Original Article

# Managing comorbidities in Covid-19 patients: A drug utilization study in a COVID-dedicated hospital in Northern India

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## Abstract

**Introduction:** In the prevailing COVID-19 pandemic, the Indian healthcare system has worked hard towards restricting the adverse outcomes to the least possible figures. The present study aims to share the experience of a COVID-dedicated tertiary care government hospital in Northern India of managing COVID-19 patients with comorbidities. **Methodology:** A retrospective, observational study was conducted in a COVID-dedicated tertiary health care government hospital in Northern India. Details on sociodemographic data, hospital admission data, and drug utilization pattern of all laboratory-confirmed COVID-19 patients of all age groups, either gender, having comorbidity (s), and admitted between April and September, 2020 were noted and evaluated. **Results:** Among the total study participants ($N$ = 406), 2868 drugs were prescribed. Out of these, 2336 were used for the management of symptoms of COVID-19 and 532 were used for the management of coexistent comorbidity (s). For COVID-19 symptoms, the most commonly prescribed class of drugs were antimicrobials (853, 36.52%), followed by nonsteroidal antiinflammatory drugs (374, 16.01%), proton pump inhibitors (299, 12.80%), antihistamines (232, 9.93%), immunosuppressant drugs (103, 4.41%), and others. For comorbidities most commonly prescribed were antihypertensive (310, 58.60%) drugs, followed by antidiabetic drugs (166, 31.38%), bronchodilators (34, 6.43%), thyroid hormones (11, 2.08%), immunosuppressant drugs (7, 1.32%). **Conclusion:** The most frequently prescribed antihypertensives were calcium channel blockers (CCBs) and least prescribed was beta blocker+CCB. Among the antidiabetic drugs, most frequently prescribed was insulin and least prescribed was DPP-4 inhibitors and Biguanide+DPP-4 inhibitor both.

**Keywords:** Co-morbidity, COVID-19, drug utilization pattern

## Introduction

The current coronavirus disease-19 (COVID-19) pandemic has challenged the human perspicacity on not one, but many fronts. Across decades and centuries, the medical science and its advancements has been marching headway to new heights of accomplishments; but the *severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2)* has dragged the humanity back to the most preliminary stage of its race for life, i.e. finding a specific drug treatment for COVID-19 that could hasten recovery and minify mortality.

Undoubtedly, ever since the onset of COVID-19 in December 2019, the humankind with its best intelligence across the globe, has been working tirelessly towards simplifying the complexities of the disease and *SARS-CoV-2*.[1,2] In this process, some path-breaking and reassuring developments have ensued; the

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most notable being the expedited research and development of COVID vaccines by nations like Russia, UK, India, and maybe few more to follow soon. Although, this has strengthened the preventive barrier, but the search for specific drugs for definitive and successful treatment of COVID-19 patients still remains highly elusive and distant.

COVID-19 commonly manifests as a respiratory disorder with a reported incubation period ranging from 2 to 14 days. Common COVID-19 symptoms are mild-moderate and include dry cough, sore throat, fever, rhinorrhoea, myalgia, loss of taste or smell, breathlessness, and altered bowel movement.[3] However, persons with advancing age or those with weak immune system are found to be more prone to severe COVID-19 illness and mortality.[4] Furthermore, comorbidities including liver disease, CVD, malignancies, or renal disease have been reported among many of the severely ill COVID-19 patients. According to Centres for Disease Control and Prevention, the risk of hospitalization increases by 6 times and death by 12 times due to any pre-existing ailment among COVID-19 patients.[5] Therefore, pre-existing comorbidities need to be accurately evaluated and adequately managed, which may otherwise adversely influence the clinical outcome. This may require treatment protocols with several classes of drugs for management of comorbidity; in addition to those for the treatment of COVID-19 symptoms.

While the pursuit of specific drugs for COVID-19 continue, an array of treatment protocols using combinations of repurposed drugs are being experimented by health experts around the world; their sole purpose being to allay fear and save precious lives. However, as new research on COVID-19 pathophysiology and clinical evidences on safety and efficacy of such treatments are being reported, there occur revisions in these protocols, leading to another array of new protocols. Thus far, no approved therapy for use to treat COVID-19 is available and symptomatic management remains the only relied upon approach. Consequently, in the prevailing circumstances, reports on drug utilization patterns for the management of COVID-19 in different healthcare settings across the world may emerge as important tool to assess the utilization and impact of such treatment protocols and to prioritize the medical needs of the community, globally.

India, with the world's second largest population to safeguard, had also faced, just like other nations in the world, a dual and Herculean task of containing the spread of infection and treating the patients. Until the end of August, 2020 approximately 38 million Indians had been infected with COVID-19 with case fatality ratio of 1.8%.[6] The Indian healthcare system had worked hard towards restricting the adverse outcomes to the least possible figures and has also, to a larger extent been successful in achieving so. It therefore, becomes noteworthy to share the treatment protocols being followed and their outcome; and since there is negligible data on drug utilization pattern among COVID-19 patients with comorbidity, therefore, in the present study we are sharing the experience of a COVID dedicated tertiary care government hospital in Northern India of managing lab confirmed COVID-19 positive patients with comorbidities.

## Material and Methods

A retrospective, observational study was conducted in a COVID dedicated tertiary health care government hospital in Jaipur, Rajasthan, India. The ethical approval (Letter No. RUHS-CMS/Ethics Comm./2020/95 dated 20.10.2020), was obtained from the Institutional Ethics Committee and the data collection was conducted after taking the permission of the hospital administration. Six months data was collected retrospectively for the period between April to September, 2020 from the Medical Records Department (MRD). Case files of all laboratory confirmed COVID-19 positive patients of both gender and of all age group having comorbidities (chronic obstructive pulmonary disease (COPD), diabetes mellitus, and hypertension) and admitted to this hospital during the study period were included. Incomplete record files and case files of pregnant and lactating females, patients diagnosed with malaria or dengue, and patients who were initially non-diabetic but later developed hyperglycemia consequent to use of steroid were excluded.

The baseline data was noted as per study proforma that included details on socio-demographic data, hospital admission data, and drug utilization pattern. Hospital admission data included date of admission, date of first COVID positive report, COVID-19 diagnosis prior to admission, Ward/ICU admission, diagnosis, presenting symptoms, clinical severity features, disease severity status, investigations (chest X-Ray, ECG, biochemical examination, ophthalmic examination, and any other investigations), comorbidity and its duration, etc., Also, the course during the stay in the hospital and details of any adverse drug reaction (ADR) were noted. For studying the drug utilization pattern**,** detailed information on drugs used including name of the drug, dosage schedule, and treatment duration were noted. The clinical outcome was assessed in terms of recovery, death, or referral of patient.

**Statistical analysis:** Data was collected and tabulated using MS excel version 2007 and was checked for normalcy before analyzing. Data was analyzed using SPSS (Statistical Packages for Social Sciences) software version 16.0. Quantitative parametric data was presented as mean ± SD. Qualitative data was presented as percentages and proportions. Descriptive statistics and Chi-square test were used as a test of significance. *P* value less than 0.05 was considered significant in the study.

## Results

A total of 406 case records of lab confirmed COVID-19 positive patients having comorbidity (s) were reviewed. The mean age of the study participants was 59.02 ± 12.16 years. The socio-demographic description of the study participants, average duration of hospital stay (among recovered patients), and clinical outcome are depicted in Table 1. Among the total study participants (N = 406), there were

59.36% discharges after recovery, 3.69% referrals to some other institute (s), and 36.95% deaths. The clinical findings among the study participants at the time of admission and their association with COVID-19 severity are displayed in Table 2.

## Distribution of pre-existent comorbidity(s) amongst study participants

Hypertension alone (173, 42.61%) was the most common underlying comorbid condition, followed by diabetes mellitus + hypertension (123, 30.30%), diabetes alone (66, 16.26%), COPD (19, 4.68%), and others. Table 3 depicts the distribution of pre-existent comorbidity (s) among the study participants.

## Drug utilization pattern amongst study participants

For the management of COVID-19 with comorbidity(s) among the study participants, total 2868 drugs were prescribed. Out of these, the COVID-19 symptoms and co-existent comorbidity(s) were managed by 2336 and 532 drugs, respectively.

**Management of COVID-19 symptoms:** The most commonly prescribed class of drugs were antimicrobials (853, 36.52%), followed by nonsteroidal antiinflammatory drugs (NSAIDs) (374, 16.01%), proton pump inhibitors (299, 12.80%), antihistamines (232, 9.93%), immunosuppressant drugs (103, 4.41%), and others, as shown in Figure 1. The prescribed antimicrobials are detailed in Figure 2.

**Dosage forms for the management of symptoms of COVID-19:** Out of the total 2336 drugs, 685 (29.32%) were prescribed as injectable and 1651 (70.68%) were prescribed orally. Among the injectable preparations, Piperacillin-Tazobactam (210, 30.66%) were the most commonly prescribed agents followed by Ondansetron (93, 13.58%), Dexamethasone

**Table 1: Gender wise, age-wise, and severity wise distribution of clinical outcome amongst study participants**

| Variables | Frequency (%) (*n*=406) | Outcome (Frequency, %) (*n*=406) | | | $\chi^2$ (*P*) | Average duration of hospital stay (in days) (*n*=241) |
|---|---|---|---|---|---|---|
| | | Mortality (M) | Recovery (R) | Referral (S) | | |
| Gender | | | | | | |
| Female | 145 (35.7) | 60 (41.38%) | 75 (51.72%) | 10 (6.90) | 9.67 (0.008) | 6.01 |
| Male | 261 (64.3) | 90 (34.48%) | 166 (63.60%) | 5 (1.92%) | | 4.61 |
| Total | 406 (100) | 150 (36.95%) | 241 (59.36%) | 15 (3.69%) | | |
| Age (years) | | | | | | |
| 20-30 | 3 (0.7) | 0 | 3 (100.00%) | 0 | 21.11 (0.002) | 4.00 |
| 31-40 | 28 (6.9) | 4 (14.29) | 23 (82.14%) | 1 (3.57%) | | 5.04 |
| 41-50 | 80 (19.7) | 18 (22.50%) | 59 (73.75%) | 3 (3.75%) | | 5.25 |
| > 50 | 295 (72.7) | 128 (43.39%) | 156 (52.88%) | 11 (3.73%) | | 6.76 |
| Total | 406 (100) | 150 (36.95%) | 241 (59.36%) | 15 (3.69%) | | |
| COVID-19 Severity | | | | | | |
| Mild/Moderate | 358 (88.18) | 117 (32.68%) | 241 (67.32%) | 0 | 93.80 (0.0001) | 4.68 |
| Severe | 48 (11.82) | 33 (68.75%) | 7 (14.58%) | 8 (16.67%) | | 4.31 |
| Total | 406 (100) | 150 (36.95%) | 241 (59.36%) | 15 (3.69%) | | |

**Table 2: Clinical findings amongst study participants at the time of admission (*n*=406)**

| Clinical Findings | Mean | Standard Deviation | Minimum | Maximum | Mild/Moderate (*n*=358) | Severe (*n*=48) |
|---|---|---|---|---|---|---|
| Respiratory rate (per minute) | 20.29 | 3.36 | 12 | 30 | 20.2 | 20.91 |
| Pulse rate (per minute) | 83.57 | 9.70 | 18 | 110 | 83.05 | 87.34 |
| Systolic BP (mmHg) | 126.71 | 10.51 | 100 | 160 | 125.35 | 136.96 |
| Diastolic BP (mmHg) | 82.32 | 7.84 | 60 | 106 | 81.7 | 87.09 |
| $SpO_2$ (%) | 94.92 | 3.67 | 79 | 106 | 95.37 | 91.64 |

**Table 3: Distribution of preexistent comorbidities and COVID-19 severity amongst study participants (*n*=406)**

| Comorbidity | Overall Frequency *n* (%) | Severity of COVID-19 | | Average duration of hospital stay (in days) (*n*=248) |
|---|---|---|---|---|
| | | Mild/Moderate *n* (%) | Severe *n* (%) | |
| COPD | 19 (4.68) | 17 (4.19) | 2 (0.49) | 7.35 |
| DM | 66 (16.26) | 63 (15.52) | 3 (0.74) | 5.81 |
| HTN | 173 (42.61) | 155 (38.18) | 18 (4.43) | 5.48 |
| DM, HTN | 123 (30.30) | 106 (26.11) | 17 (4.19) | 4.34 |
| DM, COPD | 3 (0.74) | 3 (0.74) | 0 (0.00) | 6.66 |
| HTN, COPD | 7 (1.72) | 6 (1.48) | 1 (0.25) | 10.00 |
| HTN, DM, COPD | 15 (3.69) | 8 (1.97) | 7 (1.72) | 5.00 |
| TOTAL | 406 (100) | 358 (88.18) | 48 (11.82) | |

(87, 12.70%), Remdesivir (81, 11.82%), low-molecular-weight heparin (LMWH) (80, 11.68%), and other. Among the oral preparations, Paracetamol alone (356, 21.56%) was the most commonly prescribed drug followed by Azithromycin (329, 19.93%), Monteleukast-Levocetrizine (N = 227, 13.75%), and Hydoxychloroquine (N = 164, 9.93%) and others.

**For the management of comorbidity(s):** A total of 532 drugs were prescribed to the study participants for the management of comorbidity(s). Out of these, most commonly prescribed were antihypertensive (310, 58.60%) drugs, followed by antidiabetic drugs (166, 31.38%), bronchodilators (34, 6.43%), thyroid hormones (11, 2.08%), immunosuppressant drugs (7, 1.32%), and others, as shown in Figure 3. The various antihypertensive drugs prescribed, depicted in Figures 4 and 5, provide the distribution of antidiabetic drugs in detail.

**Dosage forms used for managing comorbidity (s):** Out of 532 drugs prescribed, 104 (19.55%) were injectable, 389 (73.12%) were oral, and 39 (7.33%) inhalational. Among the injectable preparations insulin regular (77, 74.04%) was the most commonly prescribed followed by Labetalol (11, 10.58%), Furosemide (6, 5.77%), insulin Glargine (5, 4.81%), Torsemide (3, 2.88%), and other agents. Among the oral preparations, Amlodipine (*N* = 71, 18.25%) was the most commonly prescribed followed by losartan-hydrochlorothiazide (55, 14.14%), Metformin (45, 11.57%), Ramipril (32, 8.23%), Telmisartan (31, 7.97%), Metformin + Glimepride (23, 5.91%) and Amlodipine plus Lisinopril, Enalapril, and Lisinopril (all 17 each, 4.37%), and others. In metered dose inhalers (MDIs), salbutamol-ipratropium bromide-budesonide combination (17, 43.59%) was the most commonly prescribed followed by salbutamol alone (12, 30.77%), Beclomethasone (4, 10.26%), Budesonide alone (3, 7.69%), and others.

## Severity wise distribution of dosage forms of drugs prescribed to the study participants

Tablet (57.09%) was the most common dosage form prescribed to mild-moderately ill patients followed by injectables (23.95%), capsules (12.33%), and syrup (6.16%). In severe patients, maximum drugs were given in the form of tablets (58.19%) followed by injectables (32.84%), and capsules (6.27%).

# Discussion

Though extensive research continues to be conducted worldwide on various aspects of COVID-19, until now negligible data representing the utilization of drugs among COVID-19 patients with comorbidity is available. People of any age who are having certain underlying medical conditions are believed to be at higher risk of having a severe COVID-19 illness and higher mortality.[5] Therefore, to facilitate an effective management of COVID-19 cases, it is essential to accurately evaluate and adequately manage all their preexisting comorbidities. However, such data on comorbid COVID-19 patients is scarcely available. Therefore, the present study was planned to analyses the pattern of drug utilization for the management of comorbidities in COVID-19 patients admitted in a COVID-dedicated tertiary care hospital in Northern India. To our best possible knowledge, this is the first study dealing with this information on Indian population.

A total of 406 case records of lab-confirmed COVID-19 positive patients having comorbidity (s) were reviewed in the present study. The male to female ratio was high, which is in agreement with a study carried out by Orlando *et al.*[7] Most of the study participants were middle-aged and had ≥1 comorbidity. In total, 88.18% participants had mild-to-moderate COVID-19 illness while it was severe in 11.82%. This is very less in comparison to other studies, wherein 15.7–29% of the total patients were reported to have severe disease.[8,9]

There is a significant association of disease severity with advancing age as an immune system is weaker in older patients and they have significantly lower lymphocyte counts. Generally, as a response to common viral infections, there is an increase in the number of lymphocytes; however, in severe acute respiratory syndrome (SARS) and COVID-19, lymphocytes are found to

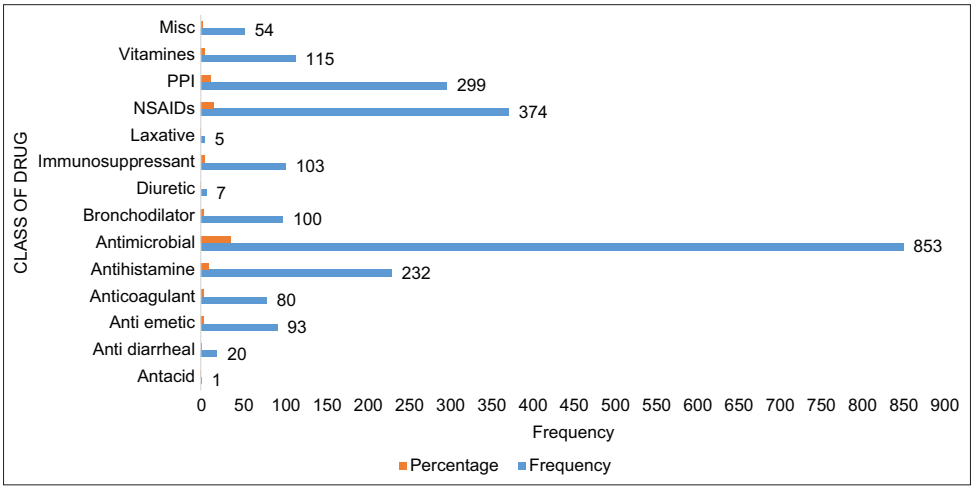


**Figure 1:** Drugs prescribed for the management of symptoms of COVID-19 among study participants (*N* = 2336)

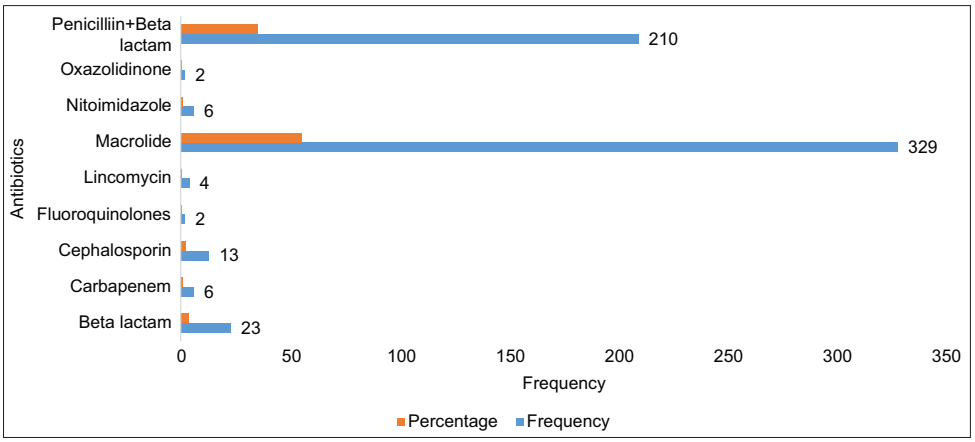


**Figure 2:** Different antibiotics prescribed among study participants for the management of symptoms of COVID-19 (*N* = 595)

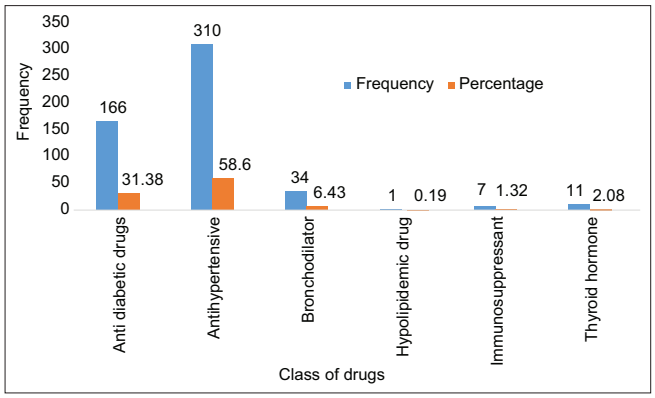


**Figure 3:** Drugs prescribed to the study participants for the management of comorbidity(s) (*N* = 532)

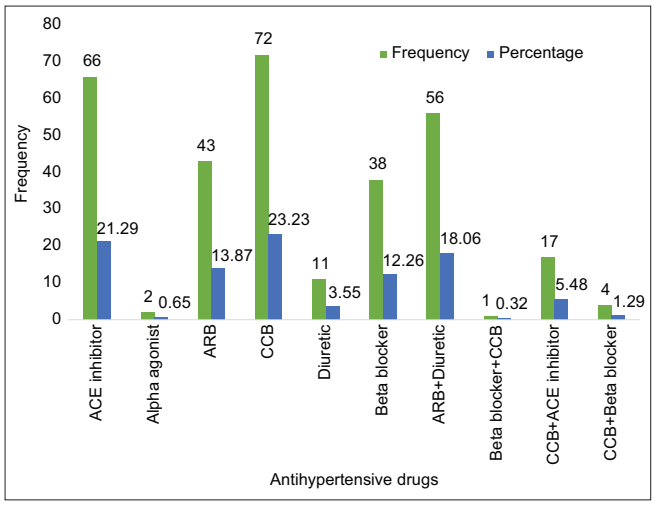


**Figure 4:** Different antihypertensive drugs prescribed to the study participants (*N* = 310)

be abnormally decreased. Albeit the reason for this paradox remains unclear, but this declining level of lymphocytes, more so in older patients, may provide a crucial hint on the severity of COVID-19 in patients. Further, in patients above 50 years of age, there is higher expression of angiotensin-converting enzyme 2 (ACE2) encoded by the *ACE2* gene as well as presence of other known factors like weak immune system, preexisting diseases, or compromised organ function that may be responsible for a greater risk of mortality.[10] In the present study, the most prevalent comorbidity(s) was found to be hypertension followed by diabetes with hypertension, diabetes, and COPD. Similarly, a retrospective study on 522 COVID-19 patients reported that the most prevalent comorbidity was hypertension followed by diabetes mellitus, bronchial asthma/COPD, coronary artery disease, chronic renal disease, and valvular heart disease.[11] COVID-19 was found to be more severe in patients with hypertension alone followed by diabetes with hypertension as a major comorbidity as compared to patients with other comorbidity(s). Similar results were reported in a study by Luo *et al.*[12]

The results of the present study have shown that mortality was higher in males and in patients with severe illness; maximum patients were in >50 years age group. These findings are in accordance with the results of Singh *et al.*,[13] which showed that a significantly increased case-fatality rate was associated with the presence of any comorbidity. In the present study, the average duration of hospital stay in males was longer than females. It was longest (6.76 days) in >50 years of age group and shortest (4 days) in the age group of 20–30 years. Our findings are in accordance with the results of a study conducted by Bhandari S *et al.*,[11] wherein the recovery time was within 5 days in 23.27% patients, while 52.58% patients took about 6–10 days, 23.27% patients took 11–15 days, and remaining 0.86% took more than 16 days to recover.

The drug utilization pattern amongst the study participants in the present study showed that a total of 2868 drugs were prescribed. Out of these, 2336 were prescribed for the management of COVID-19 symptoms and 532 were prescribed for the management of comorbidity(s).

The most commonly prescribed class of drugs for the management of symptoms of COVID-19 were antimicrobials (853, 36.52%), followed by NSAIDs (374, 16.01%), proton pump inhibitors (299, 12.80%), antihistamines (232, 9.93%), immunosuppressant

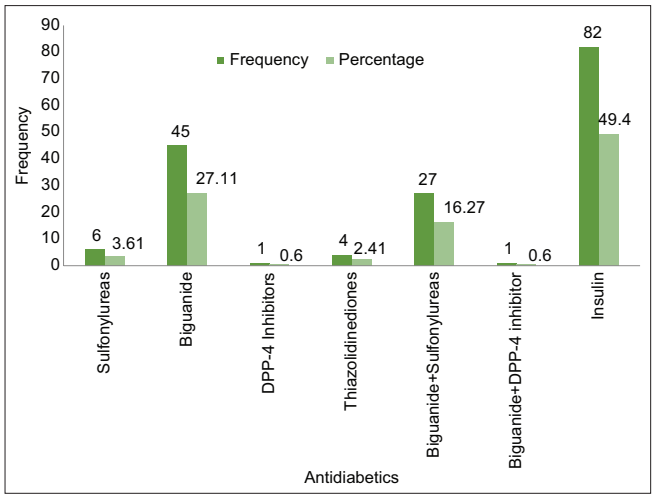


**Figure 5:** Description of the prescribed antidiabetic drugs (*N* = 166)

drugs (103, 4.41%), and others. According to the guidelines issued by Ministry of Health and Family Welfare, Government of India,[14] in mild-to-moderate cases, symptomatic treatment with an analgesic–antipyretic for fever and pain and antitussives for cough should be given along with Hydroxychloroquine (HCQ, an antimalarial drug) or Remdesivir (antiviral drug) (these were recommended at different point of time since the guidelines have been modified frequently). Use of prophylactic dose of UFH or LMWH (for anticoagulation) and corticosteroids, namely, methylprednisolone or dexamethasone (for immunosuppression) may be considered in those having high-risk factors for severe disease such as age >60 years; hypertension, diabetes, chronic lung/kidney/liver disease, cerebrovascular disease, and obesity; and under strict medical supervision.[14]

Patients in severe phase of illness have high levels of proinflammatory cytokines, such as interleukin (IL)-2, IL-6, IL-7 and tumor-necrosis factor-α. In this phase, patients can develop acute respiratory distress syndrome and multiorgan failure, which are the main causes of mortality due to COVID-19. According to a study by Recovery Collaborative Group *et al.* corticosteroids are beneficial in patients with COVID-19 as they mitigate the effects of the cytokine storm. The beneficial effect of dexamethasone was found to be greatest in the most severely ill patients.[14] Nearly 69.75% antibiotics were prescribed in the present study for the management of symptoms of COVID-19. Most bacterial pneumonias when caught early enough can be safely and effectively treated with antibiotics and for this purpose; broad-spectrum antibiotics are being widely used in patients with COVID-19.

The six most commonly prescribed drugs were paracetamol (15.24%), azithromycin (14.08%), monteleukast-levocetrizine (9.72%), piperacillin-tazobactam (8.99%), pantaprazole-domperidone (8.18%), and hydroxychloroquine (7.02%). Paracetamol has been used for fever and pain. Azithromycin appears to decrease virus entry into cells and also has antiviral activity. In addition, it can enhance the immune response against viruses by diverse actions. The immunomodulation property of azithromycin is the rationale for its use against inflammatory manifestations in COVID-19. The optimal timing for starting leukotriene-inhibitors, i.e., before severe pneumonia has set in, is crucial for achieving the desired immunomodulation in COVID-19 patients. Thus, the hospitalization rate, its duration, and mortality can be restricted by timely initiating leukotriene inhibitors. The possible pharmacological mechanisms that may confer antiviral properties to HCQ and thus account for its potential role in the prevention of COVID-19 infection and progression include its ability to: (i) interfering ACE2 receptor terminal glycosylation that is needed for viral entry, (ii) alteration of spike S protein glycosylation and binding to ACE2 receptor, (iii) inhibiting endosomal acidification, proteolytic processing, lysosomal activity, and autophagy in host cells, and (iv) immunomodulatory effects by reducing cytokine production.[15]

For managing comorbidity(s), a total of 532 drugs were prescribed. Out of these, the most commonly prescribed were antihypertensive (58.60%) drugs, followed by antidiabetic drugs (31.38%), bronchodilators (6.43%), thyroid hormones (2.08%), immunosuppressant drugs (1.32%), and others.

Among the various antihypertensive drugs, most frequently prescribed were calcium channel blockers (CCBs), while the least one was beta blocker + CCB. These findings are different from the study conducted by Gu *et al.*[16] in that diuretics were most frequently while angiotensin receptor blocker (ARB) was the least prescribed antihypertensive (s). Although typically dihydropyridine CCBs are used for managing hypertension, vasoconstriction in some pulmonary diseases can also be treated with CCBs. *SARS-CoV-2* infection has been implicated in the development of vasoconstrictive, proinflammatory, and prooxidative effects. In hospitalized elderly COVID patients, a better mortality rate and decreased need for ventilator support was observed with Nifedipine and Amlodipine. ACE2 receptors are the point of entry for SARS-CoV-2 into the host cell. Data is scarce and conflicting on the use of drugs affecting the renin-angiotensin-aldosterone system in COVID patients. Two hypotheses are put forth by the BRACE Corona trial design; one is suggestive of harmful impact of these drugs by causing an increase in ACE2 receptors expression, thus resulting in a potential increase in viral binding and entry while the other suggests that ACE inhibitors and ARBs could be protective as they may enhance angiotensin 1–7 production consequent to reduction in angiotensin II and thus may attenuate inflammation, fibrosis, and lung injury.[16]

Insulin (49.40%) was the most commonly prescribed antidiabetic, while the least common were DPP-4 inhibitors (0.60%). Diabetes weakens the immune response because of pathological alterations in cytokine production and activation of T-cells and macrophage. Further, poor glycaemic control also compromises certain aspects of immune response to a viral infection and adds to the risk of

potential bacterial secondary infection in the lungs. According to Soo Lim *et al.*[17] in mild-moderate COVID patients, DPP-4 and GLP1 analogues have good efficacy in lowering glucose levels in both in-patients and outpatients. However, to support their use in place of insulin in diabetics who are critically ill due to COVID, the available data remains insufficient. Few preclinical studies have reported an antiinflammatory effect of Metformin and its use in T2DM patients has shown to reduce the levels of circulatory inflammation biomarkers.

For MDIs, a combination of salbutamol-ipratropium bromide-budesonide (43.59%) was most commonly prescribed followed by Salbutamol alone (30.77%), Beclomethasone ($N = 4$, 10.26%), Budesonide alone ($N = 3$, 7.69%), and others. So far, the most promising preliminary data demonstrating nearly 30% reduction in mortality with the use of corticosteroids in COVID-19 have been reported from a RCT done in UK (RECOVERY). Janice M. Leung *et al.*[18] showed in their study that in COPD patients, use of ICS reduced the expression of ACE-2 in airway epithelial cells as compared to controls, suggesting a possible role of ICS in decreasing viral entry.

**Limitations of the study**: Since we had collected data from the records, so our data and their analysis is limited only to the information available in the records. More detailed patient information (mainly regarding history of comorbidity and treatment history, etc.) was not available to us for detailed analyses. Further, in majority of the records, blood investigations and other desired investigations and any mention of an ADR or symptoms suggesting any drug–drug interactions could not be found.

**Scope for further research**: This data can provide a substantial background for further analysis and interpretation especially focusing on the association of each class of drug used with clinical outcome of the participant.

## Conclusion

The information in the present study delineates the first picture of drug utilization among COVID-19 patients having comorbidity(s) in Northern India. For the management of COVID-19 symptoms, most commonly prescribed class of drug was antimicrobials and the most commonly prescribed antimicrobial drug was antibiotics. Macrolide was the most frequently prescribed antibiotic, while oxazolidinone and fluoroquinolones were the least prescribed. The most frequently prescribed antihypertensives were CCBs, and least prescribed was beta blocker+CCB. The most frequently prescribed antidiabetic drug was insulin, and DPP-4 inhibitors and Biguanide + DPP-4 inhibitor were the least prescribed.

## Ethics approval

Ethic approval letter no. RUHS-CMS/Ethics Comm./2020/95 dated 20.10.2020.

## Consent to participate

Not applicable.

## Consent for publication

Not applicable.

## Financial support and sponsorship

Nil.

## Conflicts of interest

There are no conflicts of interest.

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