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Demographic, Clinical, Radiological, and Laboratory Profiling of COVID-19 and Predicting Mortality in Rural Central India: A Cohort Study Protocol

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ABSTRACT

Background: To study the predictors of mortality and its correlation with various epidemiologic, clinical, radiologic, and laboratory profiles in hospitalized patients of COVID-19 and formulate a predictive score to predict mortality in COVID-19. **Method/Design**: This hospital based prospective cohort study, will be conducted in the Corona isolation unit of a tertiary care hospital in central rural India for a period of 1 and half years. COVID-19 will be diagnosed using ICMR accredited RT-PCR test and Rapid Antigen tests. The study will start after approval from the institutional ethical committee. We will record various demographic data, clinical parameters, hematological profiles, and Biochemical profiles on admission. The data will be analyzed as univariate, bivariate, and multivariate analyses and multiple logistic regression, Kaplan Meir survival curves will be constructed and the hazard ratio will be calculated by R software. **Discussion**: This extensive data with a large sample size involving 1736 subjects and described in all aspects of research arms namely demographic, clinical, radiologic, and laboratory will help in generating new information to describe the novel coronavirus disease. It is the first study in the Indian population. This study will find the predictive score for predicting mortality in patients of covid-19 disease. Predicting mortality will help in triaging seriously ill patients and giving them critical care facilities at the onset will help save lives in resource-limited settings of a pandemic.

1 INTRODUCTION:

Covid-19 is a novel disease and a global problem. Researching into the dynamics of this disease to help improve the management of patients and save maximum lives is the need of time. Novel coronavirus disease-2019 (COVID-19) originated in December 2019, in Wuhan, Hubei province of China in December 2019 and has taken over the entire globe within just 3 months [1]. **Globally**, as**, of March 2022**, there have been **458,479,635 confirmed cases** of COVID-19, including **6,047,653 deaths**, reported to WHO. India ranks 3rd in the number of deaths accounting for 5, 15,974 deaths till March 2022 [1].

The USA tops the mortality list with 9, 60,703 deaths followed by Brazil at 6, 55,078. The countries are facing a major burden on the health care system and are affecting the global economy [2]. While in India, the measures like lockdown of the entire nation and social distancing are playing a role in controlling the spread of this global pandemic, the mortality rate is between 2-5% and it is different for various states. Determining the nature of this novel disease, studying its various aspects like epidemiologic, clinical, radiological, biochemical, and hematological profiles, and researching how it portrays in a rural setup of central India is going to be very vital in the management of cases and also for predicting the mortality and morbidities. Predicting the mortality of COVID-19 and prognosticating it has become an important worldwide issue. Novel coronavirus disease has very limited treatment options, antiviral drugs are under research [3].Therefore, this study will provide a wealth of information as in this study we are taking into consideration all the five arms of the pandemic like demographic profile, clinical profile, biochemical profile, and treatment strategy used for patients of COVID-19 disease.

1.1 Research aim

The primary aim of this study is to find predictors of morbidity and mortality in hospitalized patients of COVID-19. The secondary aim is to derive a predicting score to predict the mortality among COVID-19 patients.

1.2 Objectives:

1. To study the predictors of mortality and morbidity in hospitalized patients of COVID-19 and formulate a predictive score to predict mortality in COVID-19.

2. To study the epidemiologic, clinical, radiologic, and laboratory profiles of COVID-19 patients.

1.3 Hypothesis:

The proposed factors, epidemiologic, clinical, radiologic, and laboratory profiles can predict the morbidity and mortality in hospitalized patients with COVID-19.

1.4 Rationale:

Covid-19 is a Novel disease. The majority of articles are Review articles, systematic reviews and meta-analyses, original research consisting of clinical trials and randomized control trials are very less. COVID-19 is the major cause of mortality in 2020. India is 2nd leading country for maximum mortality of 1,34000 deaths till November 24, 2020.

The available research is from countries with a higher number of cases and case mortality like the USA, China, and Italy[4,5]. After using the keywords like SARS-COV 2, COVID-19, Coronavirus, mortality and applying filters for showing results in RCT, clinical trials and systematically searching for original articles in 2 databases PubMed and Medline we find 32 results out of which only 7 studies have prognosticated mortality in COVID-19 disease, 5 of which are Chinese and 1 American and 1 European. In Indian context there are hardly any studies conducting such a robust profiling including various parameters like Epidemiologic, clinical, radiological, biochemical and hematological factors.

Various above-stated studies the researches have taken into account different demographic factors like age, sex, and co-morbid illnesses like hypertension, diabetes, ischemic heart disease, or cardiovascular diseases [6]. Some other studies have taken into account the ongoing drug treatment like Angiotensin receptor blockers or ARB over mortality. Some studies considered biochemical and coagulation profiles like Serum Troponin, NT-ProBNP, Serum Ferritin, Serum Lactate dehydrogenase (LDH), and D Dimers [7], CRP, IL6, and Procalcitonin[8] levels to predict mortality of the disease[9,10]. Some have considered hematological profiles like lymphopenia in predicting the severity of illness [11]. Yang et al have used the Neutrophil to lymphocyte ratio as a measure of poor outcomes in these patients[12].

Here we are considering all these factors together attributing to morbidity and mortality in the COVID-19 pandemic. Therefore, this is a unique study covering all aspects of the disease pandemic to find out predictors of mortality in COVID-19 patients.

It is also only studied in the Indian population having a large sample size, it's done in central India and incorporates rural and suburban populations so can be extrapolated to the majority of the Indian population. The predictors of mortality will be useful as a screening tool to objectively triage patients who are seriously ill and require critical care management, help in delivering the scarce resources like ventilators in a resource limited settings of rural India. It will help clinician in early decision making and delivering right treatment at right time as disease is rapidly progressive in some patients and the mortality rate is 3- 5% in India. Will help refocus COVID-19 related health policies and morbidity prevention. Prognostic index will also be helpful in improving overall life expectancy, by targeting health care services in high risk groups and help in delivering the scarce resources like ventilators in a resource limited settings of rural India. Therefore, this study has National significance and humanitarian cause.

2 METHODS/DESIGN:

2.1 Study design and setting

The present study will be a hospital-based prospective cohort study in COVID-19 patients. The study will be conducted in the Corona isolation unit of a tertiary care hospital in Central rural India. The study subjects will be followed up from the day of admission to the hospital until discharge or death.

2.2 Duration of study

Recruitment of study subjects commenced in January of 2021 and is expected to continue until June 2022, and the results will be reported by mid of 2023.

2.3 Participant eligibility

All consecutive patients diagnosed to have novel coronavirus 2019 disease (COVID-19) will be recruited. COVID-19 will be diagnosed using ICMR accredited RT-PCR test and Rapid Antigen tests.

The inclusion criteria are:

1. All patients having RT PCR and Rapid antigen test positive for COVID-19.

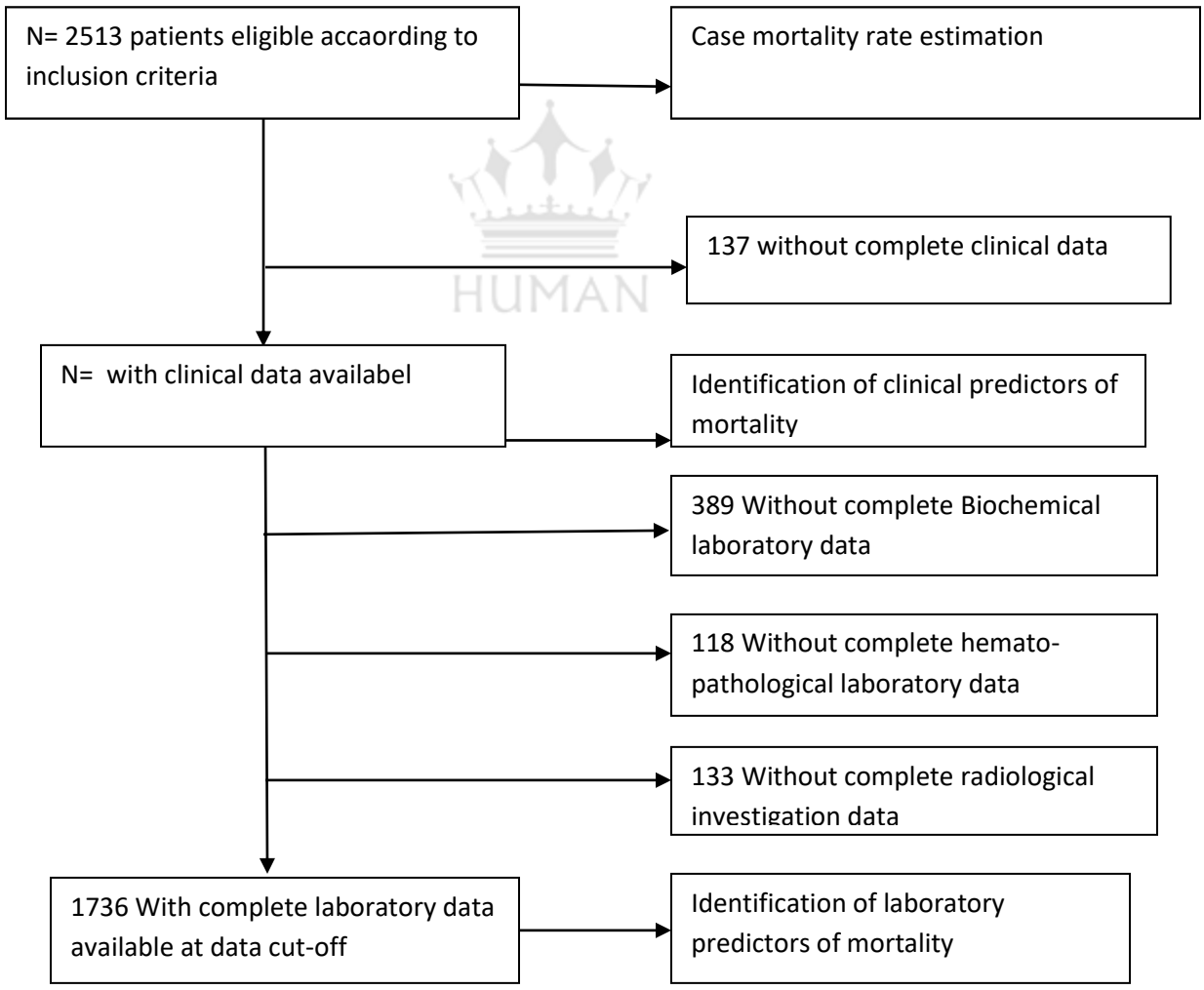
2. Age more than ≥ 15 years

The exclusion criteria are:

1. Significant co-morbidities such as ischemic heart disease, chronic kidney disease, and primary or advanced malignancy.

2. Those patients in whom consent cannot be obtained.

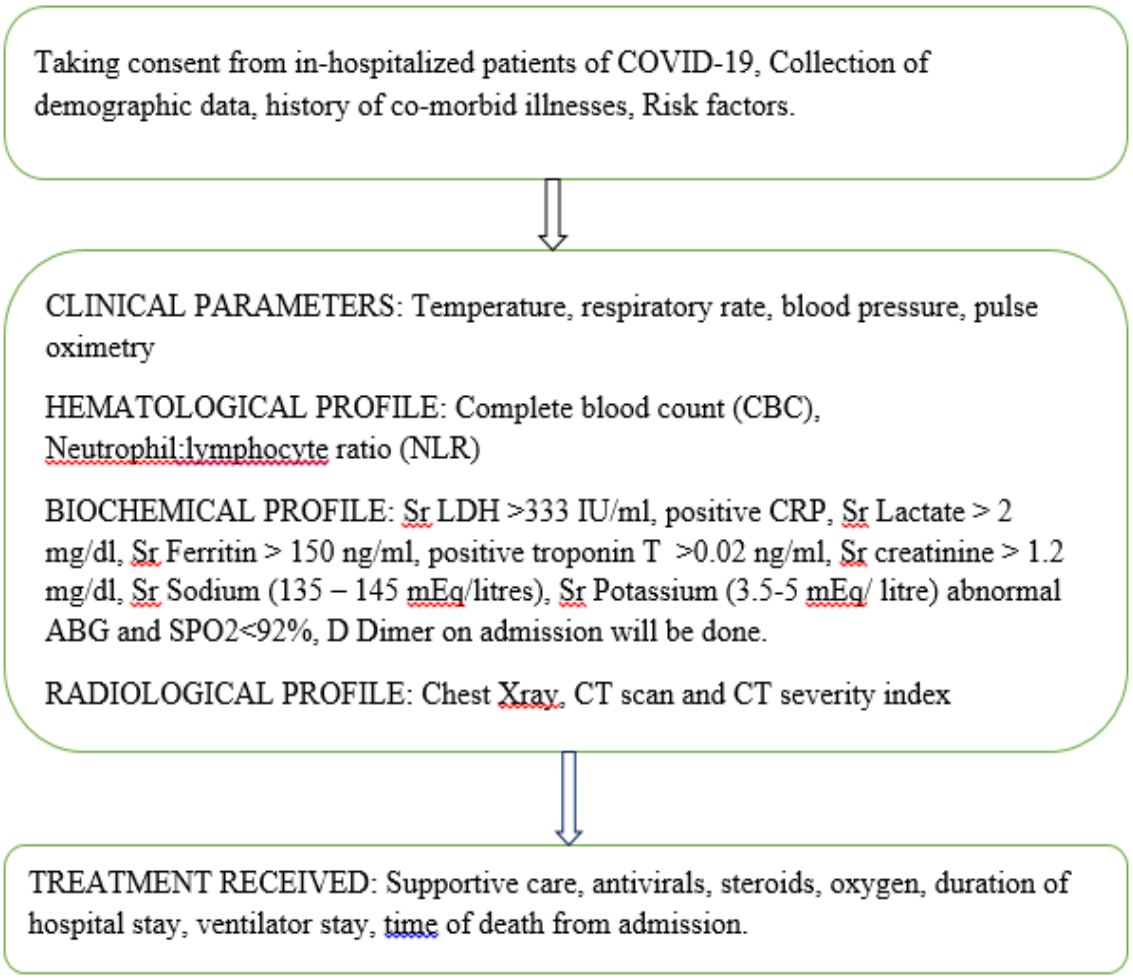
Flow chart 1: Demonstrating exclusion of patients from the study



2.4 Recruitment

Subjects who are tested positive for COVID -19 RTPCR will be enrolled in the study by the research associate who will assess the eligibility criteria, explain the study to the patients and take informed consent. Research associate will record the required investigations and follow the study subjects until his discharge for the details of symptoms, signs, and outcomes that as morbidity or mortality.

Flow chart 2: The flow chart demonstrating the study process



2.5 Outcomes:

The endpoints in this analysis shall be in-hospital morbidity and mortality. The primary outcome will be mortality. Mortality will be defined as death during the index hospitalization. The secondary outcome will be morbidity, which shall be measured in terms of:

1. The patient requiring mechanical ventilation and intubation,
2. The patient requires hemodialysis,
3. Patient developing septic shock,
4. Duration of hospital/ICU stay more than 14 days,
5. Acute kidney injury (AKI): As per the Kidney Disease: Improving Global Outcomes (KDIGO) guidelines increase serum creatinine by ≥0.3 mg/dL within 48 hours, or increase to ≥1.5 times baseline within the seven days, or Urine volume <0.5 mL/kg/hour for six hours, Coagulopathy, Myocarditis, Myocardial infarction.

2.6 Predictors:

- Demographic variables (age, sex, and socioeconomic status).
- Comorbid illnesses (hypertension, cardiovascular disease, and diabetes mellitus).
- Clinical parameters (Temperature, respiratory rate, blood pressure, and SPO2 on pulse-oximetry <92%)
- Hematological profile (Complete blood count, Neutrophil-Lymphocyte ratio (NLR), and lymphopenia)
- Biochemical profile: [Elevated serum Lactate dehydrogenase,serum LDH >333 IU/l), positive C Reactive protein, serum Lactate >2 mg/dl, serum Ferritin >150 ng/ml, positive Troponin T >0.02ng/ml, serum creatinine >1.2 mg/dl, abnormal serum Sodium(135-145 mEq/litres), serum Potassium (3.5-5 mEq/l), abnormal arterial blood gases (ABG)] on admission will also be done.

- Duration of hospital stay and ventilator stay will be included and time to death from admission will be noted.

2.7 Statistical methods:

Study size: All the patients admitted with diagnosed COVID-19 during the study period shall be approached for participation in this study.

- We calculated the sample size using the OpenEpi sample size calculator (www.openepi.com) for the present Cohort study.

- The incidence of COVID 19 in the state of Maharashtra is around 1-8 % (MoHFW site GOI: https://www.mohfw.gov.in/). We hypothesized the effect size of a 3% difference in mortality for exposure variables with 90% power and 95% confidence interval and 10% attrition to data loss, the sample size using the open EPI software formula for cohort study comes to be 1736.

- The same sample size is also adequate to calculate the diagnostic accuracy of the prognostic score. We hypothesized sensitivity and specificity of 90% with 5% precision and taking prevalence of 8% the sample size by Open EPI software with 95% CI is calculated to be 1738. So final sample size for the present study would be 1800 study participants.

- The data for COVID-19 in-hospitalized patients is available in the hospital information system (HIS) this data extraction will be done in a google spread sheet and we are also applying data validation checks to every column so the data entry errors are minimized. The data cleaning will be done and R software will be used for analyzing data and the Open Epi software for calculating sample size.

- Data will be analyzed as univariate, bivariate, and multivariate analyses, and multiple logistic regression will be done.

- Kaplan Meir survival curves will be constructed and the hazard ratio will be calculated.

3 DISCUSSION

This study will help in gathering the data on gender, and the age group most affected by the disease. Whether male or female gender is related to mortality or not, whether their rural or

urban residence relates to the severity of disease? Which were the most common presenting symptoms and signs and the most deranged laboratory parameters amongst glucose random, arterial blood gas analysis, serum creatinine, D-Dimers, serum lactate dehydrogenase, C-reactive protein, erythrocyte sedimentation rate, neutrophil-lymphocyte ratio, that caused severe illness? Is any of these parameters related independently to the morbidity or mortality of disease? This will help triage the patients appropriately. The chest X-ray findings and the computed tomography of the chest will help in finding the severity of the illness objectively. This study will find the predictive score for predicting mortality in patients of COVID-19 disease.

This extensive data with a large sample size involving 1736 subjects and described in all aspects of research arms namely demographic, clinical, radiologic, and laboratory will help in generating new information to describe the novel coronavirus disease. This study is the first in the Indian population. When we search PubMed and Medline databases with keywords like COVID-19 or coronavirus and mortality only 35 studies covering only some aspects of the study like clinical or radiologic and/or laboratory are available from American and European literature.

Implications of the study: Publication of this study results will report the results obtained to the scientific community. The results obtained will help make necessary changes in national and international policies of COVID-19 and make revisions to national protocols, to fight the pandemic.

Predicting mortality will help in triaging seriously ill patients and giving them critical care facilities at the onset will help save lives in resource limited settings of a pandemic.

- The predictors of mortality will be useful as a screening tool to objectively triage patients who are seriously ill and require critical care management and help in delivering the scarce resources like ventilators in resource limited settings of rural India.

- It will help the clinician in early decision making and delivering the right treatment at the right time as disease is rapidly progressive in some patients and the mortality rate is 3- 5% in India.

- Will help refocus COVID-19 related health policies and morbidity prevention?

The prognostic index will also help in improving the overall life expectancy, by targeting health care services in high-risk groups and help in delivering the scarce resources like ventilators in resource-limited settings of rural India. Therefore, this study has National significance and humanitarian cause.

Kindly refer to Table no 1 to find similar published studies and their results and how our study will be different from the pre-existing studies.

Table No 1: shows similar previously published studies and their results.

Sr No	Name of Study	Place of Study	Study Design	Sample size	Age/Gender	Comorbidities	Results of Study
1	**Bellan M et. al.** [13]	Northern Italy	Cohort study	1697			The mortality rate of 30%.
2	**Cummings MJ et al.**[14].	New York, United States	Cohort study	1150	Median age 62 years 67% were male	82%had at least 1 chronic illness Obesity 46%	The most common presenting symptoms were shortness of breath, fever, cough, myalgia, and diarrhea.
3	**Petrilli CM et al.**[15]	New York, United States	Cohort study	5279	The strongest risk for hospital admission was associated with age, with an odds ratio of >2 for all age groups older than 44 years and 37.9 (95% confidence interval 26.1 to 56.0) for ages 75 years and older	heart failure (4.4, 2.6 to 8.0), male sex (2.8, 2.4 to 3.2), chronic kidney disease (2.6, 1.9 to 3.6), and an increase in body mass index (BMI) (eg, for BMI >40: 2.5, 1.8 to 3.4). The strongest risks for critical illness besides age were	Age and comorbidities were found to be strong predictors of hospital admission and to a lesser extent of critical illness and mortality in people with COVID-19.

						associated with heart failure (1.9, 1.4 to 2.5), BMI >40 (1.5, 1.0 to 2.2), and male sex (1.5, 1.3 to 1.8).	
4	Haimovich AD et al.[17]		Cohort study	1792	75 years Women 49.3%	Hypertension with complications 36% Diabetes with chronic complications 37% Obesity 40%	A significant proportion of admitted COVID-19 patients progress to respiratory failure within 24 hours of admission. These events are accurately predicted with bedside respiratory examination findings within a simple scoring system The quick COVID-19 Severity Index.
5	**Ioannou GN et al.** [18]	Lombardy, Italy	Cohort study	3988			In this cohort study that involved 3988 critically ill patients admitted from February 20 to April 22, 2020, the hospital mortality rate as of May 30 was 12 per 1000 patient days after a median observation time of 70 days. In the subgroup of the first 1715 patients, 865 (50.4%) had been discharged from the intensive care unit, 836 (48.7%) had died in the intensive care unit, and 14 (0.8%) were still in the intensive care unit; 915 patients died in the hospital for overall hospital mortality of (53.4%).
6	Grasselli G et al. [19],	Lombardy, Italy	Case Series	1591	63 years median age	(68%) had at least 1 comorbidity	Older patients (n = 786; age ≥64 years) had higher mortality than younger patients (n = 795; age ≤63 years) (36% vs 15%; difference, 21% [95% CI, 17%-26%]; *P* < .001).

7	C Fernando et al.. [20]	Spain	Cohort study	663	The multivariable regression model showed that age was associated with mortality, with every year increasing risk-of-death by 1% (95%CI: 1–10, p = 0.014	Each 5-point increase in APACHE II independently predicted mortality [OR: 1.508 (1.081, 2.104), p = 0.015]. Patients with AKI [OR: 2.468 (1.628, 3.741), $p < 10^{-4}$)], cardiac arrest [OR: 11.099 (3.389, 36.353), p = 0.0001], and septic shock [OR: 3.224 (1.486, 6.994), p = 0.002] had an increased risk-of-death.	A total of 663 patients were included. Overall ICU mortality was 31% (203 patients). At ICU admission non-survivors were more hypoxemic [SpO_2 with non-rebreather mask, 90 (IQR 83–93) vs 91 (IQR 87–94); p < 0.001] and with higher sequential organ failure assessment score [SOFA, 7 (IQR 5–9) vs 4 (IQR 3–7); p < 0.001]. Complications were more frequent in non-survivors: acute respiratory distress syndrome (ARDS) (95% vs 89%; p = 0.009), acute kidney injury (AKI) (58% vs 24%; $p < 10^{-16}$), shock (42% vs 14%; $p < 10^{-13}$), and arrhythmias (24% vs 11%; $p < 10^{-4}$).
8	Suleyman G et. al[21]	Metropolitan Detroit	463	Case Series	Mean [SD] age, 57.5 [16.8] years), 259 (55.9%) were female, and 334 (72.1%) were African American. Male sex severe obesity	. Most patients (435 [94.0%]) had at least 1 comorbidity, including hypertension (295 patients [63.7%]), chronic kidney disease [39.3%]), and	In this review of urban metropolitan patients with COVID-19, most were African- Americans with a high prevalence of comorbid conditions and high rates of hospitalization, intensive care unit admission, complications, and mortality due to COVID-19.

					and chronic kidney disease were independently associated with mortality.	diabetes [38.4%]).	
9	Ioannou GN et al.[22]	United States	10131	Cohort study	Mean age 63 years 91% male		Compared with patients who tested negative for SARS-CoV-2, those who tested positive had higher rates of 30-day hospitalization, mechanical ventilation (6.7%), and death (10.8%) Among patients who tested positive for SARS-CoV-2, characteristics significantly associated with mortality included older age (eg, ≥80yrs), high regional COVID-19 disease burden, higher Charlson comorbidity index), dyspnea, high serum aspartate aminotransferase, creatinine, and neutrophil to lymphocyte ratio.
10	Page JH et al.[23]	United States	51510	Cohort study	The median age group is 50-65 years 49% Women		The use of antivirals and dexamethasone increased over time, fivefold and twofold, respectively, while the use of hydroxychloroquine declined by 98%. Among adult patients in the laboratory positive cohort, the absolute age/sex standardized incidence proportion for in-hospital death changed by −0.036 per month (95% CI −0.042 to –0.031) from March to June 2020, but remained fairly flat from June to November 2020. Decreases in most acute

							clinical outcomes were observed in the laboratory positive cohort, but not in the clinical cohort.

4. Limitations: Due to the explosive nature of this pandemic and the unavailability of enough manpower and beds in hospitals we may miss some data. As there is a shortage of life-saving ventilators and various novel treatment options like anti-viral drugs and plasma therapy, this may affect the mortality and morbidity of patients.

5 ETHICAL CONSIDERATIONS:

The study shall commence only after taking the ethical clearance from the institutional ethics committee. We understand that the patients diagnosed with COVID 19 shall be given complete autonomy to withdraw from the study at any point without affecting the standard of care available through the hospital. We shall adhere to the guidelines from The Indian Council of Medical Research (ICMR) regarding the use of personal information in Medical Research. We shall obtain approval for conducting the study from the Institutional Review Board. All the data shall be handled confidentially and will be anonymized to prevent any identification or stigmatization of the study participants.

The patients won't be required to bear the cost of any tests ordered for this study.

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6 ABBREVIATIONS:

ABG	Arterial Blood Gases
AKI	Acute kidney injury
COVID-19	Novel Corona virus disease 19
HIS	Hospital information system
ICMR	Indian Council of Medical Research
ICU	Intensive care Unit
IL	Interleukin
LDH	Serum lactate dehydrogenase
MoHFW	Ministry of Health and Family Welfare
NT-Pro BNP	N-terminal-pro hormone Brain Natriuretic Peptide
OR	Odds Ratio
RT-PCR	Reverse transcriptase polymerase chain reaction

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