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Research Article

Managing COVID-19 through collaboration: applying a novel patient care model in a rural Indian community

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Background

Rural communities in India are vulnerable to the global pandemic of severe acute respiratory coronavirus 2 (SARS-CoV-2) due to a lack of resources and delayed access to information. To address the challenges faced by Primary Health Centers, the Karuna Trust-Lopamudra Medical Center COVID-19 High Dependency Unit (KLCHDU), a collaboration between a local hospital, a non-governmental organization, infectious disease physicians from an academic medical center in the United States, and a local citizens council, was established in May 2021. This collaboration implemented diagnostic and management COVID-19 protocols recommended by the Infectious Diseases Society of America, the National Institute of Health, and the U.S. Centers for Disease Control and provided basic training on recommended practices to Primary Health Center and other local healthcare workers.

Methods

All local patients between 1 May 2021 through 31 July 2021 who tested positive for SARS-CoV-2 with a rapid antigen test or polymerase chain reaction test were admitted to the KLCHDU and were included in this study. Patient demographics, medical history, hospital course, and laboratory findings were evaluated to determine the outcomes of patients treated within this unique healthcare model.

Results

Eighty-three patients (54% male) qualified for inclusion during the study period. Common comorbidities included hypertension (52%), diabetes mellitus (48%), and coronary heart disease (10%). Nearly one-third of patients had received at least one dose of SARS-CoV-2 vaccine. The most frequently administered hospital medications were dexamethasone (65%), low molecular weight heparin (54%), and remdesivir (53%). The average absolute leukocyte count was 1534 cells/μL, average blood glucose was 182 mg/dL, average D-dimer was 849 ng/mL, and average NEW-2 score on admission and discharge was 4.4 and 3.2. The average duration of hospital stay was five days. Eleven (13%) patients were prescribed supplemental oxygen at discharge and one patient died from infection complications.

Conclusions

Our data show a duration of inpatient hospitalization and mortality rate on the lower end of most published data. The results of our study encourage allocation of resources based on recommended protocols and the use of telehealth for collaboration and resource sharing.

The global pandemic of severe acute respiratory coronavirus 2 (SARS-CoV-2) infections, which began in Wuhan in November 2019, has since been characterized epidemiologically and clinically by the World Health Organization and other public health organizations. As of June 1st, 2022, there have been close to 527 million confirmed cases globally, with approximately 6.3 million attributable deaths.[1] During the same period, nearly two-thirds of the world's population have received at least one dose of an approved COVID-19 vaccine.[2] The coronavirus disease 2019

(COVID-19) caused by the virus has been associated with substantial morbidity, mortality, and suffering across the world. The International Monetary Fund has warned that the COVID-19 outbreak will increase poverty, discontent, and geopolitical tensions, especially in economically less-developed countries.[3] Many developing countries, such as India, were not affected by the first wave of the pandemic but were devastated by the second wave. As of June 2022, the confirmed cases of COVID-19 in India stood at approximately 43 million, with about 525,000 deaths.[4] Inadequate public health spending and planning have exposed India's poor health infrastructure. Roughly 65% of India's total population live in rural areas and is served by a system of Primary Health Centers (PHCs).[5] In general, rural communities are particularly vulnerable during the pandemic due to the paucity of healthcare providers, hospitals, and delayed access to information. In the southern state of Karnataka, the Indian Ministry of Health and Family Welfare reports that the state's 2359 PHC's are staffed by only 2136 physicians.[5] This system is understaffed and inadequate for addressing the health needs of the rural population during the COVID-19 pandemic.

Several studies have reported single-center and regional models for delivering care to hospitalized COVID-19 patients in rural areas.[6–9] The expansion of telehealth services is an important tool to help overcome obstacles to patient care in rural settings.

In May 2021, in response to the surge in COVID-19 cases and a paucity of hospital beds, especially in rural areas, the Karuna Trust-Lopamudra Medical Center COVID-19 High Dependency Unit (KLCHDU) was established in Gonikoppa, South Kodagu, Karnataka, India. The center was established in a remote area of the country with a large population of tribes and migratory workers who work on the local coffee plantations. The center was set up as a collaborative endeavor between a local 30-bed hospital, a non-governmental organization working in public health, infectious disease physicians from an academic medical center in the United States, and a local citizens council.

Every day, physicians discussed complicated cases with infectious disease experts and other specialists from the United States. To maximize value, we adopted the diagnostic and management COVID-19 protocols and guidelines recommended by the Infectious Diseases Society of America (IDSA), the National Institute of Health (NIH), and the Centers for Disease Control (CDC). In addition, basic training on the pathophysiology, diagnosis, management, and infection control practices for COVID-19 was provided to all healthcare workers both in the hospital and nearby PHCs.

Protocols were continually revised based on local physician and healthcare worker feedback and resource availability. Mild, moderate, and severe COVID-19 infections not requiring invasive ventilation were treated at the center. Patients requiring invasive ventilation were transferred to the district general hospital. Basic laboratory tests were performed and antimicrobials were only prescribed for documented infections based on tried algorithms.

METHODS

This study was conducted between May 1, 2021 and July 31, 2021 at the Karuna Trust COVID Care Center at Lopamudra Medical Center (LMC) in Gonikoppa town in South Kodagu, Karnataka, India. In this region, at this time, the Delta variant was the predominant form of the SARS-CoV-2 virus. All patients from this hospital and the local government's health department who tested positive with either a rapid antigen test or a polymerase chain reaction test were admitted to the hospital's COVID care center and were included in this study. Patient medical charts were retrospectively reviewed and data on patient demographics, medical history, hospital course, and laboratory findings were collected for this study. The National Early Warning Score 2 (NEWS-2) values for each patient at admission and discharge were also calculated retrospectively. This scoring system, developed by the Royal College of Physicians, accounts for patient vital signs and level of consciousness and has shown to be a superior predictor of disease severity in patients with COVID-19.[10,11] The NEWS-2 system classifies scores of zero to four as being low risk for acute deterioration due to sepsis, scores of five to six as being medium risk, and scores of greater than seven as being at severe risk. Descriptive statistics were obtained from the collected data using R statistical software.[12]

RESULTS

Eighty-three patients (45 males and 38 females) met the case definition of SARS-Cov-2 infection during June through July 2021 (study period). The mean age was 58 (range: 24-94) years; seven (8%) patients reported a history of tobacco use and six (7%) admitted to ongoing alcohol use. Thirty (36%) patients had a family member who had also been admitted to the hospital inpatient service. The three most common pre-existing conditions in study-patients included hypertension (43 [51.8%] patients), diabetes mellitus (40 [48.2%] patients), and coronary artery disease (eight [9.6%] patients); 22 (26.5%) patients had no pre-existing conditions.

Of the 83 study-patients, 27 (32.5%) received at least one of a two-dose approved vaccine; just 3 (3.6%) received the full two doses of vaccine. Twenty-three (27.7%) patients received the Covishield vaccine and four (4.8%) received the Covaxin vaccine. Of the patients who received any vaccine, symptoms developed an average of 24 (range: 1-55) days after their last vaccine dose.

Patients presented an average of seven (range: 1-35) days after the onset of their symptoms. The average duration of hospital stay was five (range: 1-13) days. Thirty of the 40 (75%) patients with type II diabetes mellitus had random blood sugar levels >150 mg/dL, whereas six (14%) patients without a previous diagnosis of diabetes mellitus had levels exceeding 150 mg/dL. Laboratory results are summarized in Table 1.

The three most commonly administered medications during hospitalization were dexamethasone (53 [65%]), low molecular weight heparin (45 [54%]), and remdesivir (44

Table 1. Laboratory findings of admitted patients

Evaluation	Normal Range	Measurement Standard	Number of Patients (% of Total Sample)
ALC (cells/μL) (*n* = 71)	1000 - 4800	< 800	4 (6%)
		800 – 1199	23 (32%)
		> 1200	44 (62%)
Blood Glucose (mg/dL) (*n* = 72)	70 - 100	> 150	36 (50%)
CRP (mg/L) (*n* = 82)	< 10	< 10	16 (20%)
		> 10	66 (81%)
		> 20	54 (66%)
		> 30	47 (57%)
Creatinine (mg/dL) (*n* = 78)	0.7 – 1.2	< 1.2	29 (37%)
		> 1.2	49 (63%)
D-Dimer (ng/mL) (*n* = 82)	< 500	< 500	50 (61%)
		> 500	32 (39%)
		> 1000	19 (23%)
		> 2000	7 (9%)
Evaluation	**Sample Size**	**Average (± stdev)**	
ALC (cells/μL)	71	1535 (± 739)	
Blood Glucose (mg/dL)	72	182 (± 101)	
D-Dimer (ng/mL)	82	849 (± 1455)	
NEWS-2	Admission: 79	4.4 (± 2.0)	
	Discharge: 78	3.2 (± 1.4)	
	Admission – Discharge: 78	1.4 (± 0.61)	

ALC, Absolute Lymphocyte Count; CRP, C-Reactive Protein; n, sample size; NEWS-2, National Early Warning Score 2; stdev, standard deviation.

[53%]). Other medications prescribed to hospitalized patients included unfractionated heparin (15 [18%]), antimicrobial agents (13 [16%]), rivaroxaban (five [6%]), and tocilizumab (three [3.6%]). Only eight (9.6%) patients received intravenous fluids.

Eleven (13%) patients had been prescribed supplemental oxygen at discharge. Of these 11 patients, two were readmitted within two weeks of discharge for conditions unrelated to their initial admission. One month after discharge, all 11 patients required no supplemental oxygen. All patients who had a new diagnosis of diabetes mellitus were found to have a normal blood glucose on follow up visits. Only two patients were referred to the district hospital for tertiary care; unfortunately, a 93-year-old female patient died a few days after discharge from complications of her infection.

DISCUSSION

India's shortage of trained infectious disease physicians is a challenge in a country with such a high burden of infectious disease in both the primary and tertiary healthcare settings.[13] This paucity of trained specialists is apparent when examining the profile of individuals participating in various Government and Health Ministry task forces: most do not have trained infectious disease physicians to help advise and provide guidelines for diagnosing and treating patients with COVID-19.

The shortage of local trained professionals and published evidence-based data has hampered efforts by the Ministry of Health to establish policies and preventive guidelines; this has inevitably led to indiscriminate and unnecessary laboratory and radiological testing and prescribing practices. Medications like steroids, antimicrobial agents, multivitamins, and antiparasitics are often prescribed and used indiscriminately without Infectious Disease input, resulting in what might be termed blind empiricism. Indiscriminate prescribing has long been identified as a major risk factor for the emergence of antimicrobial resistance among bacteria.[14] Antimicrobial agents like azithromycin and antiparasitic medications like ivermectin continue to be prescribed despite studies showing their ineffectiveness in treating COVID-19 and their potentially dangerous side effects.[15] In our cohort, only patients with evidence of clinically diagnosed infections were treated with antimicrobials in the study center. Intravenous fluids were used sparingly to prevent exacerbation of pulmonary edema and precipitation of acute respiratory distress syndrome.

In a country where most patients seek medical care in private health settings and pay for their care from personal

savings, the indiscriminate use of diagnostic tests and arbitrary prescribing of drugs without proven effectiveness has led to increased healthcare expenditures for individuals and, in some cases, driven families into poverty.[16] Rural populations have suffered additional costs from travelling to urban areas to seek healthcare in tertiary care hospitals and private clinics. Published reports of poverty levels doubling in India, attributable to these unnecessary costs, underscore the need for national reassessment of prescribing practices for patients with COVID-19 and increasing the role of trained Infectious Disease physicians in COVID-19 management policies, algorithms, and prescribing practices.[17]

Our study reported the NEWS-2 values as a measure of illness severity in patients upon admission and discharge from the KLCHDU. By comparing NEWS-2 scores at admission and discharge, our study demonstrates substantial improvements in patient health and indicates the possibility of limiting the use of diagnostic testing and prescription medications without compromising patient outcomes. Indeed, our data show duration of inpatient hospitalizations and mortality rates on the lower end of published studies.[13,14]

Involving local communities and healthcare providers helps to build trust in the healthcare system and provides an efficient way to counter misinformation while treating conditions like long COVID. Local involvement also makes it easier for patients from rural areas to access healthcare locally and reduce costs. The patients in our study likely sought early medical care at the hospital because there were few costs involved with treatment for COVID-19 and because they were familiar with the local physicians.

For rural areas, access to internet connectivity renders telemedicine a credible and effective way of bridging the gap between the few infectious disease experts and a relatively high burden of communicable diseases. Telemedicine has been shown to be effective during previous infectious disease outbreaks.[1] With the ever-looming threat of emerging infections, telemedicine may be a valuable tool to train health workers, including the last mile healthcare workers in Primary Healthcare Centers.

Despite the successes of this project, the authors would like to recognize several constraints in study design that limit the generalizability of its findings. Importantly, this study was conducted at a single medical center within a narrow time frame and therefore the effects of diagnostic and management protocols may be different in another setting. We suggest that medical centers attempting to replicate this project design modify their protocols to local resources and values. Additionally, this study did not provide a control cohort with which to compare the intervention's outcomes. Finally, the healthcare providers in this project were not blinded to the study's goals and the improvement in patient outcomes may have been influenced by an irregularly short time between disease detection and treatment when compared to typical clinical presentation. Regardless of these limitations, we believe that a project designed to bring together local and international stakeholders, resources, and expertise to implement diagnostic and management protocols can be expected to reduce unnecessary and potentially harmful practices without compromising patient care.

CONCLUSIONS

Rural communities in India remain vulnerable to the ongoing pandemic of SARS-CoV-2. Through collaboration and resource sharing between a non-governmental organization, infectious disease physicians from an academic medical center in the United States, and a local citizens council with a local hospital, the Karuna Trust-Lopamudra Medical Center COVID-19 High Dependency Unit was established to implement a standardized diagnostic and management strategy for COVID-19. Study data showed a lower duration of inpatient hospitalization and mortality, as compared to other published data. We propose this model to encourage the sharing and allocation of resources.

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AUTHORSHIP CONTRIBUTIONS

AN, FS, VC, and GK conceived and designed the project. AN, VC, and GK collected the data. MKE and MMM performed the analysis. FS, MKE, MMM, LKA, BP, and GK wrote the manuscript.

COMPETING INTERESTS

The authors completed the Unified Competing Interest form at http://www.icmje.org/disclosure-of-interest/ (available upon request from the corresponding author) and declare no conflicts of interest.

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