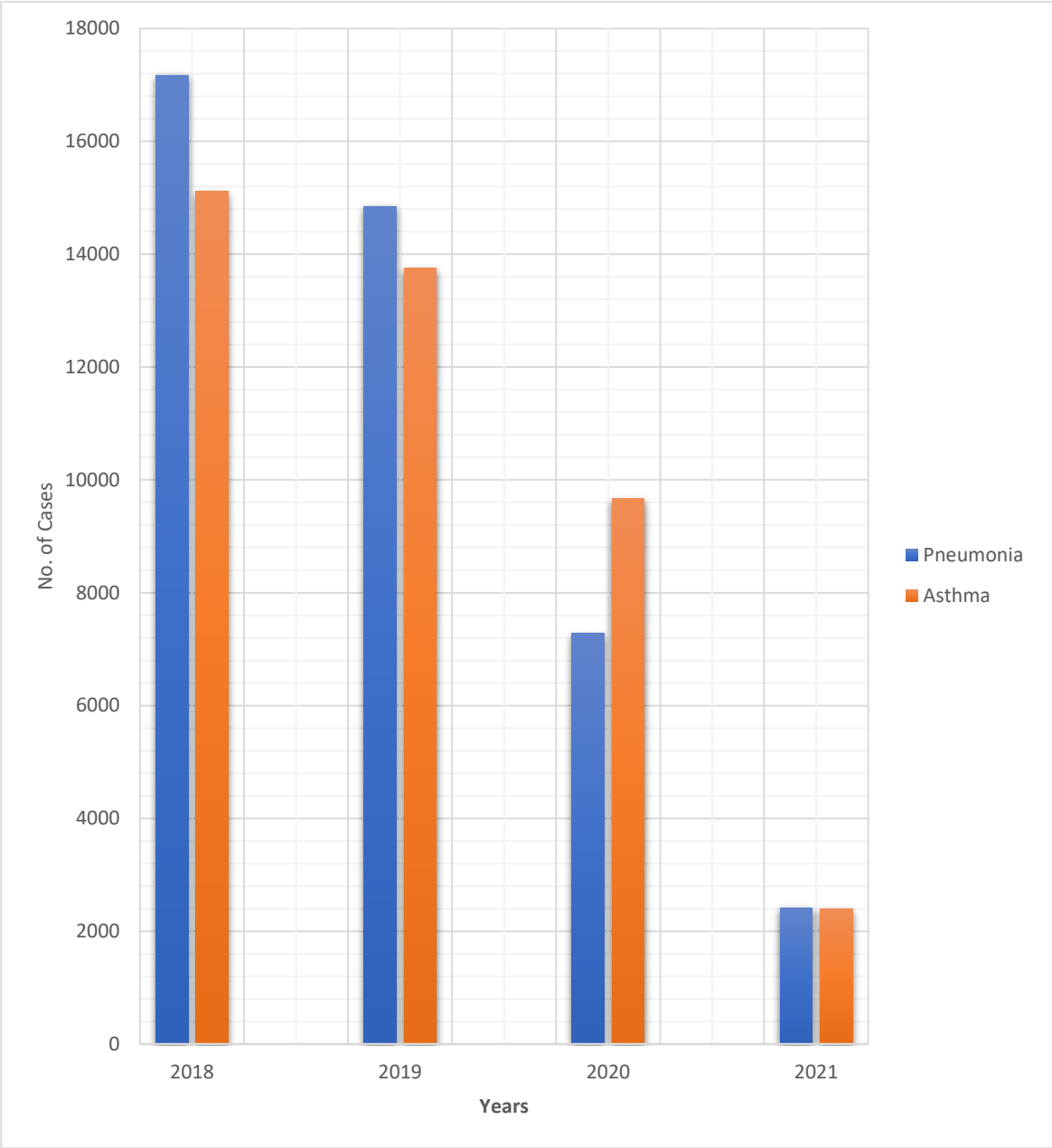


Fig. 2. Annual hospital based respiratory conditions in PHCs (2018 to 2021)
Source: Lagos State Primary Health Care Board (2021)

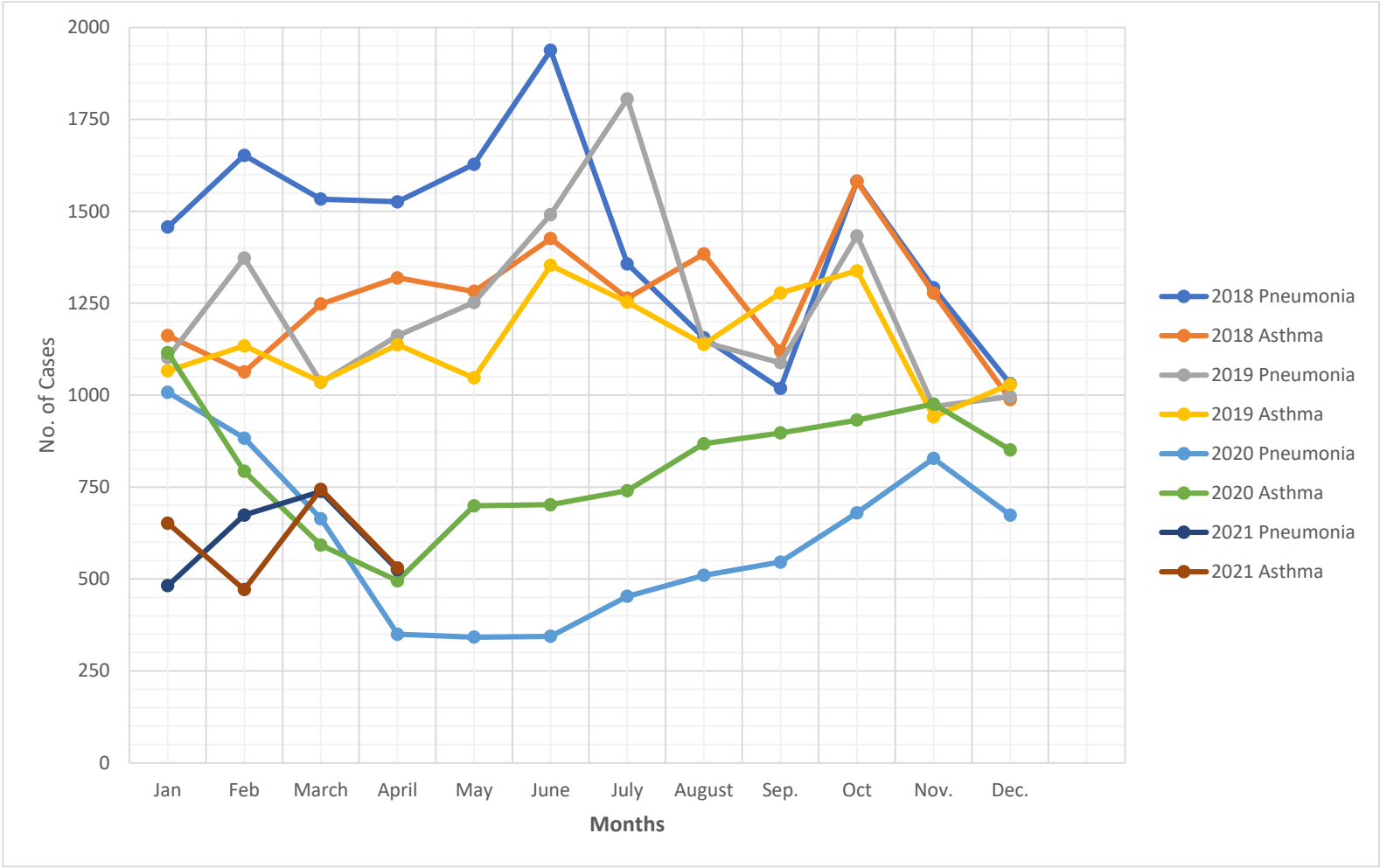


Fig. 3. Monthly hospital based respiratory conditions in PHCs (2018 to 2021)
Source: Lagos State Primary Health Care Board (2021)

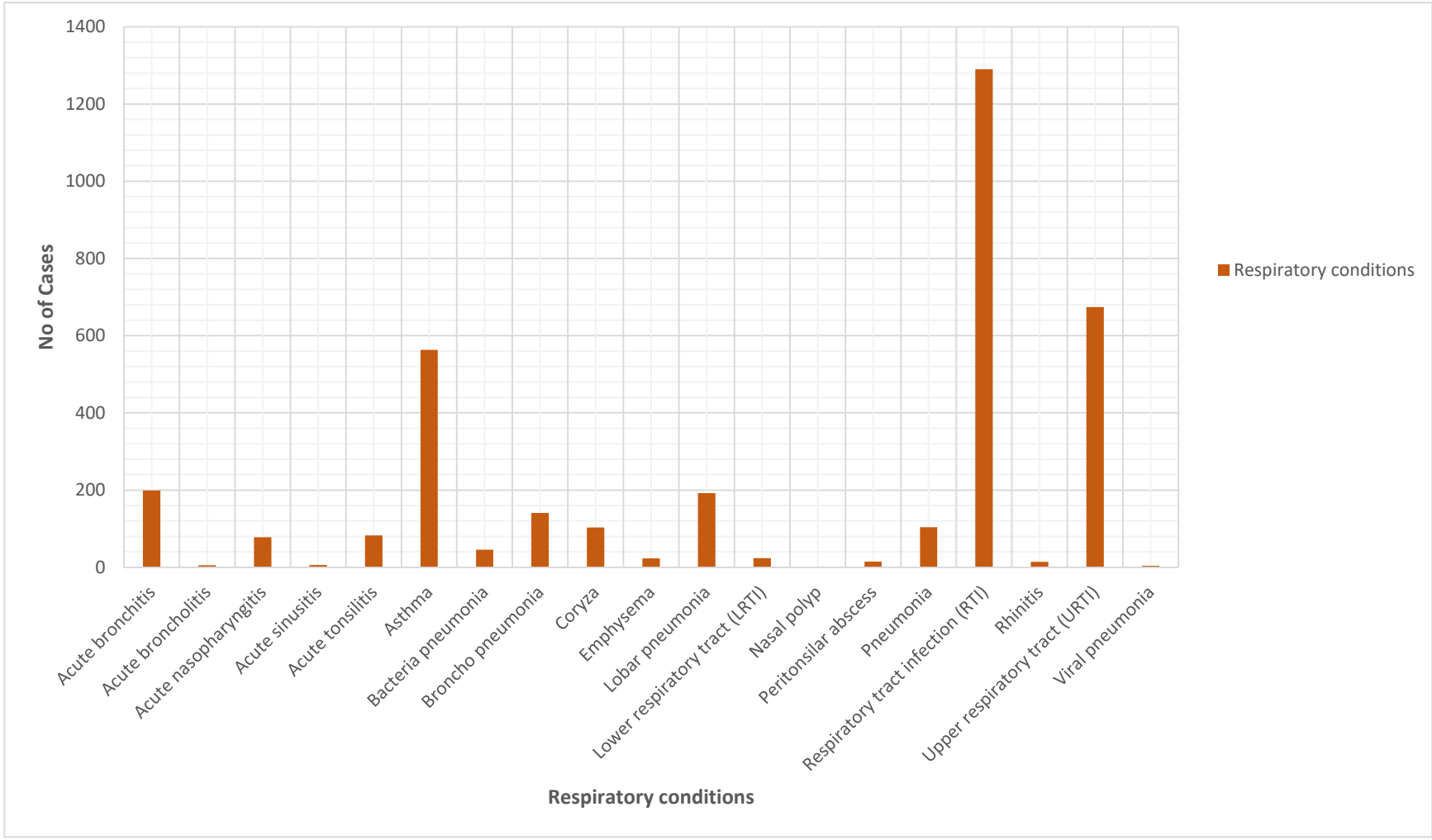


Fig. 4. Hospital based respiratory conditions in Apapa General Hospital from 2016 to 2021
Source: General Hospital, Apapa (2021)

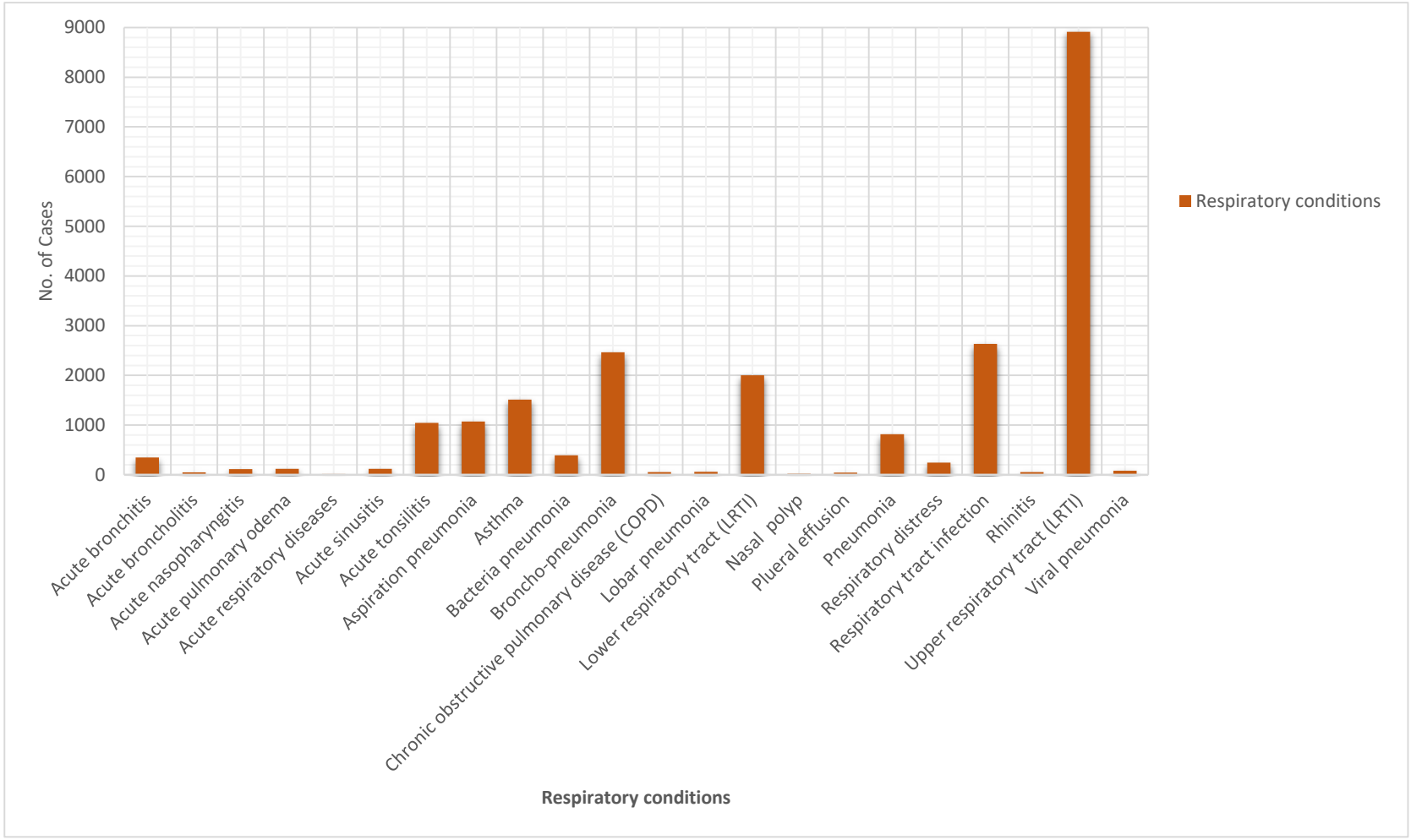


Fig. 5. Hospital based respiratory conditions in Ikorodu General Hospital from 2016 to 2021
Source: General Hospital, Ikorodu (2021)

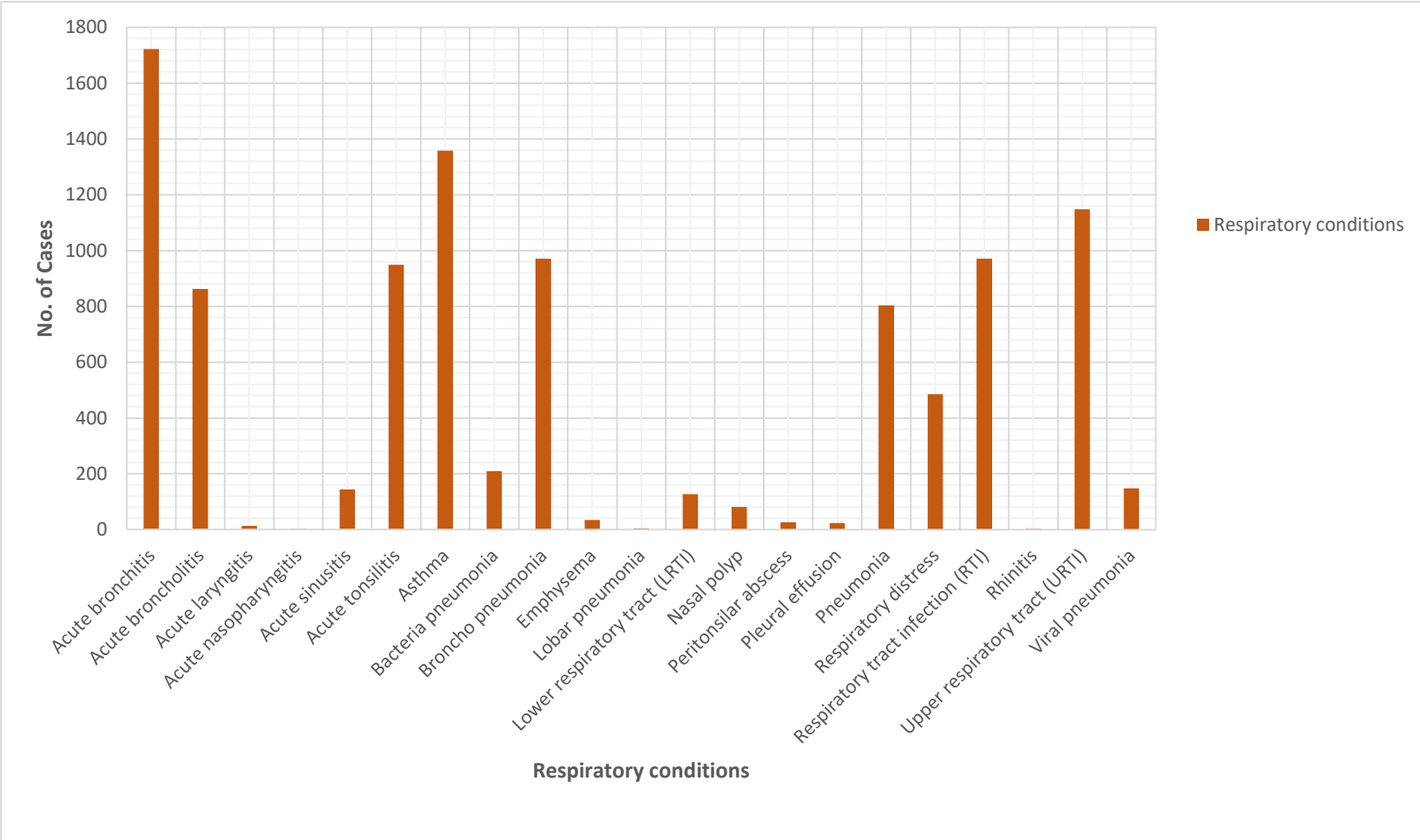

Fig. 6. Hospital based respiratory conditions in Randale General Hospital, Lagos from 2016 to 2021
Source: General Hospital, Randale (2021)

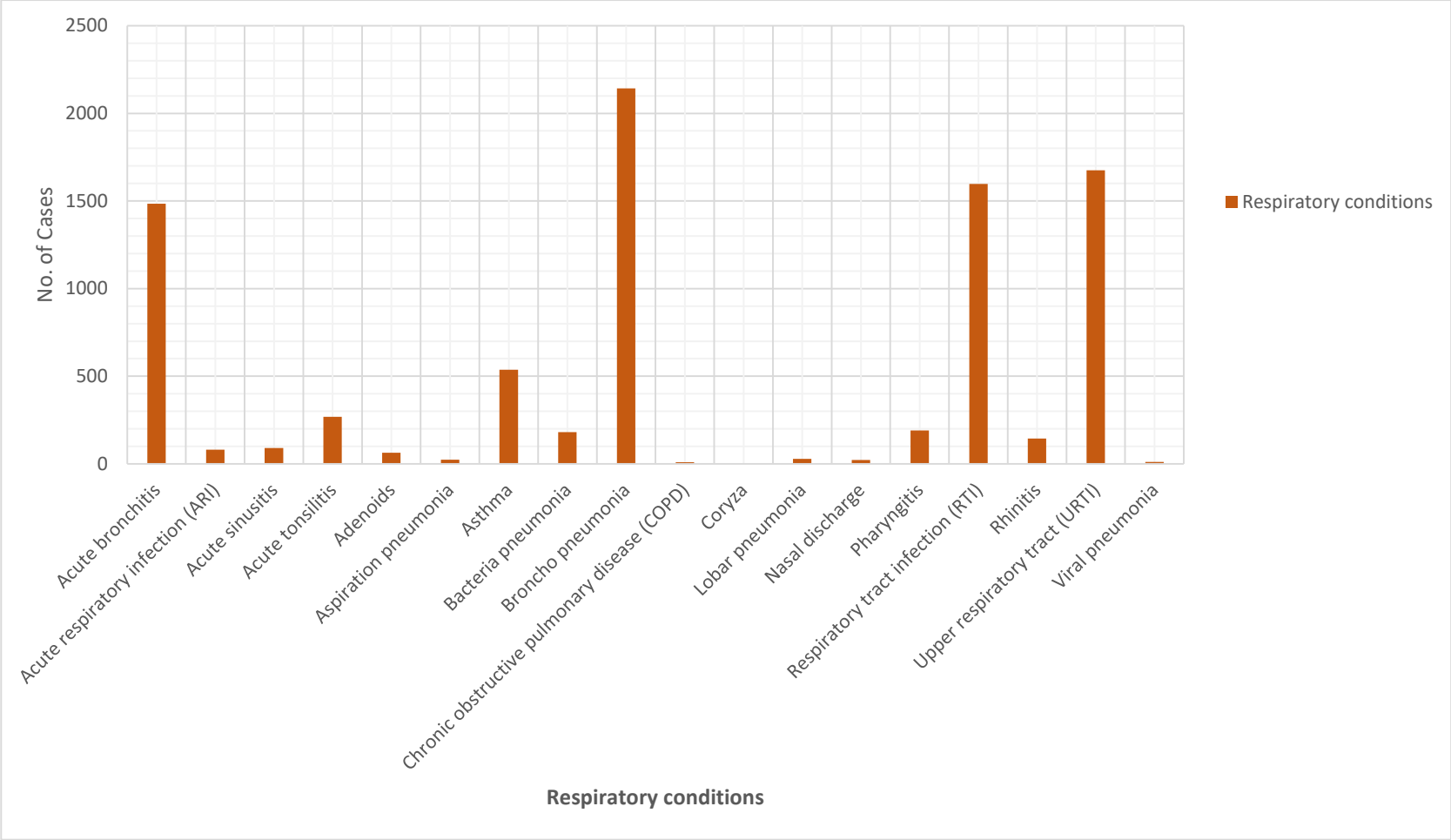


Fig. 7. Hospital based respiratory conditions in Oshodi Isolo General Hospital from 2016 to 2021
Source: General Hospital, Isolo (2021)

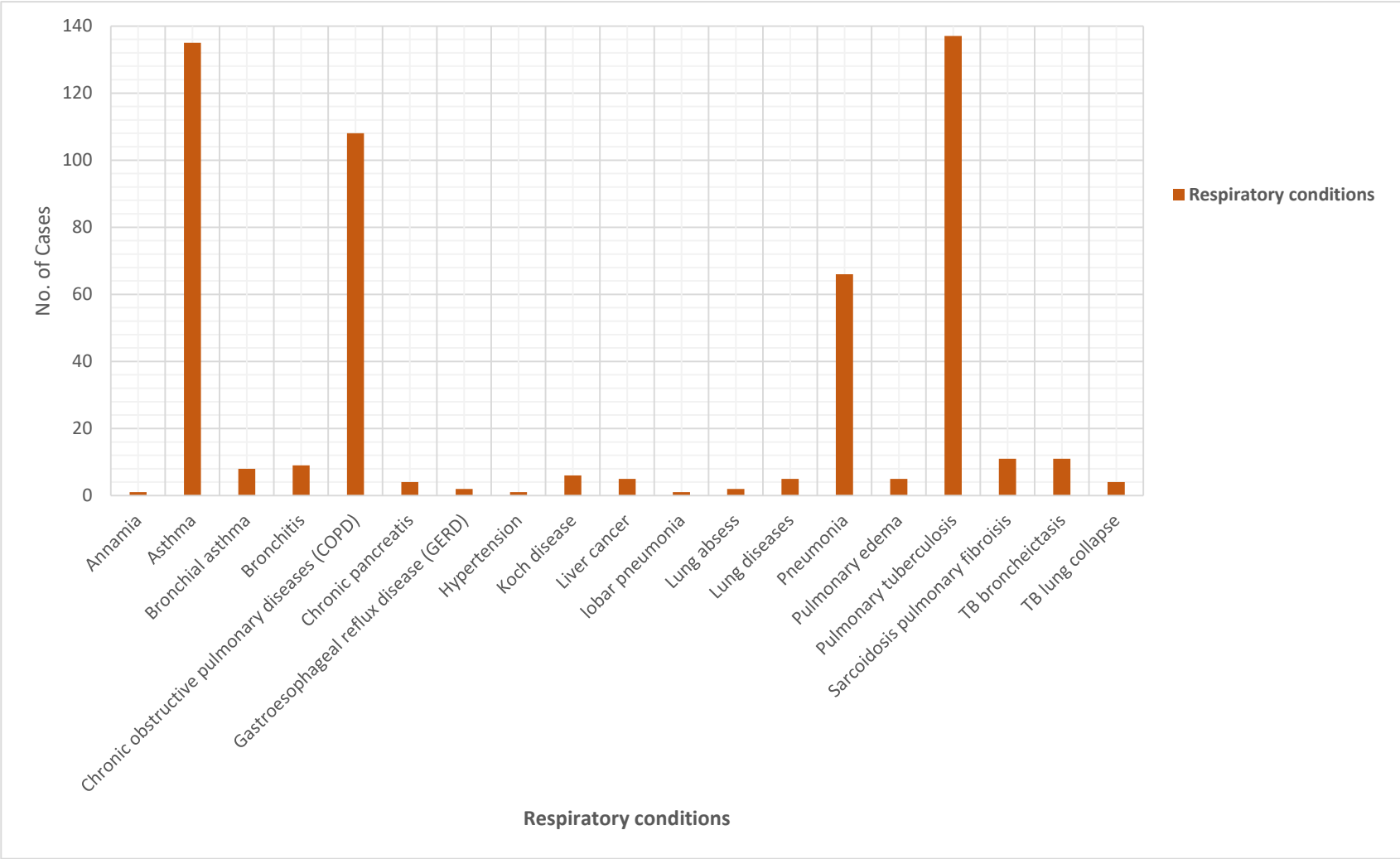


Fig. 8. Hospital based respiratory conditions in LASUTH, Ikeja from 2016 to 2021
Source: LASUTH, Ikeja (2021)

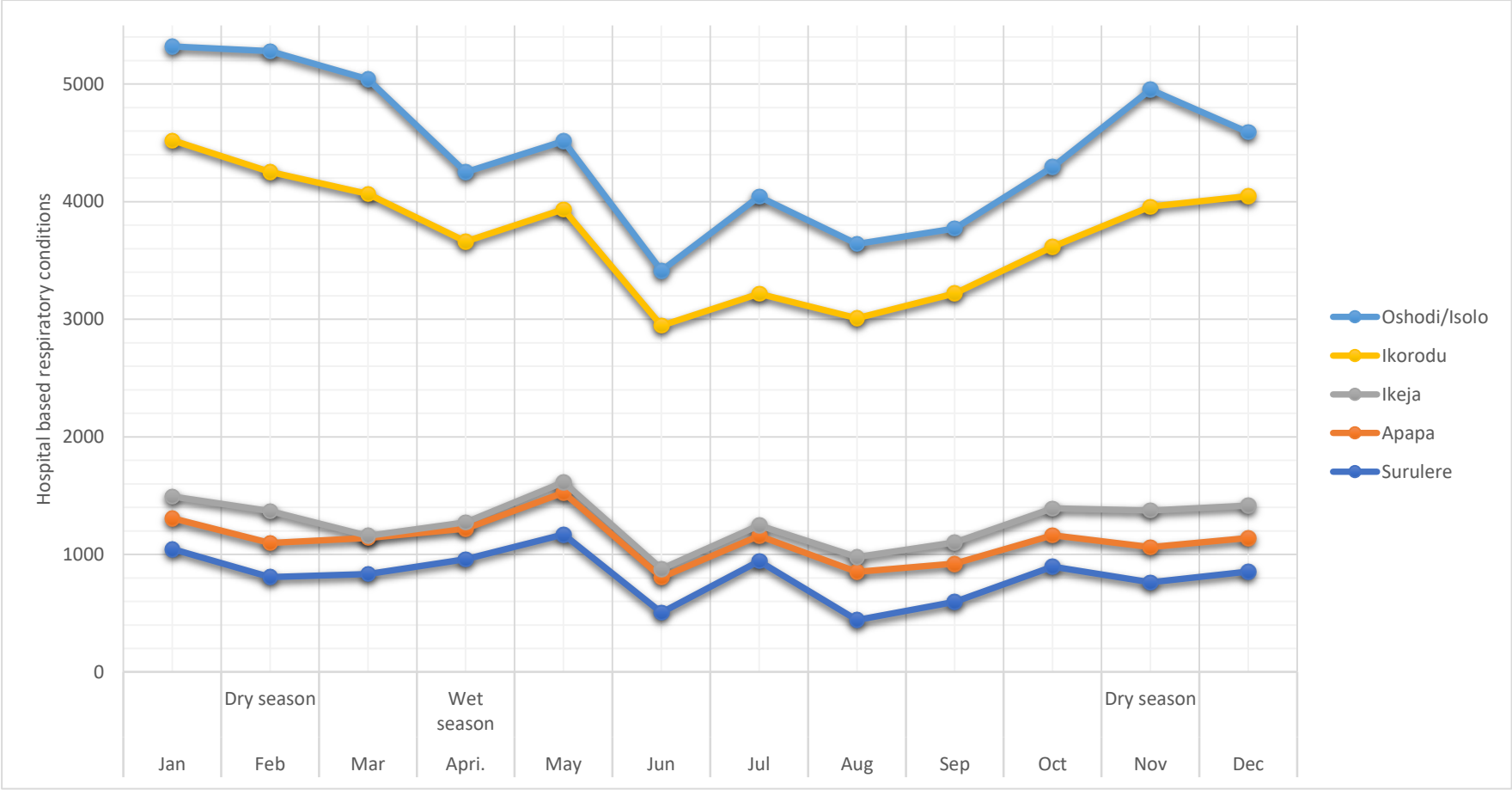


Fig. 9. Seasonal hospital based respiratory conditions in general hospitals in the study area (2016 to 2021)
Source: Apapa, Randle, Ikorodu and Isolo General hospitals, and LASUTH (2021)

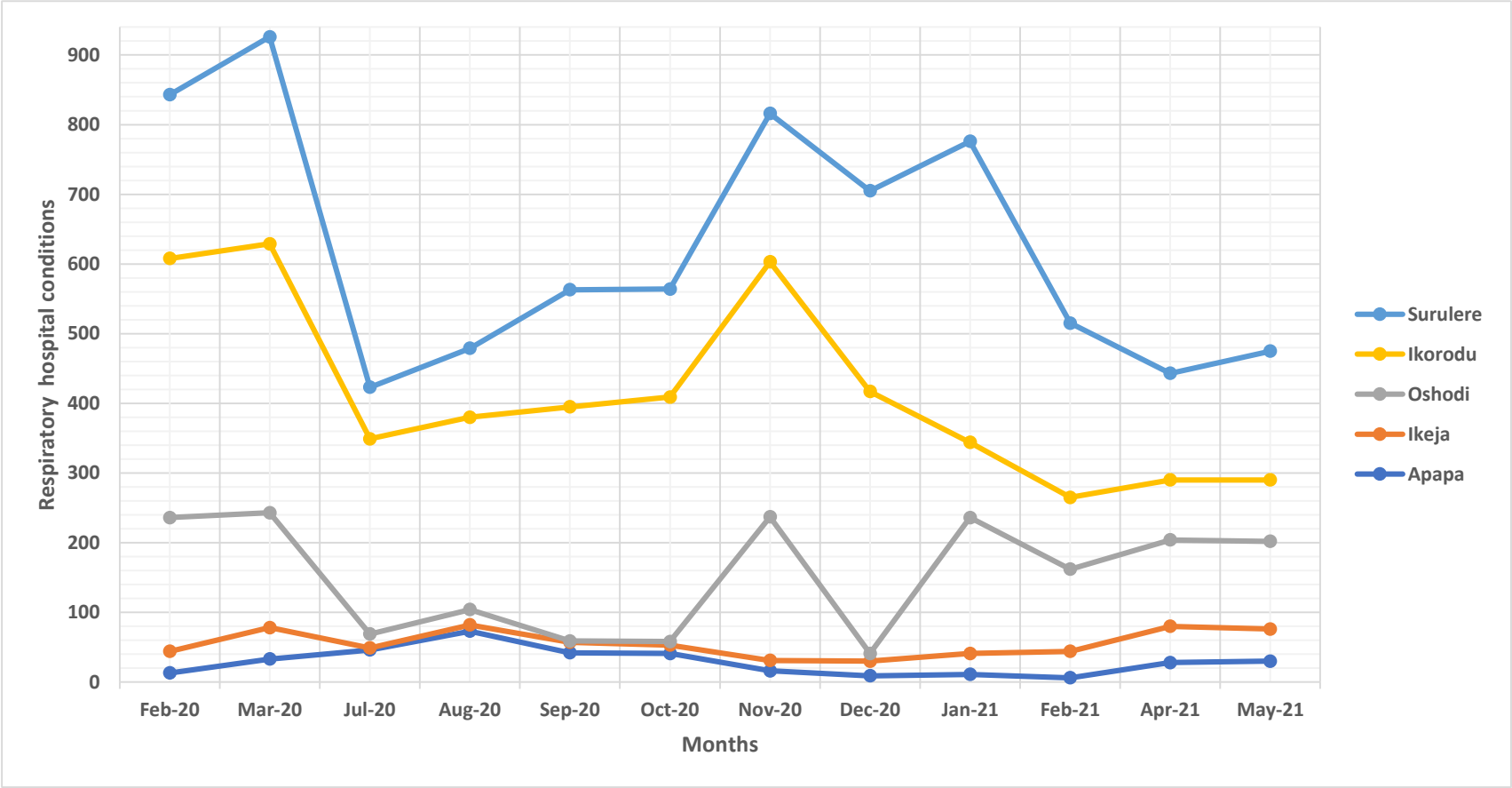


Fig. 10. Monthly hospital based respiratory conditions in general hospitals across the study area from 2020 to 2021
Source: Apapa, Randle, Ikorodu and Isolo General hospitals, and LASUTH (2021)

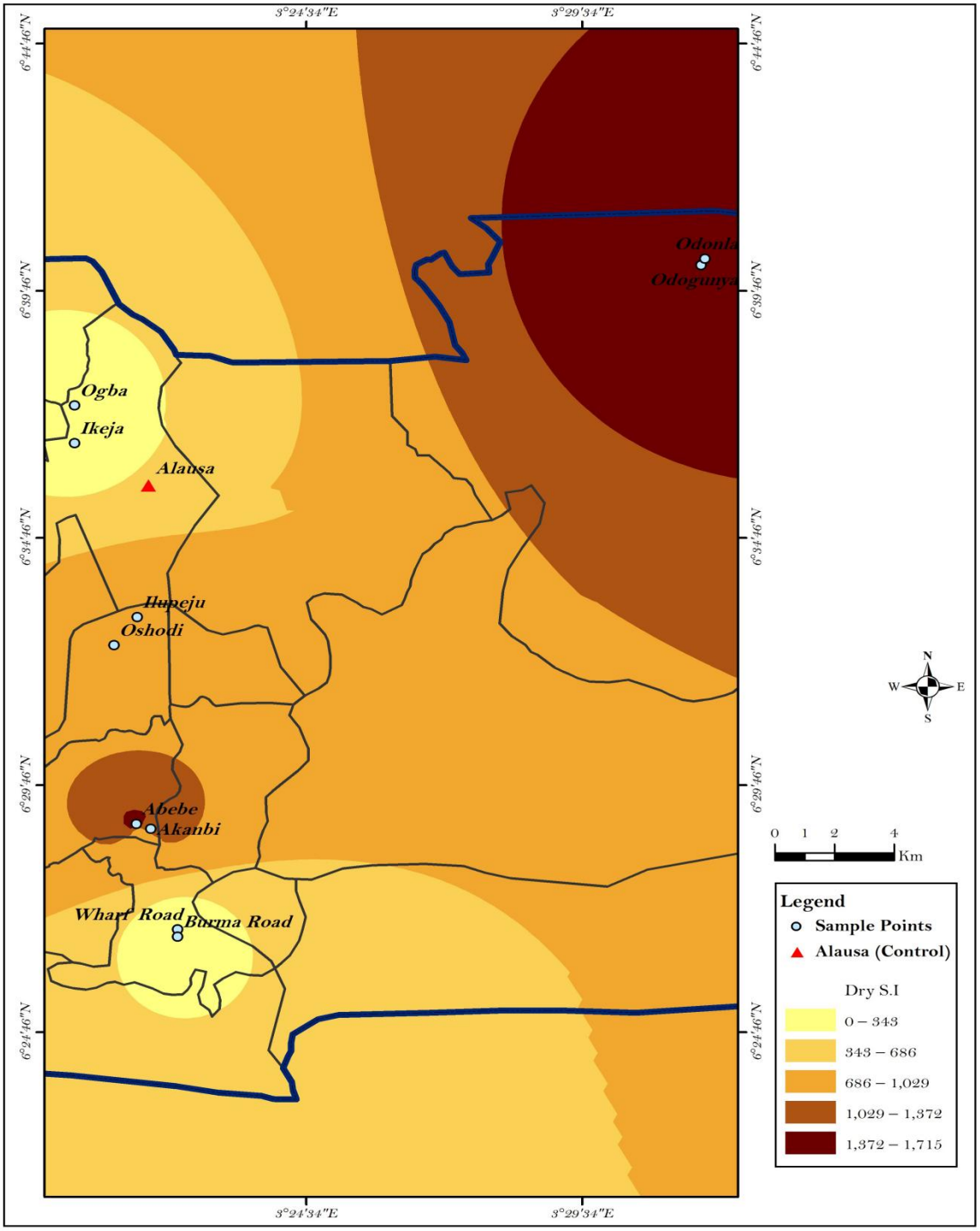


Fig. 11. Spatial variation in hospital based respiratory conditions in the dry season across selected industrial locations in Lagos state from 2020 to 2021
Source: Apapa, Randle, Ikorodu and Isolo General hospitals, and LASUTH (2021)

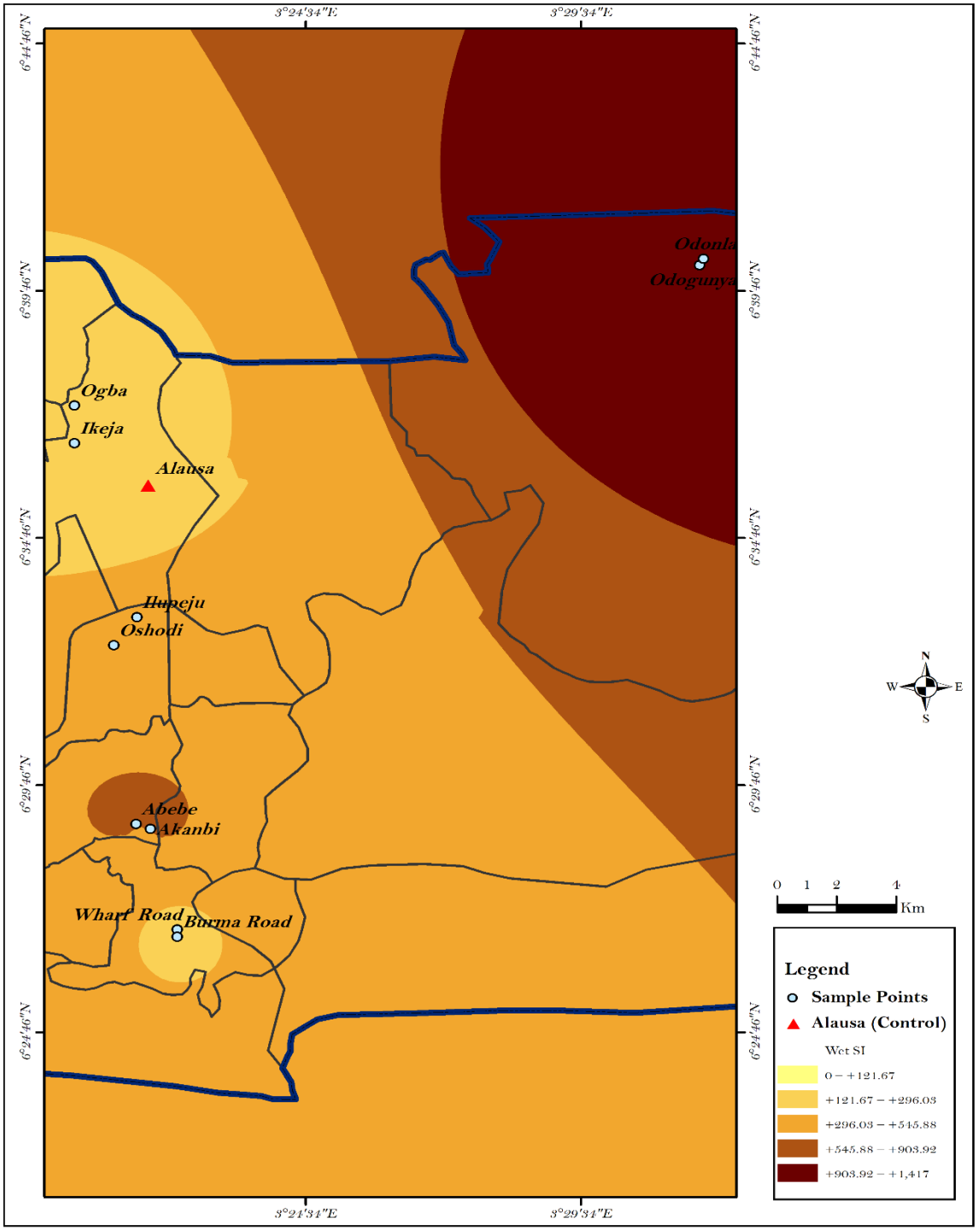


Fig. 12. Spatial variation in hospital based respiratory conditions in the wet season across selected industrial locations in Lagos state from 2020 to 2021

Source: Apapa, Randle, Ikorodu and Isolo General hospitals, and LASUTH (2021)

### 3.2. Pattern of respiratory hospital visitation in Lagos state and the study area

The pattern of respiratory hospital visitation across the study area revealed a dominance of Pneumonia, Bronchitis, Asthma, Upper and Lower Respiratory Tracts infections, COPD and Lung Cancer especially amongst the under 5. The reason for such high visitation cases is due to the developing physiological and immunological systems of the under 5. The immunity of newborns diminishes some months after birth and becomes artificially developed through immunization and naturally through infection. Furthermore, the rates of oxygen intake per unit of body weight and the resting rates of metabolism are higher in under 5 and children than in adults. Eighty per cent of the tiny air sacs in a newborn is developed after birth. Over 50% of respiratory hospital visits amongst under 5 and young children are caused by both ambient and indoor air quality (cooking fuels in homes), especially in developing countries. This is consistent with the pattern of hospital visitation amongst patients in the city of Kathmandu, Nepal between 2013 and 2014 which revealed that COPD accounted for 39%, pneumonia 28%, asthma and bronchitis 5%, respiratory symptoms 2%, chest infection and cancer at 1% (Saud & Paudel, 2018). Another reason for the high cases may be due to exposure to both environmental, socioeconomic and behavioural factors. Seasonally, the dry season recorded more hospital visits from respiratory cases than the wet season. The reason for the general pattern across the study area and the city may be due to the high concentration levels of pollutants and high residence time of pollutants during the dry season than the wet season. Long period of precipitation in the city is fundamentally responsible for lower gaseous and particulate pollutants which are removed through precipitation scavenging, wet deposition and gravitational settling. Hypothesis result revealed varying significant relationships between seasonal pollutants, meteorological variables and respiratory hospital visitation. Only seasonal ambient $CO_2$ levels and relative humidity showed a strong influenced on seasonal respiratory hospital visitation. This is consistent with the findings of Rajendra, *et al.* (2021) who investigated the impacts of mixture of pollutants on hospital visits for respiratory morbidity in Canada and found that CO, $PM_{2.5}$, $NO_2$, or Ozone had a stronger impacts on respiratory hospital visitation during the warm season than a combination of pollutants. Monthly ambient $NO_2$, $PM_{2.5,}$ relative humidity and windspeed levels showed a strong significant influence on monthly respiratory hospital visitation across the study area and period of study.

This result is similar to the findings by Hsu *et al.*,(2017) who investigated ambient $PM_{2.5}$ levels in residential areas near industrial complexes in Central Taiwan and found that daily exposure to $PM_{2.5}$ by $10\mu gm^{-3}$ resulted to an increase in respiratory physician visits for elderly aged ≥65 years in winter by over 2%. Zhaohui, *et al.* (2021) also investigated the nexus between air pollutants exposure and the risk of pulmonary embolism hospitalization in Beijing China and found a positive association between elevated levels of $PM_{2.5}$, $O_3$, CO and $PM_{10}$ on pulmonary embolism hospitalization (3500 cases in three years at 6.5 per 1000 population) amongst women ages 65 and above.

## Conclusion

This study highlights the disproportionate burden of respiratory diseases in Lagos State, especially in areas near industrial activities and among vulnerable demographic groups. The findings demonstrate seasonal spikes in respiratory morbidity during the dry season, underscoring the influence of air pollutants and inadequate urban planning on public health. The absence of standardized health data, coupled with socioeconomic and infrastructural inequities, continues to limit timely intervention and disease control. Addressing these challenges requires a multisectoral approach involving improved data collection, pollution control policies, targeted healthcare investment, and community education.

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**Article inflow**
**Received: 5th October, 2025**
**Accepted: 30th November, 2025**
**Published 31st December, 2025**