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Epidemiology

COMPARISON OF EPIDEMIOLOGICAL CHARACTERISTICS OF THE FIRST AND SECOND WAVES OF CORONAVIRUS DISEASE (2019-NCOV) IN TERTIARY CARE HOSPITAL OF AGRA, INDIA

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ABSTRACT **Introduction:** The year 2020 was marked by pandemic caused by novel-corona virus (2019-nCoV) that emerged in early December 2019 in Wuhan, China. As of 30 November 2021, the virus has caused more than 262 million cases and more than 5 million deaths across the world The nation has recorded more than 34 million cases of COVID-19 so far. The present study was undertaken to delineate epidemiological profile of the cases during first and second wave from most populated state of India. **Methods:** This was an observational study from March 2020 to August 2021 from tertiary care hospital of Agra district, Uttar Pradesh, India. The objectives of present study were to analyze trend of cases from March 2020 to July 2021 and determine demographic factors for patients admitted at our tertiary care hospital**. Results:** During first and second wave 2639 patients were admitted in our dedicated COVID-19 hospital. In age group of less than and greater than 60 years, patients were 70.55% & 29.45% during first wave and 70.70% & 29.30 % during second wave respectively**.** During second wave of COVID-19 pandemic, gender wise distribution narrowed. Almost 60% and 76% discharged within first 10 days and only 0.38% and 2.36% stayed for more than 25 days during first and second wave respectively. **Conclusion :**We have provided a comprehensive epidemiological analysis of COVID-19 cases in Agra district for both waves. Age-wise distribution highlighted no major change, male and female difference was narrowed and more of rural population admitted during second wave.

Study Participant and settings
All COVID-19 confirmed cases admitted in Sarojini Naidu Medical College, Agra, Uttar Pradesh from March 2020 to August 2021 were included in this study.

INTRODUCTION

In the journey of mankind, pandemics (e.g Plague, Small pox, AIDS, Spanish flu, SARS) have caused major misery to human beings (1) .The year 2020 was marked by another pandemic caused by novel-corona virus (2019-n CoV) that emerged in early December 2019 in Wuhan, China and surprised the world with its spread and uncertainties (2). While continuing in 2021 with multiple waves and variants, COVID-19 pandemic has been one of greatest challenge to health care system globally. As of 30 November 2021, the virus has caused more than 262 million cases and more than 5 million deaths across the world (3). India, took early and aggressive measures to condense the transmission of COVID-19 disease during early pandemic by following the strategy of testing, treating, isolating and tracing and went into strict lockdown during first wave (4,5). However, second wave gave a very bitter taste of COVID-19 to Indians and health system. With thousands of daily cases, hospitals were swamped with patients, which caused appalling situation in our country.

December 2021 will end with almost two years of this pandemic and discussion around waves and vaccines still around the corner with new variant (omicron) spread in more than 30 countries. COVID -19 pandemic has defied scientific world and health systems with its origin, transmissibility mode, wide clinical spectrum with long COVID, variants of concern (VOCs), vaccines efficacy & equity, public behaviors and varied government response. Different waves of COVID-19 were reported from many countries in 2020 and spanning over year 2021. Though better prepared after first wave, several countries experienced a devastating consequent waves, as a result of more infectious (probably more virulent) strain of virus (6,7) .Highly transmissible delta variant led the fiery second wave of India in April and May 2021. (8,9,10) The nation has recorded more than 34 million cases of COVID-19 and India's COVID-19 vaccination coverage crossed 130 crore-landmark achievements on 8 December 2021 (11,12).

While countries are taking widespread measures to fast-track the vaccination drive in order to control the pandemic at the earliest, a public health challenge has appeared due to variants, vaccine inequity, waning immunity and boosters (13). As breakthrough infections occurs after vaccination, unvaccinated individuals drives cases and more severe disease, healthcare systems in hugely populated regions should have high level of preparedness and response when cases increase exponentially. Low-and-middle-income countries with limited resources necessities real-time analysis of data to guide policies and interventions. Conversely, initially and also along different waves of COVID-19 pandemic, data from LMICs is missing and is labeled as diminutive (14). As we continue to learn more about COVID-19 and its characteristics intensive monitoring of data is imperative (third wave in India need close watch). Therefore, the present study was undertaken to delineate epidemiological profile of the cases during first and second wave from most populated state of India.

MATERIAL AND METHODS

This was an observational study from March 2020 to August 2021 from tertiary care hospital of Agra district, Uttar Pradesh, India. The Institute Ethics Committee of college approved (SNMC/IEC/2021/35) the study protocol for present study. The objectives of present study were to analyse trend of cases from March 2020 to July 2021 and determine demographic factors (age, sex, area wise distribution, duration of stay in hospital) for patients admitted at our tertiary care hospital.

Study Participant and settings

All COVID-19 confirmed cases admitted in Sarojini Naidu Medical College, Agra, Uttar Pradesh from March 2020 to August 2021 were included in this study. WHO case definition of SARS-CoV-2 infection, were included within 24 h of admission. A confirmed case of COVID-19 was diagnosed by a real-time reverse transcription- polymerase chain reaction (RT-PCR) of the nasopharyngeal and oropharyngeal swabs (15).

Study Procedure

We collected following Epidemiological data from patients' medical records during first and second wave.(1) Trends (Temporal distribution) of cases during both waves in Agra ,(2) Demographic information, including age, gender, area of residence were included in our analysis and (3) length of hospital stay of patients admitted in our hospital (LOS).

Statistical analysis

Statistical analysis was performed with Microsoft software version

16.49. The results are presented accordingly in form of descriptive statistics and data presented in from of graphs and diagrams.

RESULTS

Epidemic curve: Figure-1 and 2 shows the COVID-19 epidemic curve with number of cases plotted by month from March 2020 to July 2021. During first and second wave 2639 patients (from March 2020 to July 2021) were admitted in our dedicated COVID-19 hospital. Epidemic curve is described as; during first wave (in 2020), cases were admitted from month of march with maximum number of cases in month of September and declining thereafter till February 2021, while during second wave in year 2021, cases showed surge from March again which peaked in month of April in our tertiary care setting and no admission in COVID- hospital from month of August 2021.

Demographic characteristics: During *first wave* majority of patients belonged to age group 21-40 years and 41-60 years (33.19% and 33.02% respectively) followed by 61-80 years (27.69%), 0-20 years (4.34%) and 80+ years (1.76%). For *second wave*, in context of age profile of patients; maximum number of patients were admitted in age group of 41-60 years (43.10%) tailed by 61-40 years (27.59%), 21-40 years (24.66%), 0-20 years (3.3%) and 80+ years (1.95%). Thus overall out of total patients admitted, majority spanned over age group 41-60 years. Minimum age of COVID-19 patient was 05 days and maximum was 91 years. Further, in age group of less than and greater than 60 years, patients were 70.55% & 29.45% during first wave and 70.70% & 29.30 % during second wave respectively. Median age for first wave was 50 years and for second wave was 53 years. (Figure 4,5) Gender wise distribution showed that 65% males and 35% females were admitted during first wave; while male comprised 58.85% and females patients were 41.15% during second wave of COVID-19 pandemic. Results of area wise distribution of cases are shown in figure- 6. Around 70% cases during pandemic were from urban Agra (71.98% in first wave and 70.94% in second wave) and about 24% from urban out of Agra (25.77% in first wave and 23.32% in second wave). 2.25% and 5.74% of admitted patients in hospital were from rural area of Agra region (figure- 7).

Duration of hospital stay: Figure-8 depicts duration of hospital during both waves during this ongoing pandemic. Almost 60% and 76% discharged within first 10 days and only 0.38% and 2.36% stayed for more than 25 days during first and second wave respectively. Then duration of stay is as followed: between 11-15 days 30.27% and 19.29%, between 16-20 days 7.6% and 1.97% and between 21-25 days 1.88% and 0.39% stayed during first and second wave respectively.

DISCUSSION

India has faced two waves of COVID-19 in ongoing pandemic of novel- corona virus (2019-nCoV). In view of the rapid spread of COVID-19, various epidemiological studies were done. Most published research so far is from developed part of world while such crucial research is lacking from LMICs and produced at snail pace .(14) Understanding epidemiological characteristics of coronavirus disease guides epidemic control and public policy practices. Here, we report the first epidemiological profile of the SARS CoV 2 infected patients presenting to a tertiary care academic institute in Agra district of Uttar Pradesh, India. Uttar Pradesh is a most populated state in northern India with over 200 million population. *The first cluster of COVID-19 from India was reported from Agra, Uttar Pradesh* on March 4, 2020. Description of Agra cluster is like; 8 persons were infected, country of origin of index case was Italy, type of contact with index case (households and co-workers and index case was reported on 4th march (16).   Thereafter, the first case of novel-corona virus was admitted at our hospital from Karnataka on 13th March 2020 and subsequently 2639 patients were admitted in our dedicated COVID-19 hospital across first and second wave. During first wave (in 2020), maximum number of cases were admitted in month of September, which parallels, to national (16 September), state (9 September) and district peak of cases. While during second wave in year 2021, cases peaked in month of April in our tertiary care setting and like wise in state (38,055 cases on April 24 and declined since). At national level also the middle of March 2021 set the pace of the second wave and while highest number of cases about 4 lakhs on May 7, 2021 identified in India (17,18,19). First wave lasted for almost a year (March 2021 to Feb 2020) and then second wave showed exponential rise in cases beginning in March 2021,maximum cases in April 2021 and only two cases in July 2021(lasted for about 4.5 months). Very few studies are available for both waves. Similar study from Pune city highlighted that the first wave was for 7-8 months and second for about 5 months (20) .

Control measures implemented at the early stages during the first wave of COVID-19 helped in the successful mitigation of virus spread and *Agra model for containment* of first cluster was discussed and applauded at national level. (21) However, the second wave of this pandemic was high and fast, started with unlocking social activities and highly transmissible delta variant (22). These findings of initial transmission via travel and then local transmission are very similar to experience worldwide (USA, Italy) (5).

Furthermore, considering some current waves in UK, and US with high vaccination coverage in Europe, recognition of susceptible population is important in terms of epidemiological profile.(23

All age groups are susceptible to COVID-19 infection but advanced age has been previously reported as an independent predictor of mortality in SARS, MERS and COVID-19. (22) Uttar Pradesh is a young state with median age of population being 20 years (census 2011). We observed that majority of admitted patients were between age group 21 to 60 years in both waves, similar to Delhi study till September 2020 (23); median age for first wave was 50 years and for second wave was 53 years, similar to ICMR study (24). Study done in Rajasthan found median age as 32 years (1634 patients, till June 2020) and in Kerala reported 32 years as mean age 3404 patients, till May 2020) (25,26) which is much less than present findings Research from china showed median age between 49 to 56 years that in Huang et al (49.0 years) and Chen et al (55.5 years) and Wang et al (56.0 years).(2,27). China during early first wave reported average age 44-48 years (28,29). Similarly meta analysis (till march 2020) from US and UK found median age from COVID-19 infection as 46.2 years. Most studies were conducted between January and February 2020. (30) Detailed analysis from Tamil Nadu and Andhra Pradesh showed a younger age distribution than cases re- ported in the United States as of 21 August 2020 (31).

In our study almost same age distribution was reported for both waves. Elderly patients (>60 years) were around 30% during both waves of pandemic in our hospital. Very few studies are available to compare both waves. Age-sex distribution of the cases in the second wave was not much different from those admitted in the first wave (32). Published literature reports that the second wave in India has affected the younger age group with the reason for the same to be explored further (33,34) but study from eastern UP comparing both waves found higher positivity rates among the older age groups during second wave (35). The second and subsequent waves in other countries such as Germany, Japan, South Korea, and Iran have also reported a shift towards younger demography. While 0-20 years constituted <5% in present analysis, this finding is in consensus with other studies (29,36,37). India has about 8% of elderly population.

In our study, there was a male predominance, which is similar to other national and international studies (20,23,33,37,38). Though this difference of both sexes narrowed during second wave, similar to findings of both waves from 10 hospitals from North India and COVID-19 national registry (32,33).   Some reasons cited in most studies were; higher exposure in male members of the family in pursuit out of doors, increased level of angiotensin converting enzyme in males as compared to females can also be another reason (23,39). Geographical distribution of disease is important for interventions. During first wave, COVID-19 pandemic didn't penetrate much in rural areas but rural areas were not exempted from cases during second wave. We found that proportion of patients from rural area increased from 2.25% and 5.74%. Life in India includes urban and rural; COVID-19 impacted them both. At start of pandemic the disease transmission was earlier epicentre in all the major metro and capital cities of Indian states. SARS-CoV-2 second seroprevalence (May-June 2020) studies carried out across India have indicated that substantial transmission has occurred in rural areas although it was higher in urban settings (40). However, both people from rural and urban sectors face a real traumatized situation during second wave. (37,41).

As a highly contagious disease, early detection, isolation, hospitalization, and diagnosis of COVID-19 are also crucial for control, and they can effectively reduce the risk of disease transmission. (27) Few studies have described some characteristics of patients with COVID-19, including the time interval between key events. *Our study has described duration of hospital discharge.* Almost 60% and 76% discharged within first 10 days and only 0.38% and 2.36% stayed for more than 25 days during first and second wave

respectively. More patients were discharged within 10 days during second wave because of home isolation policy. In an analysis done from 1 Jan to 25 May 2020 over 83% of the Indian patients recovered in 11–25 days, more than our study about 23.3% patients took 21–25 days to recover fully. Meta analysis including seven studies (China, France, South Korea, the UK, Singapore and Japan in early phase of pandemic found (till MARCH 2020) found the estimated mean number of days from the onset of symptoms to recovery was reported in seven studies and the resulting pooled mean was 18.55 days (42).

CONCLUSION:

We have provided a comprehensive epidemiological analysis of COVID-19 cases in Agra district for both waves. Age-wise distribution highlighted no major change, male and female difference was narrowed and more of rural population admitted during second wave. Data-driven analyses are important to take necessary measures and interventions during ongoing pandemic. India needs to invest in public health and major reforms are required for quality research in our country.
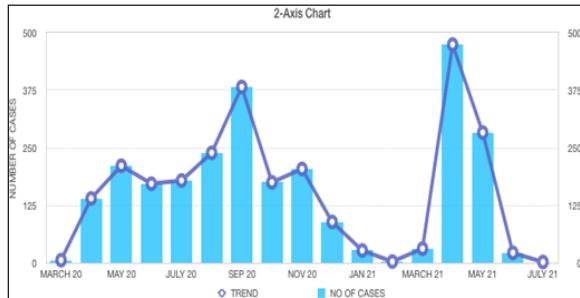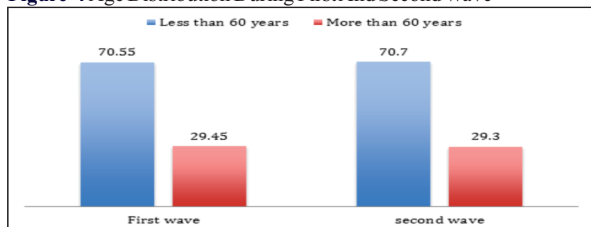

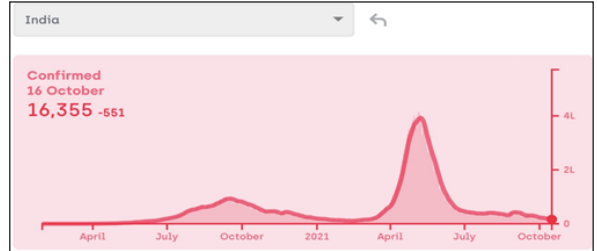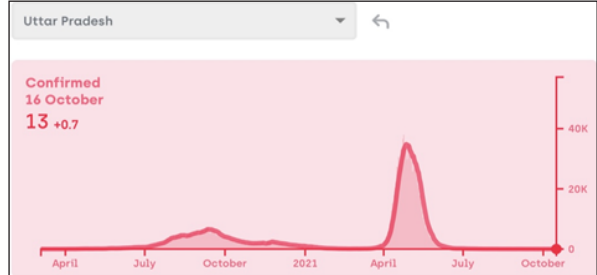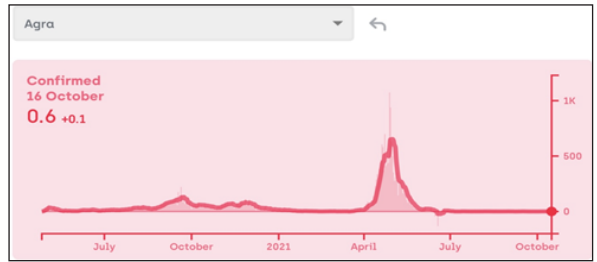**Figure-1 Epidemic Curve at our Dedicated COVID hospital**
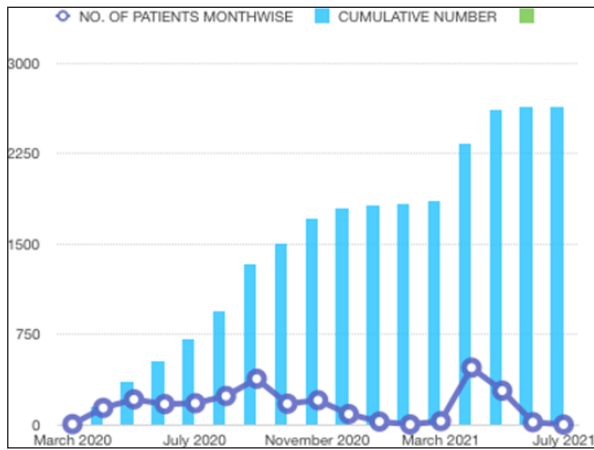
Figure-2 Number of patients admitted monthwise ad cumulative number in our Dedicated COVID hospital
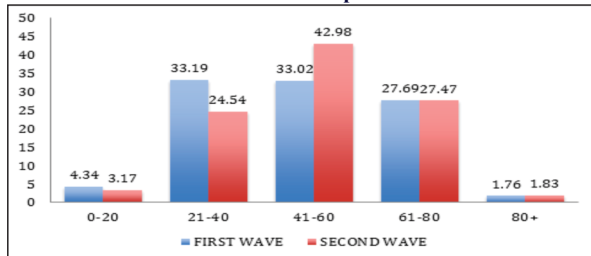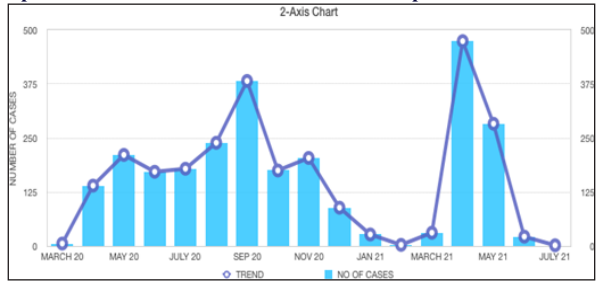

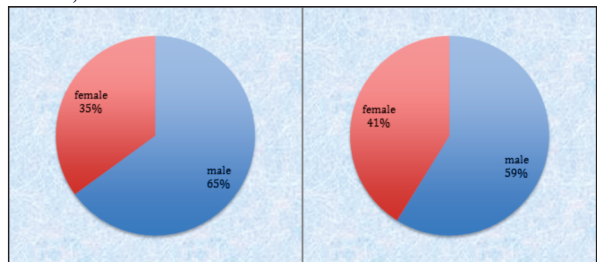**Figure-4** Age Distribution During First And Second Wave

Figure-5 Age Distribution (Less Than And More Than 60 Years) During First And Second Wave
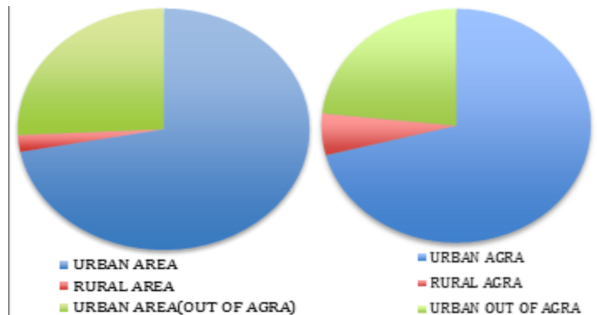

Epidemic Curve at our Dedicated COVID hospital

**Figure -3 Camparision of epidemic curve at our hospital ,Agra district, Uttar Pradesh and India**

Sex distribution during first wave

Sex distribution during Second wave

Figure-6 Sex distribution during first and second wave

URBAN AREA
RURAL AREA
URBAN AREA(OUT OF AGRA)

URBAN AGRA
RURAL AGRA
URBAN OUT OF AGRA

Figure-7 Area wise distribution during first and second wave
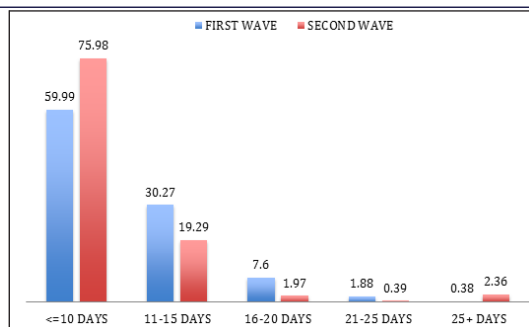
Figure-8 Duration of stay in our Dedicated COVID –19 hospital during both waves

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