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A Unified Decision-Making Technique for Analysing Treatments in Pandemic Context

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Abstract: The COVID-19 pandemic has triggered a global humanitarian disaster that has never been seen before. Medical experts, on the other hand, are undecided on the most valuable treatments of therapy because people ill with this infection exhibit a wide range of illness indications at different phases of infection. Further, this project aims to undertake an experimental investigation to determine which treatments for COVID-19 disease is the most effective and preferable. The research analysis is based on vast data gathered from professionals and research journals, making this study a comprehensive reference. To solve this challenging task, the researchers used the HF AHP-TOPSIS Methodology, which is a well-known and highly effective Multi-Criteria Decision Making (MCDM) technique. The technique assesses the many treatment options identified through various research papers and guidelines proposed by various countries, based on the recommendations of medical practitioners and professionals. The review process begins with a ranking of different treatments based on their effectiveness using the HF-AHP approach and then evaluates the results in five different hospitals chosen by the authors as alternatives. We also perform robustness analysis to validate the conclusions of our analysis. As a result, we obtained highly corroborative results that can be used as a reference. The results suggest that convalescent plasma has the greatest rank and priority in terms of effectiveness and demand, implying that convalescent plasma is the most effective treatment for SARS-CoV-2 in our opinion. Peepli also has the lowest priority in the estimation.

Keywords: AHP-TOPSIS; hesitant fuzzy sets; SARS-CoV-2; healthcare sector; preventive drugs

1 Introduction

A new virus with new and distinctive protein attachment and distribution configurations appeared as a tragedy in Wuhan, China, in December 2019. Following that, the World Health Organization (WHO) proclaimed the virus occurrence a worldwide pandemic in early January 2020, naming the unknown unique virus the Severe Acute Respiratory Syndrome Corona virus (SARS-CoV-2). Furthermore, the disease caused by the virus SARS-CoV-2 is defined using COVID-19 terminology. COVID-19 has been a forerunner of irreversible injury, with an estimated global death toll of WHO. As COVID-19 instances continue to rise, the globe is stimulating for even additional unpredictable times forward, with no vaccination as a preventive strategy and no uniform and conventional therapy or medication approach [1] available. The most difficult aspect of treating this sickness, according to medical professionals, is the virus's unexpected nature [2]. COVID-19 individuals exhibit a wide array of indications; while circumstances of COVID-19 can sort from moderate to severe, other patients remain completely asymptomatic and linger to shed the virus without being infected. COVID-19 is thus an illness with a significant mortality rate. Even doctors treating COVID-19 patients are having trouble prescribing a first medicine and drug training that will uniform the patients and provide a real treatment.

Quarantine and lockdown/shutdown are the only prophylactic measures now proposed for breaking the COVID-19 transmission chain. Though, they are not, a long-term explanation [3] to the difficult. Numerous researches by altered workshops and separate investigators are already ongoing in the hopes of discovering a viable vaccination and creating a structured course of treatment to cure COVID-19. Among these are the efforts of Oxford University, a pharmaceutical company Inovio, and a US laboratory that is a focal point for vaccine research in the United States, among others, whose vaccine samples are currently being tested.

Doctors are currently treating COVID-19 patients symptomatically, which means that the drug administered is exclusively based on the patients' symptoms [2]. By the support of before recognised and deep-rooted action regimens, researchers are successfully determining the treatment for the COVID-19. This ambiguous environment serves as the backdrop for an in-depth research question that must describe the various treatment options for COVID-19 cases in order to convey simplicity and ambiguity-free corrective treatments. To address this investigation prospect, the suggested study uses a hesitant fuzzy decision-making method to summarise and then quantify the success of the numerous courses of therapy quantitatively that are under trial for discussing SARS-CoV-2 infected individuals. This type of classification of treatment approaches is meant to aid clinicians in their efforts to choose the best treatment for infected patients based on the available data.

The medical community is dealing with a highly complex problem due to the heterogeneity in curing patients of COVID-19 pandemic due to the lack of a standard therapeutic strategy. To solve and lessen the stated complexity for medical specialists, the authors of this study used a Multi-Criteria Decision Making (MCDM) Methodology [2–9]. In critical instances of multi-criteria decision, the MCDM tactic is an established and powerful scientific procedure that produces crisp and real solutions. In today's world, there are numerous MCDM approaches to choose from. There are 30 MCDM [4] techniques, according to Wikipedia. The Analytical Hierarchy Process (AHP) is a well-known and commonly utilised MCDM procedure. However, there are certain consequences in AHP, such as when a decision-maker is unable to determine the value for a factor from the hierarchy and want to increase or reduce the prescribed value, but the approach provides no options [2]. To address this issue in the evaluation, the Hesitant Fuzzy Set (HFS) procedure was proposed, which aids decision-makers in selecting their preferred factor valuation. When compared to other MCDM methodologies,

this sort of calculation produces more precise and unambiguous results. Furthermore, for the purposes of this work, the authors used a hybrid hesitant fuzzy AHP-TOPSIS technique to assess the efficacy of several COVID-19 therapy options.

Furthermore, the study's analysed findings, which are based on technical validation, a novel knowledge, and methodical classification, will aid the examination team, as well as doctors and medical professionals, in adopting a standardised pharmaceutical approach. The empirical tabulations from this study will make a substantial contribution to healing SARS-CoV-2 sick people and will mark a watershed moment in advanced medicine research using decision-making approaches.

The remainder of this work is organised as follows: the second portion depicts a perspective on past Coronavirus data for comprehension, and the third segment depicts the earlier literature inspection connected to drug cataloguing using a decision-making method. The paper's fourth segment displays and describes the chosen Coronavirus preventative medications, and the fifth and sixth sections, respectively, define the approved procedure and its numerical assessment. The study's seventh segment addresses the evaluated results from multiple perspectives, and the paper's eighth section finishes with a discussion of the paper's limitations and benefits.

2 Materials and Methods

2.1 COVID Outbreak Census and Condition

Given the severity of the SARS-CoV-2 crisis, it's critical to look at COVID-19 statistics and assess the virus's impact on different countries and regions. According to the WHO [5], the number of verified corona cases worldwide was 10,117,687 at the time of writing this study article, with 502,278 deaths. There are a variety of resources that provide SARS-CoV-2 information, however the authors chose to study the data provided and published by the WHO for correctness and validation. In addition, Tab. 1 shows the data for weekly detected cases and deaths in various WHO-categorized regions [6]. After a few weeks of normal infection ratio, a review of the statistics in Tab. 1 clearly shows that there was an abrupt distribution pattern and sudden surge in COVID-19 cases around the world. By the third week of the pandemic, every location in the world had zero deaths and a maximum of 14 infected people (Tab. 1). The virus required some time to trace a dramatic growth curve, according to the per week instances tally. This may be seen in all locations and countries. This spread pattern shows that if researchers can identify and establish an effective course of therapy for COVID-19 patients, clinicians will be able to recognise and cure the patients at an early stage, preventing the loss of life.

To better understand the SARS-CoV-2 death pattern and ratio, the authors calculated the per week death percentage ratio for each selected location using the data in Tab. 1. The following Tab. 2 shows the calculated per week death percent ratio. Furthermore, an average assessment of each region reveals that the death rate in each of these areas is less than 10%. Europe has the highest fatality rate at 8.62 percent, followed by the United States at 3.39 percent, the Eastern Mediterranean at 3.36 percent, Southeast Asia at 2.80 percent, and Africa at 1.76 percent. Furthermore, the average death ratio indicates that while the virus is not very fatal, its dissemination is greater than that of other viruses. This type of analysis shows that by filling the existing void in treating SARS-CoV-2 infections, the fatality rate can be dramatically lowered.

Table 1: Per week cases in different regions

Weeks (Started from Jan 20, 2020)	America		Europe		Eastern mediterranean		South-East Asia		Africa	
	Infected	Deaths	Infected	Deaths	Infected	Deaths	Infected	Deaths	Infected	Deaths
1	6	0	3	0	0	0	4	0	0	0
2	6	0	22	0	5	0	17	0	0	0
3	7	0	14	0	2	0	14	0	0	0
4	3	0	8	2	3	0	2	0	0	0
5	22	0	126	2	48	8	1	0	0	0
6	42	0	1995	34	685	35	7	1	2	0
7	273	12	10,050	381	6,225	158	58	0	26	0
8	2168	35	43,403	2,112	8,393	539	262	6	633	3
9	17158	205	9,800	6568	9,800	993	2,281	49	2,256	17
10	1,01,113	1681	2,11,749	15962	20,746	1064	2,281	96	2,256	32
11	1,94,916	6254	2,59,523	25517	27,170	1158	4,277	160	3,372	183
12	2,58,194	13344	2,59,949	28693	25,622	1122	7,920	416	3,310	208
13	2,47,952	21023	2,37,534	26891	29,806	932	11,930	511	4,164	185
14	2,72,986	18604	2,06,291	21785	36,864	965	16,617	536	6,423	211
15	2,89,795	22482	1,89,900	15910	40,635	983	20,479	616	9,121	225
16	2,96,607	16635	1,88,977	12260	56,899	1020	31,517	993	13,190	305
17	3,08,497	19844	1,62,215	9763	72,185	939	38,448	1027	16,037	341
18	3,72,530	19849	1,36,100	7200	80,718	1072	54,036	1386	18,632	363
19	3,99,480	18807	1,35,035	6061	89,195	1365	69,943	1716	23,315	481
20	4,73,120	20619	1,26,003	5710	1,18,683	1973	86,527	2159	30,714	594
21	4,76,893	19858	1,30,348	4346	1,34,867	2314	1,04,897	2854	36,242	850
22	5,68,086	19892	1,28,840	3931	1,38,852	3435	1,25,094	4687	49,433	876
23	6,54,118	22787	1,28,579	3468	1,26,819	3374	1,55,321	3408	61,816	911

Table 2: Per week death ratio in different regions

Weeks (Started from Jan 20, 2020)	America	Europe	Eastern mediterranean	South-East Asia	Africa
1	0.00%	0.00%	0.00%	0.00%	0.00%
2	0.00%	0.00%	0.00%	0.00%	0.00%
3	0.00%	0.00%	0.00%	0.00%	0.00%
4	0.00%	25.00%	0.00%	0.00%	0.00%
5	0.00%	1.25%	16.66%	0.00%	0.00%
6	0.00%	1.70%	5.10%	14.28%	0.00%
7	4.40%	3.79%	2.54%	0.00%	0.00%
8	1.61%	4.87%	6.42%	2.29%	0.47%
9	1.19%	67.02%	10.13%	2.15%	0.75%
10	1.66%	7.54%	5.13%	4.21%	1.42%
11	3.21%	9.83%	4.26%	3.74%	5.43%
12	5.17%	11.04%	4.38%	5.25%	6.28%

(Continued)

Table 2: Continued

Weeks (Started from Jan 20, 2020)	America	Europe	Eastern mediterranean	South-East Asia	Africa
13	8.48%	11.32%	3.13%	4.28%	4.44%
14	6.82%	10.56%	2.62%	3.23%	3.29%
15	7.76%	8.38%	2.42%	3.01%	2.47%
16	5.61%	6.49%	1.79%	3.15%	2.31%
17	6.43%	6.02%	1.30%	2.67%	2.13%
18	5.33%	5.29%	1.33%	2.56%	1.95%
19	4.71%	4.49%	1.53%	2.45%	2.06%
20	4.36%	4.53%	1.66%	2.50%	1.93%
21	4.16%	3.33%	1.72%	2.72%	2.35%
22	3.50%	3.05%	2.47%	3.75%	1.77%
23	3.48%	2.70%	2.66%	2.19%	1.47%

Furthermore, the linear representation and tabular depiction of data in Fig. 1 and Tab. 2 reveal that the virus's effect and activity are comparatively modest in the first four weeks of its propagation when compared to the next five to twenty-three weeks. The figures show that the situation of cases around the world is severe and concerning. According to records, America is the world's most impacted region, followed by Europe, the Eastern Mediterranean, and then Southeast Asia. COVID-19 has the least impact on Africa of all the areas. However, while the preceding figures indicate the global spread and new cases, the death ratio is also important in this situation. In a comparison of active cases, the death rate is substantially lower.

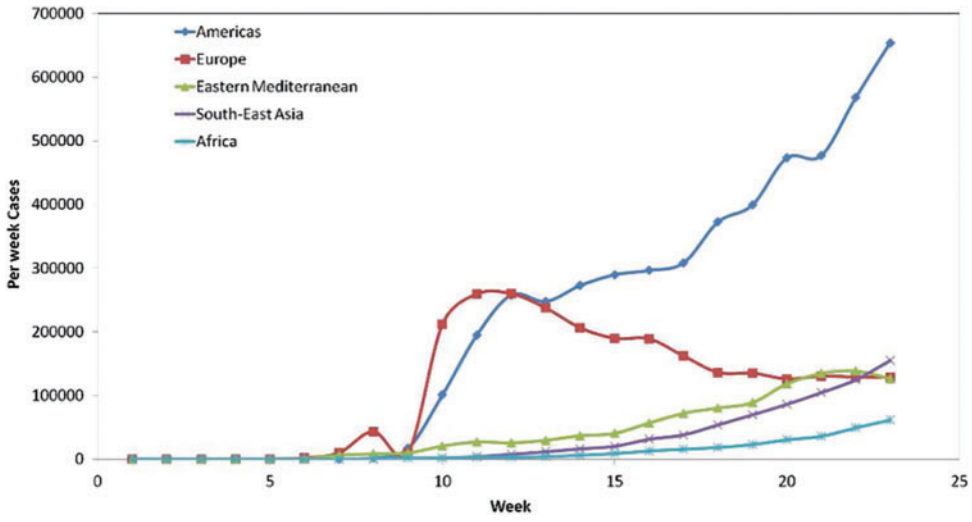

Figure 1: Graphical representation of cases

Several research studies show that immediate lockdowns/ shutdowns imposed by various governments have not resulted in highly convincing gains in the prevention of SARS-CoV-2. According to a study on the state and impact of lockdown in India, there are no effective benefits of lockdown if

the government does not accurately identify, pick, and restrict diseased and susceptible people [7]. The report also depicts the predicted dynamics of SARS-CoV-2 for three Indian states, clearly indicating that the states require greater medical infrastructure and resources to combat COVID-19. Due to the similar dynamics and pattern of transmission, this type of research is equally useful in identifying and analysing the virus's position in other nations. Many dynamic forecasting papers [8,9] with varied methods and approaches are available for various nations. However, most of these papers have one thing in common: they all forecast a significant increase of COVID-19 cases in the next months.

In light of the bleak backdrop described in the preceding paragraph, the current study is motivated by the desire to develop a standard solution for SARS-CoV-2 that will assist doctors and experts in selecting the most effective prognosis for COVID-19 victims in a shorter time frame while keeping the mortality rate low.

2.2 COVID-19 Treatment

The COVID-19 outbreak has been deemed a major public health crisis. Doctors and researchers in the healthcare profession are seeking therapeutical approaches that they believe are best matched to the patient's physical makeup in order to reduce mortality and boost recovery rates. As a result, treatment for COVID-19 instances has included Allopathy, Unani, and Ayurveda.

We reviewed the numerous studies that cover the courses of therapy for COVID-19 in the proposed study, as well as the opinions of medical professionals on the subject. Following this, a hierarchical model of the therapy procedures has been created that were chosen. Fig. 2 shows a model of potential preventive medications produced by the authors for evaluation. Because of their great effect and significance in modern treatment procedures, the study solely summarised the Allopath, Unani, and Ayurveda as primary therapy patterns.

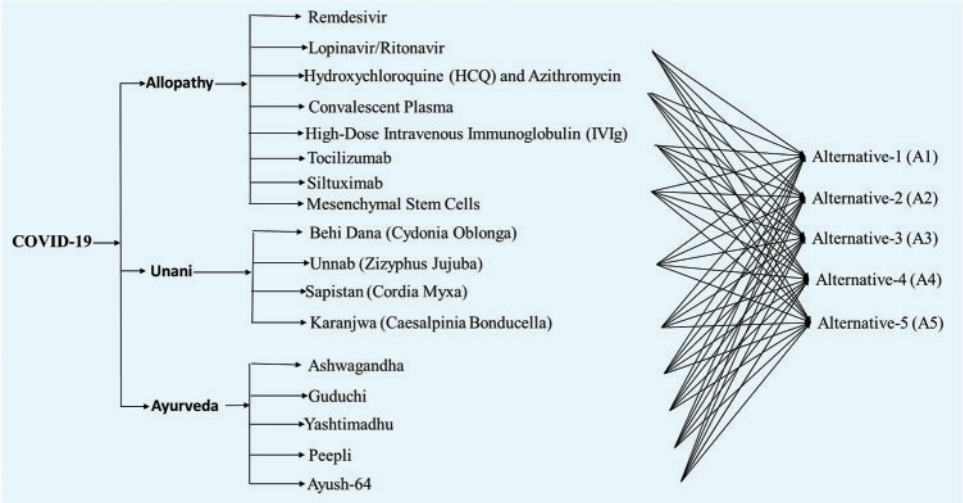

Figure 2: Hierarchical view of selected preventive treatments

2.2.1 Use of Allopathy

Allopathy is a useful, rapid, and cutting-edge [10–13] style of therapy. The consequences of allopathic medications are worldwide efficacious and acceptable. We nominated eight treatments that

are presently being employed for COVID-19 treatment for our tree structure. The therapy selection is conducted by specialists proposal computation. The following is an details:

Remdesivir: Various research groups and experts are looking at the role of remdesivir (C17H35N6O8P) in the treatment of COVID-19 disease. It comprises a nucleotide analogue that has a high antiviral effectiveness ratio. According to a study of patients of COVID-19 disease treated with remdesivir as a compassionate-use drug, 61 patients of COVID-19 disease received at least one dosage of this medicine. The data of 8 patients could not be computed due to a technical issue, but the data of the remaining patients revealed that the overall improvement ratio was 68 percent [14]. The works's conclusions are that remdesivir is a valuable medicine against COVID-19 disease.

Lopinavir/Ritonavir: Although the drug (C37H48N6O5S2) is mostly used to treat Human Immunodeficiency Virus/Acquired Immunodeficiency Syndrome (HIV/AIDS), experts and tests show that it may also be used to treat corona sufferers. On positive COVID-19 patients, a random, open-label, controlled study of lopinavir/ritonavir was done. Furthermore, 47 COVID-19 patients were chosen for inspection in another trial using the same medicine, with 43 patients receiving lopinavir/ritonavir treatment and 5 patients receiving standard therapy. The lopinavir/ritonavir therapy group returned to normal body temperature faster than the other groups [15]. The researchers feel that the results of the study, as well as the effect of the medication on a day-to-day basis, indicate that future research and trials using lopinavir/Ritonavir for treating COVID-19 patients, will generate better results.

Hydroxychloroquine (HCQ) and Azithromycin: In the treatment of SARS-CoV-2, HCQ and azithromycin have shown to be efficient and effective [16]. A research with 26 COVID-19 patients was presented by Gautret et al. During treatment with 200mg HCQ three times a day, 70% of the patients had negative PCR results, according to the study. Only six patients had azithromycin added to their treatment regimen, although it was found to be highly successful in treating SARS-CoV-2 [16]. Furthermore, based on research findings, numerous doctors have begun to employ HCQ and azithromycin to treat Coronavirus.

Convalescent Plasma: It's an experimental but effective treatment of COVID-19 pandemic. Convalescent plasma is a treatment procedure in which doctors use the blood of COVID-19 patients who have recovered from the disease to treat active individuals. Patients who recover from SARS-CoV-2 produce antibodies in their blood, which are employed to treat COVID-19 patients by medical professionals. This treatment is currently being used all over the world. The outcomes are very pleasing [17] and highly recommendable in Delhi, India. "Plasma therapy is the most successful and traditional treatment course that has had huge favourable benefits in prior virus infections as well," says renowned doctor and medical expert Dr. Budhirja [17]. The treatment approach was applied for 5 COVID-19 patients in order to examine the actual effect of the therapy. Four to five patients' body temperatures returned to normal within three days of treatment, according to the findings. In these individuals, the Sequential Organ Failure Assessment (SOFA) score also fell. The viral load was also zero after 12 days after transfusion [18]. In conclusion, the therapy has a positive and successful consequence, but experts believe that the treatment procedure needs to be scrutinised and improved further.

High-Dose Intravenous Immunoglobulin (IVIg): The procedure of treating patients with a blood serum manufactured from 1000 to 15000 donors every batch is known as IVIg. In the body, the manufactured serum possesses antibody properties and acts as an anti-disease drug [19]. Furthermore, Cao et al. presented a therapy research in which three severe corona patients were given a high dose of IVIg. The study's findings revealed that all three patients were effectively treated [20].

Tocilizumab: It's an immunosuppressive medication commonly employed to treat rheumatoid arthritis (RA) and systemic juvenile idiopathic arthritis (SJIA). Attacks of COVID-19 disease the

Interlukin 6 (IL-6) pathway in the body, according to Xu et al. They also attempted treating patients with tocilizumab, which has a high valuable ratio against the interleukin-6 receptor (IL-6R). The treatment practice was examined, and it was discovered that the body's temperature returned to normal on the first day of treatment, as well as that other illness indications were valuable minimised and controlled. After 5 days of tocilizumab treatment, 15 to 20 patients' oxygen intake decreased. There were no side effects or deaths reported during or after the treatment [21]. As a result, the medication is suggested for the treatment of severe Corona cases.

Siltuximab: Siltuximab is a drug that targets IL-6 in the body. It is used to treat prostate cancer as well as other disorders. Thirty patients were treated with siltuximab in the context of curing COVID-19 instances, and the results showed that the average mean follow-up value in siltuximab treated patients was 33.3 days [22]. Although the results are not entirely convincing and effective, practitioners feel that siltuximab can be helpful as an asymptomatic preventative medication.

Mesenchymal Stem Cells: Mesenchymal stem cells are multipotent stem cells found in bone marrow that repair and create skeletal tissues in the body. The transplantation of these cells has shown to be valuable in the treatment of Corona patients. A study was conducted on 7 active patients of COVID-19 disease in order to determine the effect of Mesenchymal Stem Cells. After 2-45 days of transplant, all relevant COVID-19 disease illness indications, such as shortness of breath, weakness, high fever, and others, were observed to be reduced [23]. Mesenchymal stem cell transplant, according to researchers [23], is a valuable and secure treatment option for patients of COVID-19 disease.

2.2.2 Unani

Unani medicine is a traditional system of medicine that dates back to the Middle Ages and treats patients with natural medications derived from plants, animals, and minerals. Traditional medical systems are being investigated for providing preventive, supportive, and rehabilitative care to patients in epidemics and pandemics. While there is no direct evidence, certain uncontrolled investigations on traditional medicines show that they may have direct antiviral activity. In their classical Unani writings, under the chapter on influenza, Unani physicians emphasised pandemic (Nazla Wabai/ Nazla Haar) and epidemic infections.

During an epidemic, renowned Unani Scholars advised staying at home and fumigating shelters with aromatic plants such as Ood kham (*Aquilaria agallocha* Roxb.), Kundur (*Boswellia serrata* Roxb.), Kafoor (*Cinnamomum camphora* L.), Sandal (*Santalum album* L.), Hing (*Ferula foetida* L.), and others. Antidotes (Tiryaqe Wabai, Tiryaqe Arba, Tiryaqe Azam, Gile Armani), Herbal Decoction (Joshandah), Sharbate Khaksi, Habbe Bukhar, Sharbate Zanjabeel, Khamira Marwareed, Jawarish Jalinus, and Sirka are among the Unani formulations that have been claimed to be effective in the management of epidemics and (vinegar). Antioxidant, immunomodulatory, cardiotonic, and general tonic properties are claimed for these medicines. The study lists the works on epidemic management in Unani medicine and aims to compare and contrast them in terms of COVID-19 prevention and management.

Behi Dana (Cydonia Oblonga): In traditional medicine, *Cydonia oblonga* has been used to treat a wide range of ailments since ancient times. Nephroprotective, anti-atherosclerotic, antibacterial, anti-hypertensive, anti-allergic, antioxidant, aphrodisiac, hepatoprotective, antispasmodic, antimicrobial, hypolipidaemic, anti-inflammatory, and anti-cancer properties have been demonstrated in research. Scientific research have backed up the claims of the traditional medical system. To establish it as a standard medicine, further detailed clinical study is needed to investigate its medical benefits. MOA

has approved the trial of Behi Dana for use in SARS-CoV-2 treatment since it is an antioxidant, immunomodulator, antiallergic, and anti-flu [24].

Unnab (Zizyphus Jujuba): The Rhamnaceae family includes *Ziziphus jujuba*, which is named after the genus Rhamnus. Drupes are drupes, which are dry fruits. Ziziphus is derived from the North African Coastal Arabic term zizoufo, the Old Persian words zizfum or zizafun, and the ancient Greek word ziziphon, all of which were used to describe jujube. *Z. mauritiana* Lam. (Indian jujube, or ber) and *Z. jujuba* Mill are the two most prevalent domesticated jujubes (the Chinese or common jujube). These two species have been widely farmed around the world. Many Ziziphus species produce edible fruits, which are prepared in a variety of ways. MOA has approved the trial of Zizyphus Jujuba as an anti-influenza, immunomodulator, and antioxidant for use in SARS-CoV-2 treatment [25].

Sapistan (Cordia Myxa): Cordia myxa is a flowering plant that belongs to the Boraginaceae family of plants. It's a medium-sized deciduous tree with broad leaves. Assyrian plum, lasura, laveda, pidar, panugeri, naruvilli, geduri, spistan, burgund dulu wanan, and ntege are some of the common names. It grows mostly in Asia, but also in other parts of the world, particularly in tropical places with the correct kind of geophysical environment. Because Cordia Myxa is an immunomodulator, tracheal smooth muscle relaxant, and anti-oxidant, MOA has approved its use in SARS-CoV-2 treatment [26].

Karanjwa (Caesalpinia Bonducella): Malaria fever, leucorrhea, abdominal pain, rheumatoid arthritis, diabetes, cystic fibrosis, and amenorrhea are just a few of the diseases and disorders that the plant Caesalpinia Bonducella is used to treat across Africa and Asia. Using the FCR-3/A2 falciparum clone in vitro, Kalauni et al. [27] investigated the antimalarial potential of 44 cassane- and norcassane-type diterpenes isolated from cultivars harvested in Myanmar and Indonesia. MOA has approved the trial of Caesalpinia Bonducella in the treatment of SARS-CoV-2 since it is an antipyretic, antibacterial, anti-inflammatory, and immunomodulator [28].

2.2.3 Ayurveda

Ayurveda is India's purest and oldest type of therapy, dating back thousands of years. Ayurvedic medicine includes eight different forms of treatment [24–29] to treat every condition and body area. Ayurvedic medicine is well-known for having minimal side effects and, in addition to healing the illness, effectively eliminates the disease's fundamental cause. Several academics and alternative medicine practitioners trust that Ayurveda has the ability and capabilities [25] to effectively treat patients of COVID-19. More importantly, Ayurveda medications are a highly recommended form of treatment and are suggested [26] by doctors in both India and other nations. Ayurveda is the world's oldest system of medicine [26], with its unique significance and effects on a variety of complex ailments. The authors have included an examination of ayurveda medicines in the current study because of Ayurveda's fundamental involvement in modern medical science. In order to communicate with Indian experts and identify a successful cure for SARS-CoV-2 in Ayurveda, US researchers sought the Indian embassy in America [27]. The authors of the suggested study discovered that the first Corona patient from India underwent regular Ayurvedic care. Girija et al. examined and described the therapy results. According to the study, the patient is 43 years old and has a medical history. Furthermore, the patient had been receiving ayurvedic treatment for a previous sickness. The results demonstrate that after treating the patient with ayurvedic medicines, the symptoms of the Coronavirus decreased day by day [28]. We checked the efficacy levels of numerous authorised authorities of Ayurveda to build a more realistic context for our research analysis on ayurvedic medications.

Ashwagandha: Withania somnifera is the scientific name for this Ayurveda herb. Ashwagandha has been used in Indian traditional medicine for ages. According to study, ashwagandha has a great

likelihood of treating Coronavirus patients. According to one study, ashwagandha is a highly effective herb that can be utilised to treat corona patients [29,30].

Guduchi: Guduchi is the second ayurvedic medicine that the Indian government is testing as part of a treatment plan for corona sufferers. Guduchi contains strong immunomodulatory properties that improve and raise the body's immunity as well as produce a strong antiviral system [31]. The government and academics are convinced that conducting a thorough and systematic study of Guduchi for corona treatment will yield favourable and beneficial findings.

Yashtimadhu: Another ayurvedic medication is being investigated by India's Ministry of Ayush. Mulethi, also known as Yashtimadhu, has advanced and advantageous effects on Coronavirus's primary protease, spike protein, and RNA polymerase, as well as the ACE2 receptor and furin protease. According to a study, yashtimadhu has a high potential for treating SARS-CoV-2 [32]. The scientific community is certain that this herb's inherent property should be exploited further.

Peepli: Peepli is commonly used in traditional Indian medicine to cure colds and coughs. Several research works [33,34] describe and deduce the significance of peepli. The Ministry of Ayush, Government of India, has urged more research on Peepli to cure Corona symptoms [35].

Ayush-64: Ayush-64 is a malaria treatment that has no side effects [20]. Malaria allopathic treatments have negative side effects on the human body. MOA has approved the testing of Ayush-64 for use in SARS-CoV-2 treatment because the symptoms of COVID and Malaria are comparable [29].

The doctors will be able to prescribe a single therapy course for COVID-19 patients based on the success of the treatments. The adopted approach and thorough tabulations are mapped in the next section in order to achieve this goal.

2.3 Methodology

Because numerous therapies for COVID-19 are being tested or researched, it became necessary to use the MCDM tactic to develop valuable selection criteria for mapping the tree structure that would decide the best treatment. In this aspect, the AHP is one of the utmost reliable and tested MCDM strategies. Although comparison matrixes formed during the computation of AHP tactic produce reliable results, many researchers feel that the tactic produces unclear results in certain situations, such as when the number of choices is considerable. We involved the TOPSIS tactic, which delivers more exact results [36,37], to limit the impact of tactic.

Furthermore, in light of the importance of the subject mentioned in the paper, the authors used the hesitant fuzzy tactic in the fuzzy AHP-TOPSIS tactic as a valuable extra tactic for producing precise answers free of any ambiguity and consequences. As a result, the HF-AHP tactic is used to weight the various medications for the COVID-19. After that, the HF-TOPSIS tactic is utilised to choose the best function or alternative for the medications that have been chosen. The complete computation practice has been broken down into 15 steps, which are listed below:

Step 1: Creating a tree arrangement with summarised and nominated qualities or components (in our case, therapies) to allow for proper estimation.

Step 2: It's also crucial to know what kind of output the HF-AHP procedure expects after you've created the evaluation hierarchy. Tab. 3 was created to help grasp the different ranks and their language words for the accepted methodology.

Table 3: Standard scale

Rank	Abbreviation	Linguistic term	Triangular fuzzy number
10	AHI	Absolutely High Importance	(7.0000, 9.0000, 9.0000)
9	VHI	Very High Importance	(5.0000, 7.0000, 9.0000)
8	ESHI	Essentially High Importance	(3.0000, 5.0000, 7.0000)
7	WHI	Weakly High Importance	(1.0000, 3.0000, 5.0000)
6	EHI	Equally High Importance	(1.0000, 1.0000, 3.0000)
5	EE	Exactly Equal	(1.0000, 1.0000, 1.0000)
4	ELI	Equally Low Importance	(0.3300, 1.0000, 1.0000)
3	WLI	Weakly Low Important	(0.2000, 0.3300, 1.0000)
2	ESLI	Essentially Low Importance	(0.1400, 0.2000, 0.3300)
1	VLI	Very Low Importance	(0.1100, 0.1400, 0.2000)
0	ALI	Absolutely Low Importance	(0.1100, 0.1100, 0.1400)

Step 3: Assume T0 has the lowest and Tg has the highest importance from Tab. 3 with relation to step 2. The assessment between Ti and Tj, on the other hand, is T0≤ Ti ≤ Tj ≤ Tg. Eq. (1) is used to calculate the calculated weight average for the n factor:

$$\mathrm{OWA}\,(\mathrm{a}_1, \mathrm{a}_2, \ldots \mathrm{a}_\mathrm{n}) = \sum_{\mathrm{j}=1}^{\mathrm{n}} \mathrm{W}_\mathrm{j}\mathrm{b}_\mathrm{j} \tag{1}$$

where, $W = (w_1, w_2, \ldots . w_n)^S$ is the vector recognized for weighting from rule $\sum_{i=1}^{n} W = 1$ and b_j describes the higher equivalent of $a_1, a_2, \ldots . . a_n$. Thereafter, for computing these equations, the trapezoidal number $\tilde{C} = (a, b, c, d)$ is calculated through Eqs. (2)–(5).

$$a = min\left\{a_L^i, a_M^i, a_M^{i+1}, \ldots \ldots a_M^j, a_R^j\right\} = a_L^i \tag{2}$$

$$d = max\left\{a_L^i, a_M^i, a_M^{i+1}, \ldots \ldots a_M^j, a_R^j\right\} = a_R^j \tag{3}$$

$$b = \left\{ \begin{array}{c} a_M^i, ifi + 1 = j \\ OWA_w^{2\left(a_m^j, \ldots . . a_m^{\frac{i+j}{2}}\right), ifi+jiseven} \\ OWA_w^{2\left(a_m^j, \ldots . . a_m^{\frac{i+j+1}{2}}\right), ifi+jisodd} \end{array} \right\} \tag{4}$$

$$c = \left\{ \begin{array}{c} a_M^{i+1}, ifi + 1 = j \\ OWA_w^{2\left(a_m^j a_m^{j-1}, \ldots . . a_m^{\frac{(i+j)}{2}}\right), ifi+jiseven} \\ OWA_w^{2\left(a_m^j, a_m^{j-1} \ldots . . a_m^{\frac{(i+j+1)}{2}}\right), ifi+jisodd} \end{array} \right\} \tag{5}$$

After these estimations, the inspectors want to classify the 1st and 2nd type weights through η, as well as classify the number [0,1], with the help of Eqs. (6) and (7). For estimating 1st type weight and 2nd type weight:

$$w_1^1 = \eta_2, w_2^1 = \eta_2 (1 - \eta_2), \ldots\ldots\ldots w_n^1 \eta_2 (1 - \eta_2)^{n-2} \tag{6}$$

$$w_1^2 = \eta_1^{n-1}, w_2^2 = (1 - \eta_1) \eta_1^{n-1} \tag{7}$$

Here, from the equations $\eta_1 = \dfrac{g - (j-1)}{g-1}$, and $\eta_2 = \dfrac{g - (j-1)}{g-1}$ where g is the higher rank from Tab. 3.

Step 4: The pair-wise comparison matrix ($\tilde{A}$) is finalized through Eqs. (8) and (9).

$$\tilde{A} = \begin{bmatrix} 1 & \cdots & \tilde{c}_{1n} \\ \vdots & \ddots & \vdots \\ \tilde{c}_{n1} & \ldots & 1 \end{bmatrix} \tag{8}$$

$$\tilde{c}_{ji} = \left(\frac{1}{cij_u}, \frac{1}{cij_{m2}}, \frac{1}{cij_{m1}}, \frac{1}{cij_1} \right) \tag{9}$$

Step 5: The examiners employed Eq. (10), which is used for defuzzing, to get crisp numbers from trapezoidal numbers.

$$\mu_x = \frac{l + 2m_1 + 2m_2 + h}{6} \tag{10}$$

Thereafter, the value of CR (Consistency Ratio) is assessed via. Eqs. (11) and (12).

$$CI = \frac{\gamma_{max} - n}{n-1} \tag{11}$$

$$CR = \frac{CI}{RI} \tag{12}$$

In Eqs. (11) and (12), the CI and λmax exemplifies the consistency index and highest eigenvector of matrix. In addition, n is factor number where calculation is continuing and RI signifies the random index value.

Step 6: The geometric mean for every row is assessed through Eq. (13).

$$\tilde{r}_i = \left(\tilde{c}_{i1} \otimes \tilde{c}_{i2} \ldots\ldots \otimes \tilde{c}_{in} \right)^{\frac{1}{n}} \tag{13}$$

Step 7: The weights for highest factor are assessed through Eq. (14).

$$\tilde{w}_i = \tilde{r}_1 \otimes \left(\tilde{r}_1 \oplus \tilde{r}_2 \ldots\ldots \tilde{r}_n \right)^{-1} \tag{14}$$

Step 8: All the fuzzy values of matrix are defuzzified, with the help of Eq. (15).

$$\mu_x = \frac{l + 2m_1 + 2m_2 + h}{6} \tag{15}$$

Step 9: After recognizing the defuzzified values, the normalized values are deliberated with the help of Eq. (16).

$$\frac{\tilde{w}_i}{\sum_i \sum_j \tilde{w}_j} \tag{16}$$

Following step 9, the HF-TOPSIS approach must be used to identify and find the most suited and best choice. The TOPSIS procedure is one of the most elegant and straightforward methods to selecting and evaluating amazing alternatives for real-world issues [38], such as the one under consideration in this work. In comparison to other methodologies, the TOPSIS technique generates outcomes that are the farthest away from the negative perspective and the closest to the positive perspective. Further, for this preventive drug evaluation study, Eq. (17) employed to estimate the distance in-between H1s (env(H1s)= [Tp,Tq]) and H2s ($env(H2s) = [T_p^*, T_q^*]$).

$$d\,(H1s, H2s) = |q^* - q| + |p^* - p| \tag{17}$$

The other significant stages are distinct as follows:

Step 10: As a first stage in alternative assessment let's assume that the prioritized values has E alternatives ($C = \{C_1, C_2, \ldots..C_E\}$) as well as n criteria. The experts are well-defined as e_x and decision makers are exemplified through K. Additional, fuzzy decision matrix is presented as $\tilde{X}^l = \left[H^l_{S_{ij}}\right]_{E\times n}$ and the scale for HF-TOPSIS is as: Let Scale= {nothing, very bad, bad, medium, good, very good, and perfect}. Now take two experts e1 and e2 to give ranks to two alternatives A1 and A2.

r_1^1 = between medium and good (bt M and G)

r_2^1 = at most medium (am M)

r_1^2 = at least good (al G)

r_2^2 = between very bad and medium (bt VB and M)

The calculation of fuzzy function envelop for intake ranks is defined as follows:

env_F(EGH (btM and G)) = T (0.3300, 0.5000, 0.6700, 0.8300)

env_F(EGH (amM)) = T (0.0000, 0.0000, 0.3500, 0.6700)

env_F(EGH (alG)) = T (0.5000, 0.8500, 1.0000, 1.0000)

env_F(EGH (btVB and M)) = T (0.0000, 0.3000, 0.3700, 0.6700)

Step 11: For the second step of assessment, we constructed an aggregated decision matrix X = [xij] where, Xij is xij = [Tpij, Tqij] just like (Eq. (18)),

$$T_{pij} = min\left\{min_{i=1}^{K}\left(maxH^x_{t_{ij}}\right), max_{i=1}^{K}\left(minH^x_{t_{ij}}\right)\right\}$$

$$T_{qij} = max\left\{min_{i=1}^{K}\left(maxH^x_{t_{ij}}\right), max_{i=1}^{K}\left(minH^x_{t_{ij}}\right)\right\} \tag{18}$$

Step 12: Let us assume that the hesitant fuzzy linguistic term set (HFLTS) positive perspectives showed with $\tilde{C}^+ = (\tilde{V}_1^+, \tilde{V}_2^+, \ldots \tilde{V}_n^+)$ here, $\tilde{V}_j^+ = \left[V_{pj}^+, V_{qj}^+\right] (j = 1, 2, 3 \ldots .n)$. Likewise, the negative HFLTS solution of alternatives are demonstrated as $\tilde{C}^- = (\tilde{V}_1^-, \tilde{V}_2^-, \ldots \tilde{V}_n^-)$ where, $\tilde{V}_j^- = \left[V_{pj}^-, V_{qj}^-\right] (j = 1, 2, 3 \ldots .n)$ now further evaluation is distinct as following Eqs. (19)–(22).

$$\tilde{V}_{pj}^+ = max_{i=1}^{K}\left(max_i\left(minH^x_{S_{ij}}\right)\right) j \in \alpha_b$$

and

$$min_{i=1}^{K}\left(min_i\left(minH^x_{S_{ij}}\right)\right) j \in \alpha_c) \tag{19}$$

$$\tilde{V}_{qj}^+ = max_{i=1}^{K}\left(max_i\left(minH^x_{S_{ij}}\right)\right) j \in \alpha_b$$

and

$$min_{i=1}^{K}\left(min_i\left(minH_{S_{ij}}^{x}\right)\right) j \in \alpha_c) \tag{20}$$

$$\tilde{V}_{pj}^{-} = max_{i=1}^{K}\left(max_i\left(minH_{S_{ij}}^{x}\right)\right) j \in \alpha_c$$

and

$$min_{i=1}^{K}\left(min_i\left(minH_{S_{ij}}^{x}\right)\right) j \in \alpha_{b)} \tag{21}$$

$$\tilde{V}_{qj}^{-} = max_{i=1}^{K}\left(max_i\left(minH_{S_{ij}}^{x}\right)\right) j \in \alpha_c$$

and

$$min_{i=1}^{K}\left(min_i\left(minH_{S_{ij}}^{x}\right)\right) j \in \alpha_{b)} \tag{22}$$

Step 13: Now when the Eqs. (19)–(22) are calculated, the negative and positive ideal separation matrix (D^+ and D^-) through the following Eqs. (23)–(24) are estimated.

$$D^{+} = \begin{bmatrix} d\left(x_{11}, \tilde{V}_1^{+}\right) + & d\left(x_{12}, \tilde{V}_2^{+}\right) + & \ldots + d\left(x_{1n}, \tilde{V}_n^{+}\right) \\ d\left(x_{21}, \tilde{V}_1^{+}\right) + & d\left(x_{22}, \tilde{V}_2^{+}\right) + & \ldots + d\left(x_{21}, \tilde{V}_n^{+}\right) \\ d\left(x_{m1}, \tilde{V}_1^{+}\right) + & d\left(x_{m2}, \tilde{V}_1^{+}\right) + & \ldots + d\left(x_{mn}, \tilde{V}_n^{+}\right) \end{bmatrix} \tag{23}$$

$$D^{-} = \begin{bmatrix} d\left(x_{11}, \tilde{V}_1^{-}\right) + & d\left(x_{12}, \tilde{V}_2^{-}\right) + & \ldots + d\left(x_{1n}, \tilde{V}_n^{-}\right) \\ d\left(x_{21}, \tilde{V}_1^{-}\right) + & d\left(x_{22}, \tilde{V}_2^{-}\right) + & \ldots + d\left(x_{21}, \tilde{V}_n^{-}\right) \\ d\left(x_{m1}, \tilde{V}_1^{-}\right) + & d\left(x_{m2}, \tilde{V}_1^{-}\right) + & \ldots + d\left(x_{mn}, \tilde{V}_n^{-}\right) \end{bmatrix} \tag{24}$$

Step 14: After calculating the D+ and D- values, the closeness score was estimated for them by following Eqs. (25)–(26).

$$CS\left(A_i\right) = \frac{D_i^{+}}{D_i^{+} + D_i^{-}}, i = 1, 2, \ldots .m \tag{25}$$

Here,

$$D_i^{+} = \sum_{j=1}^{n} d\left(x_{ij}, V_j^{+}\right) \text{ and } D_i^{-} = \sum_{j=1}^{n} d(x_{ij}, V_j^{-}) \tag{26}$$

Step 15: The closeness values for each choice are calculated, and an order is created based on the closeness value for a clear and intelligible form. In addition, with appropriate tables, the real calculation and arithmetical examination of Fig. 2 are given in the next part. In this study, five hospitals were used as options for evaluation, including the Sanjay Gandhi Postgraduate Institute of Medical Sciences (SGPGI) in Lucknow and other local hospitals in Varanasi, and the findings were calculated using HF-TOPSIS.

3 Data Analysis and Results

The authors gathered comments and data for each of the COVID-19 treatment described from twenty professionals from all over the healthcare industry in order to enable the adoption and discussion of the HF-AHP-TOPSIS tactic in our setting. Experts were invited to an online meeting app and informed about the pharmacological tree structure tactic for COVID-19 treatment. Expert

opinions were gathered in the form of linguistic values, and computations were performed on them, as shown in the preceding section. The data from the experts was also used to create the pair-wise comparison matrix. The professionals obvious to create a fuzzy envelope for level 1 of the tree structure, where authors categorise two treatment paths. The fuzzy envelope values developed for the first level of the tree structure are listed in Tab. 4.

Table 4: Fuzzy envelopes for level 1

	M1	M2	M3
Allopath (M1)	EE	B/W EHI and WHI	B/W ESHI and VHI
Unani (M2)	–	EE	B/W WHI and ESHI
Ayurveda (M3)	–	–	EE

The CR value was calculated using the supplied scores, and t was confirmed using step 5 and Eqs. (1)–(12). The procedure of evaluating level 1 of the hierarchy was carried out using Tabs. 3 and 4 as well as Eqs. (1)–(12).

The fuzzy envelope (D12) was selected as "B/W EHI and WHI". The Triangular Fuzzy Numbers (TFN) related with the declared linguistic values are (1, 1, 3) and (1, 3, 5), respectively. With the help of Eqs. (1)–(5), the trapezoidal fuzzy numbers $\tilde{C} = (a, b, c, d)$, showing the linguistic value is evaluated as:

$$a = min\left\{a_L^6, a_L^7, a_M^6, a_M^7, a_R^6, a_R^7\right\}$$
$$= min\{1.000000, 1.000000, 1.000000, 3.000000, 3.000000, 5.000000\} = 1.000000$$

$$d = max\left\{a_L^6, a_L^7, a_M^6, a_M^7, a_R^6, a_R^7\right\}$$
$$= max\{1.000000, 1.000000, 1.000000, 3.000000, 3.000000, 5.000000\} = 5.000000$$

and then, i + 1 = j (i = 6; j = 7); then, $b = a_M^6 = 1.0000$ and $c = a_M^7 = 3.0000$. At the end, it is determined that the trapezoidal fuzzy set of this envelop is (1.000000, 1.000000, 3.000000, 5.000000). Similarly, trapezoidal fuzzy sets were calculated for other relative importance. Thereafter, the evaluated pair-wise comparison matrix for level 1 of hierarchy is shown in Tab. 5.

Table 5: HF-pair-wise comparison matrix at level 1

	M1	M2	M3
Allopath (M1)	1.000000, 1.000000, 1.000000, 1.000000	1.000000, 1.000000, 3.000000, 5.000000	0.330000, 1.000000, 1.000000, 3.000000
Unani (M2)	0.200000, 0.330000, 1.000000, 1.000000	1.000000, 1.000000, 1.000000, 1.000000	0.200000, 0.330000, 1.000000, 1.000000
Ayurveda (M3)	0.330000, 1.000000, 1.000000, 3.000000	1.000000, 1.000000, 3.000000, 5.000000	1.000000, 1.000000, 1.000000, 1.000000

Eqs. (13) and (14) is employed to estimate the fuzzy weights for level 1 and then by Eq. (14) other fuzzy weights for level 2 of the tree structure is measured as follows:

$\tilde{r}_1$ = [(1.000000, 1.000000, 1.000000, 1.000000) ⊗ (1.000000, 1.000000, 3.000000, 5.000000) ⊗ (0.330000, 1.000000, 1.000000, 3.000000)]1/3

= [(1.000000 X 1.000000 X 0.330000)1/3, (1.000000 X 1.000000 X 1.000000)1/3, (1.000000 X 3.000000 X 1.000000)1/3, (1.000000 X 5.000000 X 3.000000)1/3]

= (0.690000, 1.000000, 1.440000, 2.470000)

Correspondingly, remaining $\tilde{r}_i$ obtained as shown in Tab. 6. Now, the weight of each factor can be assessed with the help of Eq. (14) as follows:

$\tilde{w}_1$ = (0.690000, 1.000000, 1.440000, 2.470000) ⊗ ((0.690000, 1.000000, 1.440000, 2.470000) ⊕ (0.340000, 0.480000, 1.000000, 1.000000) ⊕ (0.700000, 1.000000, 1.400000, 2.500000))$^{-1}$ = (0.120000, 0.260000, 0.580000, 1.430000)

Correspondingly, remaining $\tilde{w}_i$ estimated as shown in Tab. 6. Further, with the help of Eq. (15), defuzzified value of each factor is estimated as follows:

$$\tilde{w}_1 = \frac{0.120000 + 2 \times 0.260000 + 2 \times 0.580000 + 1.430000}{6} = 0.538300$$

Similarly, defuzzified weights of $\tilde{w}_2 = 0.283300$ and $\tilde{w}_3 = 0.530000$.

Thereafter, normalize the weights by using Eq. (16).

$\tilde{w}_1 = 0.538300$; $\tilde{w}_2 = 0.283300$; $\tilde{w}_3 = 0.530000$

= 0.538300+ 0.283300 + 0.530000

=1.351600

$$\tilde{w}_1 \textit{in normal form is} = \frac{0.538300}{1.351600} = 0.398300$$

Similarly, normalized weights of $\tilde{w}_2 = 0.209600$ and; $\tilde{w}_3 = 0.392100$

Table 6: Normalized weights of level 1 factors

	Geometric means	Fuzzify local weights	Defuzzified weights	Normalized weights
Allopath (M1)	0.690000, 1.000000, 1.440000, 2.470000	0.120000, 0.260000, 0.580000, 1.430000	0.538300	0.398300
Unani (M2)	0.340000, 0.480000, 1.000000, 1.000000	0.060000, 0.120000, 0.400000, 0.600000	0.283300	0.209600
Ayurveda (M3)	0.700000, 1.000000, 1.400000, 2.500000	0.120000, 0.250000, 0.570000, 1.420000	0.530000	0.392100

The fuzzy local weights through the hierarchy are displayed in Tab. 6 and Fig. 3 using a similar technique for level 2 factors. The contribution of each attribute is represented by the weights of the attributes. Local weights are also attribute weights that are determined independently of the hierarchical structure, whereas global weights are derived using the hierarchical structure. Tab. 7 and Fig. 4 shows the last level independent and dependent normalised weight of each factor through the hierarchy, based on prior calculations.

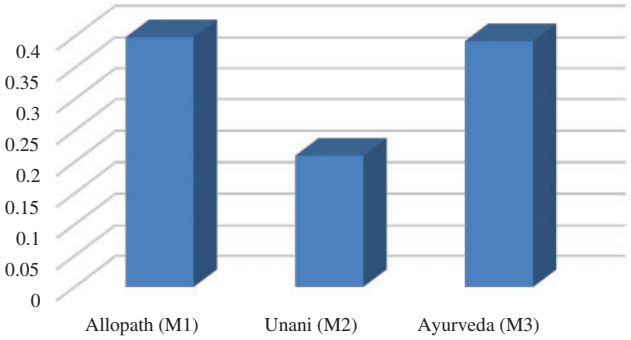

Figure 3: Graphical representation of weights at level 1

Table 7: Dependent weights

Criteria of level 1	Local weights of level 1	Criteria of level 2	Local weights of level 2	Global weights of level 2	Defuzzified weights	Normalized weights	Ranks
Allopath (M1)	0.120000, 0.260000, 0.580000, 1.430000	Remdesivir [M11]	0.050000, 0.164000, 0.280030, 1.010040	0.006000, 0.042000, 0.165000, 1.447000	0.311000	0.089548	4
		Lopinavir/Ritonavir [M12]	0.030045, 0.160056, 0.225006, 0.620000	0.004000, 0.040030, 0.130010, 0.880050	0.206000	0.059315	9
		HCQ and Azithromycin [M13]	0.050090, 0.200080, 0.300480, 1.263000	0.000700, 0.050040, 0.200020, 1.800020	0.387000	0.111431	2
		Convalescent plasma [M14]	0.060040, 0.200400, 0.420060, 1.210040	0.000080, 0.060020, 0.240080, 1.730020	0.393000	0.113159	1
		High-dose IVIg [M15]	0.030030, 0.080060, 0.180010, 0.490080	0.000040, 0.020020, 0.100050, 0.710010	0.162000	0.046646	11
		Tocilizumab [M16]	0.040080, 0.150070, 0.270010, 1.020050	0.000060, 0.040000, 0.150070, 1.460020	0.311000	0.089548	5
		Siltuximab[M17]	0.030030, 0.120090, 0.210020, 0.780010	0.000040, 0.030030, 0.120030, 1.110040	0.239000	0.068817	8
		Mesenchymal Stem Cell [M18]	0.050040, 0.130030, 0.280010, 0.940080	0.006000, 0.030040, 0.160040, 1.350030	0.292000	0.084077	6

(Continued)

Table 7: Continued

Criteria of level 1	Local weights of level 1	Criteria of level 2	Local weights of level 2	Global weights of level 2	Defuzzified weights	Normalized weights	Ranks
Unani (M2)	0.060000, 0.120000, 0.400000, 0.600000	Behi Dana (Cydonia Oblonga) [M21]	0.050020, 0.100590, 0.290070, 1.020050	0.000060, 0.040010, 0.170030, 1.460020	0.316000	0.090988	3
		Unnab (Zizyphus Jujuba) [M22]	0.020020, 0.070030, 0.110030, 0.500030	0.000030, 0.019000, 0.066000, 0.718000	0.148000	0.042614	12
		Sapistan (Cordia Myxa) [M23]	0.030010, 0.070080, 0.120010, 0.39000	0.002000, 0.010000, 0.040090, 0.220050	0.057000	0.016412	15
		Karanjwa (Caesalpinia Bonducella) [M24]	0.149000, 0.276000, 0.723000, 1.509000	0.000090, 0.034000, 0.290020, 0.870030	0.255000	0.073424	7
Ayurveda (M3)	0.120000, 0.250000, 0.570000, 1.420000	Ashwagandha [M31]	0.070060, 0.218000, 0.455000, 1.031000	0.004000, 0.027000, 0.183000, 0.596000	0.170000	0.048949	10
		Guduchi [M32]	0.035000, 0.097000, 0.198000, 0.513000	0.000020, 0.012000, 0.080000, 0.297000	0.080000	0.023035	13
		Yashtimadhu [M33]	0.031000, 0.078000, 0.121000, 0.39000	0.000020, 0.010000, 0.040090, 0.225000	0.042000	0.012093	16
		Peepli [M34]	0.030030, 0.129000, 0.212000, 0.780010	0.004000, 0.030030, 0.120030, 1.114000	0.039000	0.011229	17
		Ayush-64 [M35]	0.111900, 0.200060, 0.700030, 1.000090	0.000090, 0.030040, 0.290020, 0.870030	0.065000	0.018716	14

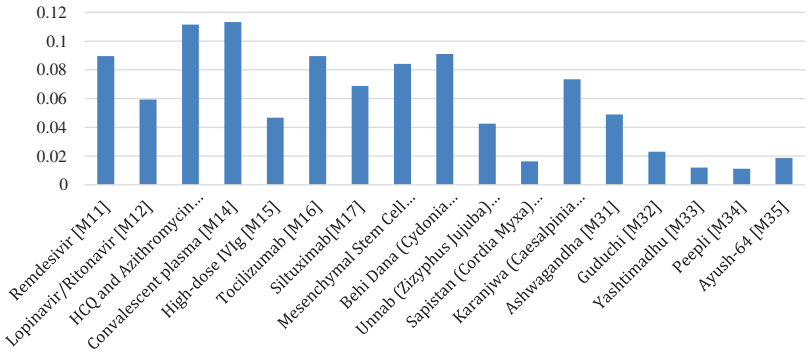

Figure 4: Graphical representation of weights at level 2

The different ranks, as well as their related weights, are shown in Tab. 7 for each selected and evaluated SARS-CoV-2 treatment course. The results of the HF-AHP ranking assessment suggest that Allopathy's Convalescent Plasma has the highest priority and rank, while Ayurveda's Peepli has the lowest. Following the outcomes of the HF-AHP methodology, we used the HF-TOPSIS approach on five other hospitals as a comparison.

Eqs. (1)–(5) were also utilised to test the conclusions obtained from Tab. 7. Further, Tab. 8 shows the technical information for each of the five options. The normalised fuzzy matrix from Eqs. (16)–(18) and the weighted normalised fuzzy matrix are calculated and following the last phase of the calculation, we used Eqs. (19)–(26) to evaluate the closeness of the analysed alternatives, as shown in Tab. 9 and Fig. 5.

Table 8: Subjective values

Criteria / Alternatives	A1	A2	A3	A4	A5
Remdesivir [M11]	1.820000, 3.730000, 5.730000, 6.730000	1.640000, 3.550000, 5.550000, 6.730000	1.820000, 3.730000, 5.730000, 6.730000	1.640000, 3.550000, 5.550000, 6.730000	1.450000, 3.180000, 5.180000, 6.250000
Lopinavir/Ritonavir [M12]	0.910000, 2.450000, 4.450000, 5.650000	2.450000, 4.270000, 6.270000, 8.650000	0.910000, 2.450000, 4.450000, 5.650000	2.450000, 4.270000, 6.270000, 8.650000	1.910000, 3.730000, 5.730000, 7.510000
HCQ and Azithromycin [M13]	2.820000, 4.640000, 6.640000, 8.510000	1.910000, 3.730000, 5.730000, 7.510000	2.820000, 4.640000, 6.640000, 8.510000	1.910000, 3.730000, 5.730000, 7.510000	1.640000, 3.550000, 5.550000, 6.730000
Convalescent plasma [M14]	1.450000, 3.070000, 4.910000, 5.650000	0.820000, 2.270000, 4.270000, 6.650000	1.450000, 3.070000, 4.910000, 5.650000	0.820000, 2.270000, 4.270000, 6.650000	2.450000, 4.270000, 6.270000, 8.650000
High-dose IVIg [M15]	1.910000, 3.730000, 5.730000, 7.510000	2.820000, 4.640000, 6.640000, 8.510000	1.910000, 3.730000, 5.730000, 7.510000	2.820000, 4.640000, 6.640000, 8.510000	1.910000, 3.730000, 5.730000, 7.510000
Tocilizumab [M16]	0.820000, 2.270000, 4.270000, 6.650000	1.450000, 3.070000, 4.910000, 5.650000	0.820000, 2.270000, 4.270000, 6.650000	1.450000, 3.070000, 4.910000, 5.650000	0.820000, 2.270000, 4.270000, 6.650000
Siltuximab [M17]	1.820000, 3.730000, 5.730000, 6.730000	1.640000, 3.550000, 5.550000, 6.730000	1.820000, 3.730000, 5.730000, 6.730000	1.640000, 3.550000, 5.550000, 6.730000	1.820000, 3.730000, 5.730000, 6.730000

(Continued)

Table 8: Continued

Criteria / Alternatives	A1	A2	A3	A4	A5
Mesenchymal Stem Cell [M18]	1.820000, 3.730000, 5.730000, 6.730000	1.640000, 3.550000, 5.550000, 6.730000	1.820000, 3.730000, 5.730000, 6.730000	1.640000, 3.550000, 5.550000, 6.730000	1.820000, 3.730000, 5.730000, 6.730000
Behi Dana (Cydonia Oblonga) [M21]	0.910000, 2.450000, 4.450000, 5.650000	2.450000, 4.270000, 6.270000, 8.650000	0.910000, 2.450000, 4.450000, 5.650000	2.450000, 4.270000, 6.270000, 8.650000	0.910000, 2.450000, 4.450000, 5.650000
Unnab (Zizyphus Jujuba) [M22]	2.820000, 4.640000, 6.640000, 8.510000	1.910000, 3.730000, 5.730000, 7.510000	2.820000, 4.640000, 6.640000, 8.510000	1.910000, 3.730000, 5.730000, 7.510000	2.820000, 4.640000, 6.640000, 8.510000
Sapistan (Cordia Myxa) [M23]	1.820000, 3.730000, 5.730000, 6.730000	1.820000, 3.730000, 5.730000, 6.730000	1.640000, 3.550000, 5.550000, 6.730000	1.820000, 3.730000, 5.730000, 6.730000	1.640000, 3.550000, 5.550000, 6.730000
Karanjwa (Caesalpinia Bonducella) [M24]	0.910000, 2.450000, 4.450000, 5.650000	0.910000, 2.450000, 4.450000, 5.650000	2.450000, 4.270000, 6.270000, 8.650000	0.910000, 2.450000, 4.450000, 5.650000	2.450000, 4.270000, 6.270000, 8.650000
Ashwagandha [M31]	2.820000, 4.640000, 6.640000, 8.510000	2.820000, 4.640000, 6.640000, 8.510000	1.910000, 3.730000, 5.730000, 7.510000	2.820000, 4.640000, 6.640000, 8.510000	1.910000, 3.730000, 5.730000, 7.510000
Guduchi [M32]	1.450000, 3.070000, 4.910000, 5.650000	1.450000, 3.070000, 4.910000, 5.650000	0.820000, 2.270000, 4.270000, 6.650000	1.450000, 3.070000, 4.910000, 5.650000	0.820000, 2.270000, 4.270000, 6.650000
Yashtimadhu [M33]	1.910000, 3.730000, 5.730000, 7.510000	2.820000, 4.640000, 6.640000, 8.510000	1.910000, 3.730000, 5.730000, 7.510000	1.910000, 3.730000, 5.730000, 7.510000	2.820000, 4.640000, 6.640000, 8.510000
Peepli [M34]	1.820000, 3.730000, 5.730000, 6.730000	1.640000, 3.550000, 5.550000, 6.730000	1.820000, 3.730000, 5.730000, 6.730000	0.820000, 2.270000, 4.270000, 6.650000	1.450000, 3.070000, 4.910000, 5.650000
Ayush-64 [M35]	0.910000, 2.450000, 4.450000, 5.650000	2.450000, 4.270000, 6.270000, 8.650000	0.910000, 2.450000, 4.450000, 5.650000	1.820000, 3.730000, 5.730000, 6.730000	1.640000, 3.550000, 5.550000, 6.730000

Table 9: Closeness coefficients among different alternatives

Alternatives	d+i	d–i	Gap degree of CC+i	Satisfaction degree of CC–i
A1	0.045654141	0.024002515	0.385474445	0.645447445
A2	0.033325647	0.047898632	0.655654744	0.345655874
A3	0.044457874	0.025685974	0.387856322	0.622362221
A4	0.031653874	0.045658745	0.525654449	0.455655585
A5	0.035665599	0.045487932	0.532235412	0.455444447

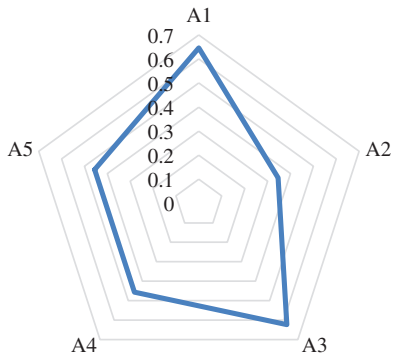

Figure 5: Graphical representation of satisfaction degrees

Tab. 9 shows the level of satisfaction for five distinct nominated alternatives; Alternative A1 indicates good performance, while Alternative A2 indicates poor performance in terms of medicine effectiveness. As a result, it is clear that among all of the alternatives, alternative A1 has the best performance ratio.

4 Discussion

The pandemic is one of the century's furthermost dangerous outbreaks. According to the study's material and tactics part, the number of infected patients of COVID-19 disease is rising at an alarming rate in every region of the world. The death ratio of disease is substantially lower in comparison to infection ratio, according to the analysis of the tactic and material portion of this work. For the COVID-19 disease, there is currently no standardised or officially proclaimed treatment [1], but clinicians are treating patients using the symptomatic medication tactic [2]. In this situation, the most pressing requirement is to identify a valuable COVID-19 treatment that will allow medical personnel to respond quickly to this critical crisis. As a result, it's become critical to analyse and categorise the various scientifically proved and advised treatments that are being utilised to cure COVID-19 instances based on their efficacy levels.

The authors conducted an examination of numerous therapies provided by doctors treating COVID-19 instances in order to satisfy the study's objectives. According to the results of the computation practice, "Convalescent Plasma" is the most chosen treatments against the COVID-19. Peepli has the lowest ranking in the calculation, thus we can conclude that it is ineffective in the treatment of patients of COVID-19 disease. This form of computation gives a trustworthy and conclusive reference for specialists who want to confirm the success of various COVID-19 therapy options being pursued

around the world. Our findings would also contribute to the scientific community's COVID contagion research and development efforts.

Furthermore, when conducting a mathematical computation, it is critical to comprehend and analyse the robustness of the computed outcomes [39]. Tab. 10 displays the results of the Sensitivity Analysis in tabular format, whereas Fig. 6 depicts the results in a graphical format for easy interpretation. When we look at the findings of the robustness analysis, we can see that the difference in effectiveness between the various COVID-19 treatments is minimal.

Table 10: Sensitivity analysis

Tryouts		A1	A2	A3	A4	A5
Tryout-0	Satisfaction Degree (CC-i)	0.6454475	0.3456559	0.6223622	0.4556556	0.4554444
Tryout-1		0.6699784	0.5545357	0.5232751	0.6202751	0.5085751
Tryout-2		0.6742357	0.5615784	0.5137751	0.6859784	0.5050357
Tryout-3		0.7292357	0.6020751	0.5532751	0.6589357	0.5460784
Tryout-4		0.5908751	0.4821784	0.4482751	0.6065784	0.4291784
Tryout-5		0.5908784	0.4855751	0.4407764	0.5364751	0.4290357
Tryout-6		0.6740357	0.5651357	0.5260751	0.6121764	0.5079764
Tryout-7		0.6295764	0.5272751	0.4810784	0.5625764	0.4661357
Tryout-8		0.6250751	0.5311357	0.4764751	0.5482357	0.4659764
Tryout-9		0.6449751	0.5155764	0.4832784	0.5769764	0.4592357
Tryout-10		0.6432784	0.5265357	0.4847357	0.5755357	0.4629751
Tryout-11		0.6272751	0.5025764	0.4862764	0.5735764	0.4702764
Tryout-12		0.6196751	0.4975357	0.4870357	0.5725751	0.4735751
Tryout-13		0.7072784	0.7480784	0.5647764	0.6712751	0.5545784
Tryout-14		0.5908751	0.4821784	0.4482751	0.6065784	0.4291784
Tryout-15		0.5908784	0.4855751	0.4407764	0.5364751	0.4290357
Tryout-16		0.6740357	0.5651357	0.5260751	0.6121764	0.5079764
Tryout-17		0.6295764	0.5272751	0.4810784	0.5625764	0.4661357

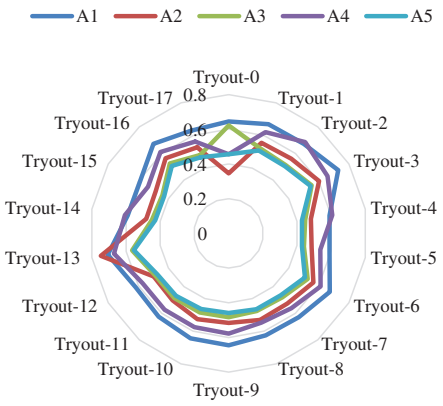

Figure 6: Graphical representation of sensitivity analysis

The results in Fig. 6 show that the variance of 0.05 shift in values is minimal; the figure also shows the linear values for each alternative. The chart shows that variations in values have no effect on the tactic's computed results. In a summary, the quality of the analysed outcomes in this study is evidently valuable in any scenario or alteration.

In addition, because the examined outcomes are connected to a very sensitive domain, the authors wished to double-check the results for correctness. To do this, authors used a Marginal Mean analysis and sensitivity analysis, Tab. 11 to combine the results from the original Tab. 9 with the sensitivity analysis as shown in Tab. 11, Figs. 7 and 8. Marginal Mean Analysis [38–39] is a basic yet valuable tactic that gives you a clear picture of the outcomes. The marginal mean is a statistical term that is recycled to depict data in huge data sets. In our case, authors used the marginal mean for each tryout for sensitivity analysis, as well as the original tested outcomes, to ascertain the actual fluctuation in values, if any, when the factor's weight differed somewhat from earlier readings.

Table 11: Marginal mean evaluation

Experiments/ Alternatives	A1	A2	A3	A4	A5	Marginal mean
Unique Results	0.6454475	0.3456559	0.6223622	0.4556556	0.4554444	0.50240200
Tryout-0	0.6295764	0.5272751	0.4810784	0.5625764	0.4661357	0.50240800
Tryout-1	0.6740357	0.5651357	0.5260751	0.6121764	0.5079764	0.57532700
Tryout-2	0.6295764	0.5272751	0.4810784	0.5625764	0.4661357	0.58812000
Tryout-3	0.6740357	0.5651357	0.5260751	0.6121764	0.5079764	0.61792000
Tryout-4	0.5904784	0.4855751	0.4407764	0.5364751	0.4290357	0.51141700
Tryout-5	0.6740357	0.5651357	0.5260751	0.6121764	0.5079764	0.49654800
Tryout-6	0.6295764	0.5272751	0.4810784	0.5625764	0.4661357	0.57707900
Tryout-7	0.6740357	0.5651357	0.5260751	0.6121764	0.5079764	0.53332800
Tryout-8	0.6740357	0.5651357	0.5260751	0.6121764	0.5079764	0.52937900
Tryout-9	0.6295764	0.5272751	0.4810784	0.5625764	0.4661357	0.53600800
Tryout-10	0.5908451	0.4874784	0.4487851	0.6065784	0.4277474	0.53861200
Tryout-11	0.6295764	0.5272751	0.4810784	0.5625764	0.4661357	0.53199600
Tryout-12	0.6740357	0.5651357	0.5260751	0.6121764	0.5079764	0.53007900
Tryout-13	0.6740357	0.5651357	0.5260751	0.6121764	0.5079764	0.64919700
Tryout-14	0.6295764	0.5272751	0.4810784	0.5625764	0.4661357	0.61794500
Tryout-15	0.6295764	0.5272751	0.4810784	0.5625764	0.4661357	0.51147400
Tryout-16	0.6740357	0.5651357	0.5260751	0.6121764	0.5079764	0.53344700
Tryout-17	0.6295764	0.5272751	0.4810784	0.5625764	0.4661357	0.52887400
Marginal mean	0.64636800	0.52193000	0.51293200	0.58070100	0.47801000	

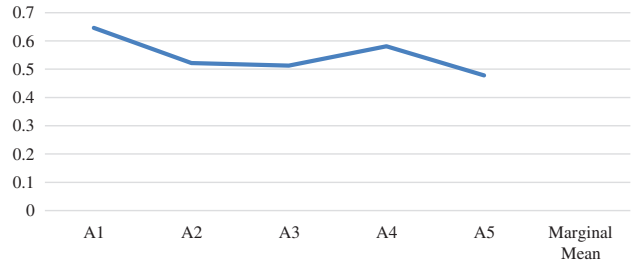

Figure 7: Marginal mean evaluation in alternative perspective

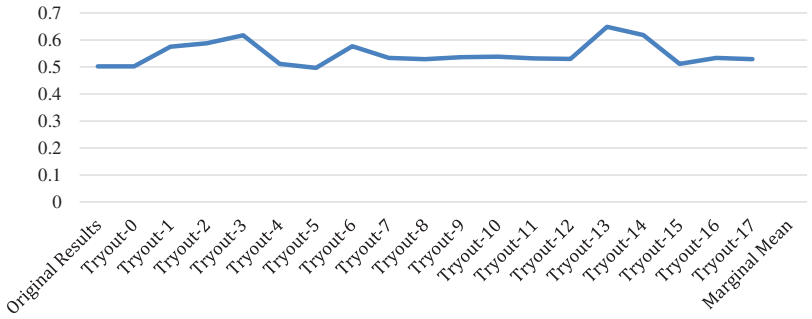

Figure 8: Marginal mean evaluation in tryouts perspective

Furthermore, after determining the marginal means for each tryout and the innovative tested outcomes [shown in Tab. 11 and Fig. 7], the authors concluded that the largest difference between the marginal means of the original evaluated results and the marginal means of various tryouts is only 0.14, or (0.20), and is thus considered negligible. As a result, it is clear that the produced outcomes from the adopted technique are of high quality and have a low sensitivity, implying that the evaluated outcomes are efficient and effective. We also looked at the marginal mean for numerous alternatives [shown in Fig. 8] and discovered that alternative A1 consistently outperforms all others.

Furthermore, we did a comparison analysis of other similar MCDM procedures to reinforce the choice of the adopted methodology and verify its applicability as well as benefits for the current study. The comparison analysis results are explained and displayed in the accompanying Tab. 12 and Fig. 9.

Table 12: Comparative analysis

Different MCDM Approaches/Alternatives	A1	A2	A3	A4	A5
Hesitant-Fuzzy-AHP-TOPSIS	0.6454475	0.3444759	0.6223622	0.4556556	0.4554444
Fuzzy-AHP-TOPSIS	0.6345244	0.5346587	0.4754574	0.5846539	0.4784547
Fuzzy-Delphi-AHP-TOPSIS	0.6245474	0.5147494	0.4454745	0.5647457	0.4645748
Classical-AHP-TOPSIS	0.6244547	0.5444587	0.4445955	0.5445474	0.4648597
Delphi-AHP-TOPSIS	0.6244784	0.5454727	0.4745874	0.5447459	0.4645566

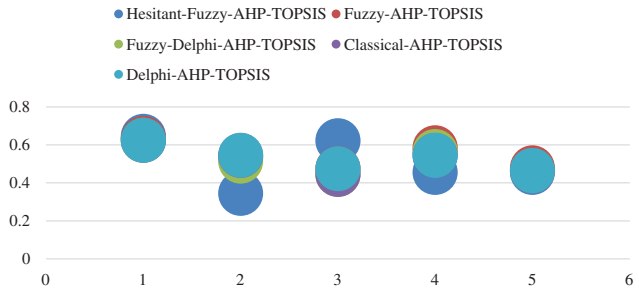

Figure 9: Graphical representation of comparative analysis

Because the hesitating circumstance is so widespread during the expert opinion intake process, HFS has been widely used by researchers in earlier years [2,35–39]. The HFS approach is a method in which each related attribute contains some membership values that are not fuzzy set values. This form of innovation allows specialists to give their judgments on the hierarchy and apply weights based on their own preferences rather than a pre-determined quantitative assignment. Furthermore, the authors chose fuzzy-AHP-TOPSIS, Fuzzy-Delphi-AHP-TOPSIS, Classical-AHP-TOPSIS, and Delphi-AHP-TOPSIS for this comparison analysis [39]. In order to compare and examine different methodologies, the same experts are contacted for their input on various methods. The authors then used the same five choices to test the performance of the assessed outcomes from various methodologies. Tab. 12 and Fig. 9 clearly show that all techniques show that Alternative A1 has the best performance ratio among the five options for testing. Furthermore, Fig. 9 shows that the Hesitant-Fuzzy-AHP-TOPSIS and Fuzzy-Delphi-AHP-TOPSIS findings have a linear and continuous value calculation with no sensitivity instability. Other MCDM techniques showed some sensitivity in their calculation and evaluation of outcomes when values for distinct alternatives fluctuated. As a result, when compared to other procedures, it is clear that the adopted methodology produces accurate results.

The following is a list of our study's major contributions

- The study uses a scientific methodology to assess the efficacy of various coronavirus treatment courses. This is a one-of-a-kind endeavour that will serve as an accurate repository for clinicians who will be able to study our tabulations and choose the best course of treatment for COVID-19 instances.
- Healthcare experts and researchers are currently befuddled by the lack of a verified and assured treatment/therapy or vaccination against SARS-CoV-2. Our research is based on three key steps: I identifying the 13 most commonly used COVID-19 treatment strategies and proving their efficacy through various research studies involving the treatment of active COVID-19 cases, (ii) gathering doctors' opinions on those drugs, and (iii) conducting a thorough mathematical analysis to determine the most prioritised course of action. As a result, the scientifically processed and tested outcomes from our study's decision-making technique will aid in dispelling the ambiguity around the selection of effective treatments.
- Based on numerical prioritising and efficacy assessment, the paper's findings reflect and provide a methodical, intelligible pathway for experts of healthcare to determine and choice a suitable treatment.
- The belief system and logical approach used in this study will prove to be a success for future scientists and can be applied to a variety of fields in the future.

There are also a slew of potential future possibilities linked to this research. As a follow-up to this study, new treatment paths and courses could be added to cover more therapy patterns and provide a large prioritisation list based on effectiveness. Furthermore, after forecasting for future years, this methodology can be used to rank the most contaminated and least infested regions. However, there are a few limitations to this research, which are noted below:

- The study summarises and selects just the most extensively utilised and popular SARS-CoV-2 treatment options. However, the authors feel that there are a variety of additional drugs and treatment patterns for COVID-19 patients that are probably in use but are not widely known.
- The evaluated outcomes in this study were mathematically achieved and evaluated solely on the basis of medical practitioners' ideas and opinions, but pharmaceuticals and medicines are a sector in which only the element's actual properties can provide accurate and efficient results. As a result, it's possible that the produced results aren't as convincing as they should be in some circumstances and in the view of some experts.

5 Conclusions

A high infection rate demonstrates the critical need for a SARS-CoV-2 vaccination or a conventional treatment protocol. Doctors have prescribed various courses of treatment according on their calculation of the patients' situation, but the fight against COVID-19 is far from over. Various medical specialists and governments have offered a number of therapy options. However, the plethora of therapy options for COVID-19 patients causes misunderstanding among doctors and researchers as to which treatments are helpful and which are not. To fill this scientific void, the study aims to present a prioritised list of common treatment courses for two medical paths: Allopathy, Unani, and Ayurveda. The effectiveness of treatments is assessed using a scientific MCDM approach known as Hesitant-Fuzzy-AHP-TOPSIS, which produces accurate and high-quality results (Tested). Furthermore, it is clear from the assessment procedure that Convalescent plasma has the highest priority and Peepli has the lowest, and that all treatment courses are ranked in between these two treatment courses. Furthermore, to improve the quality and efficiency of the acquired results, the authors used various types of analysis such as sensitivity, marginal mean, and comparison analysis. These analyses clearly demonstrate that the study's assessed results are of high quality (through Sensitivity Analysis), efficiently effective (by Marginal Mean Assessment), and analysed and assessed using the best feasible approach (through Comparison Analysis). As a result, the current study, with its validated, correct, and authentic empirical frame, provides a sound foundation for the scientific community and the medical community to build on. We are convinced that the proposed findings and priority list (Ranks) of various courses of treatment can give medical experts and personnel an idea and efficiently assist them in treating corona patients.

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