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## Coronavirus Disease Diagnosis, Care and Prevention (COVID-19) Based on Decision Support System

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### Abstract:

Automated clinical decision support system (CDSS) acts as new paradigm in medical services today. CDSSs are utilized to increment specialists (doctors) in their perplexing decision-making. Along these lines, a reasonable decision support system is built up dependent on doctors' knowledge and data mining derivation framework so as to help with the interest the board in the medical care gracefully to control the Corona Virus Disease (COVID-19) virus pandemic and, generally, to determine the class of infection and to provide a suitable protocol treatment depending on the symptoms of patient. Firstly, it needs to determine the three early symptoms of COVID-19 pandemic criteria (fever, tiredness, dry cough and breathing difficulty) used to diagnose the person being infected by COVID-19 virus or not. Secondly, this approach divides the infected peoples into four classes, based on their immune system risk level (very high degree, high degree, mild degree, and normal), and using two indices of age and current health status like diabetes, heart disorders, or hypertension. Where, these people are graded and expected to comply with their class regulations. There are six important COVID-19 virus infections of different classes that should receive immediate health care to save their lives. When the test is positive, the patient age is considered to choose one of the six classifications depending on the patient symptoms to provide him the suitable care as one of the four types of suggested treatment protocol of COVID-19 virus infection in COVID-19 DSS application. Finally, a report of all information about any classification case of COVID-19 infection is printed where this report includes the status of patient (infection level) and the prevention protocol. Later, the program sends the report to the control centre (medical expert) containing the information. In this paper, it was suggested the use of C4.5 Algorithm for decision tree.

**Key words:** C4.5 Algorithm, Clinical Decision Support Systems, Corona Virus Pandemic 2019, Decision Support System, Decision tree.

### Introduction:

With commencing 2020, pandemic coronavirus (Covide-19) has initiated and spread worldwide extraordinarily. It appeared during December 2019 via the food market in Wuhan, China. The infection (authoritatively named SARS-CoV-2) has been liable for a lot of contaminations (more than 25 million infections) around the world, causing considerable number of deaths (about 370 thousands). The US is the nation generally influenced. The infection from a disease with SARS-CoV-2 is called Coronavirus, which represents COVID pandemic virus 2019. In the report about this infection; you're probably not

going to contract SARS-CoV-2 except if you've been in contact with somebody who has a SARS-CoV-2 disease (1).

Clinical decision support systems (CDSSs) are Computer software designed to allow health-being for doctors who decide about medical treatment regarding specific patients. Clinical decision support systems are Real - time information structures that use at least two elements of sickness data to generate situation-explicit guidance. These types of software development use specific knowledge, information base rules and essential patients' clinical personal data to enhance clinical

dynamics on issues such as protective, extreme and ceaseless consideration, therapeutics, explicit demand for tests, endorsing rehearses. Clinical decision support systems corresponding data regarding diagnostic criteria for patient with reasonable information base to manage doctors with indulgent explicit guidance, appraisals or suggestions. In the PC systems, doctors, emergency healthcare workers or patients may actually access quiet attributes. However, electronic clinical history for the recurrence of patient characteristics may be checked. These types of Decision Support System (DSS) permit the doctors to detect and choose the best suitable therapy. The option assist relies on stages of detailed assessment of outcome measures and estimates that use data bases to query for the most recent developments in recommended practice (2).

CDSS is expected to develop medical services conveyance by upgrading clinical decision with focused clinical information, infected data, and other prosperity data. It involves programming intended to be an immediate guide to medical-decision, in which the features of an individual patient are coordinated to an automated clinical information base and patient-explicit appraisals or proposals are then introduced to the doctor for a choice (3).

Albeit clinical information aggregation and translation used to be the area of medical care experts, the wide accessibility of prosperity information in phenomenal sums has altogether and unavoidably changed the scene of present up to date care (4).

The utilization of CDSSs has been suggested as a possible solution for developing the general proficiency and feature of medical services. They have been accounted to urge better adherence to confirm based rules, to develop the utilization of preventive measures, recognize potential dangers related with the medicine of different meds, to increment the accessibility of more exact clinical records, and to upgrade persistent doctor correspondence (5).

The DSS was created to help doctors in the analytic cycle regularly depending on static information which might be out dated. A DSS which can get familiar with the connections between understanding history, infections in the populace, manifestations, pathology of an ailment, family ancestry and test outcomes, would be valuable to doctors and medical clinics (6).

The mix of Data Mining can prompt the developed exhibition of DSS and can empower the handling of new kinds of issues that have not been tended to previously. They likewise contend that the

combination of Data Mining and decision support can altogether develop current methodologies and make new ways to deal with critical thinking, by empowering the combination of information from specialists and Information extricated from information (7).

One of the determinants that prompted us to develop a decision support system for Corona disease is that most of the decision systems that were proposed for this disease did not include many classifications of the disease and different levels, but most of them take the known apparent symptoms of the disease and then the severity of the infection is determined. For example, (8) design, create and manage a mobile decision support system for COVID-19 (DDC19) to assist GPs in data collection, risk evaluation, triage, management, and follow-up with patients during the epidemic of COVID-19. During the development of a dynamic measurement tool, such as the signs and symptoms and pre-existing of associated chronic diseases, the complete clinical condition should be regarded, but the early historical records for fever clinics do not include these data element. A research to build, validate, and expand a clinical decision support system and mobile app was suggested by the authors in (9) to help in COVID-19 symptom evaluation, management and treatment. Training data was obtained from 701 COVID-19 patients through services within the network of Family Medical Clinics at New York University Langone Health Centers. A framework of clinical decision support for the early diagnosis of COVID 19 was suggested in (10) utilizing deep learning based on chest radiographic images. In order to have a medical assessment before the pathogen examination, they are designing an in-depth learning tool that could extract the graphical attributes of COVID-19. In their research, they suggested a method of clinical decision support for the early detection of COVID-19 using deep learning without any symptoms based on chest X-ray images. A machine learning model based on clinical features for severity risk evaluation and triage for COVID-19 cases at hospital admission was developed and validated in (11). Therefore we suggested our COVID19DSS, which contains almost comprehensive information. Firstly, it needs to determine the three early symptoms of COVID-19 pandemic criteria (fever, tiredness, dry cough and breathing difficulty) used to diagnose the person being infected by COVID-19 virus or not. Secondly, this approach divides the infected peoples into four classes, based on their immune system risk level (very high degree, high degree, mild degree, and normal), and using two indices of age and

current health status like diabetes, heart disorders, or hypertension. Where, these people are graded and expected to comply with their class regulations. There are six important COVID-19 virus infections of different classes that should receive immediate health care to save their lives. When the test is positive, the patient's age is considered to choose one of the six classifications depending on the patient symptoms to provide him the suitable care as one of the four types of suggested treatment protocol of COVID-19 virus infection in COVID-19 DSS application.

The objective of this article is to describe the development of a decision support system for clinical managing pandemic Coronavirus19 issue and to recommend the symptoms, treatment and avoidances for each level among them. In our proposed work, we have provided a tool for doctors or their representatives that contains all the information of Corona virus disease through which the appropriate decision can be taken to diagnose the level of the disease and determine the appropriate treatment to avoid the risks that reach death. DSS gives instruments to evaluate the degree of infection, discovers the arrangement, and offers a quick guidance or activity. It additionally shows the reasonable activity and treatment to spare individuals from death, supports the doctor worker in pandemic coronavirus and focuses to discover data assets. Also the main task of this paper is to Improving a DSS dependent on DTCIS (Decision Tree C4.5 Inference System) to oversee request in a medical care gracefully to decelerate the COVID-19 virus symptoms and to control the flare-up of a pandemic to moderate its effect on the medical care flexibly to provide a suitable treatment by using a good treatment protocol.

The main contributions of this work can be summarized as follow:

- Construct a multi-criteria decision on the basis of determined evaluation criteria for COVID-19 diagnostic method.
- Proposes a new evaluation and decision making methodology for selecting the optimal COVID-19 diagnostic method based on Decision Tree C4.5 Inference System (DTCIS) method.
- Evaluate the proposed decision making Methodology using 6 main classes Dataset of COVID-19.

The organization of this manuscript is as the following. Section 2 discusses the importance of Clinical Decision -Making. In section 3 we talk about a clinical decision analysis (problem solving). Section 4 discusses relevant related works referred to the exploitation of classification technology in the medical DSS field are surveyed. Section 5

explains all the information that related with COVID-19(symptoms, treatment, and prevention). Section 6 depicts the design of the COVID-19 DSS framework. Section 7 describes the COVID-19 DSS implementation. Section 8 illustrates conclusions.

### Clinical Decision-making

A Clinical Decision Support System (CDSS) is designed to enhance the delivery of healthcare by improving treatment decisions with tailored clinical expertise, patient data, and other health records. A typical CDSS consists of software constructed to be an immediate aid to clinical decision-making, matching the features of a particular patient to a computerized clinical knowledge base, and then providing patient-specific evaluations or suggestions to the clinician for a decision. Today, CDSSs are mostly used at the patient - centered to integrate the clinician's expertise with advice and support given by the CDSS. However, CDSS is rapidly being built with the potential to manipulate otherwise unachievable or uninterruptable observations and data by humans. DSS was a piece of medical services data framework for quite a while. The early CDSS is an all-encompassing type of past expert system, where the objective is to make PC projects to reproduce the human deduction by utilizing Artificial Intelligent (AI) procedures. The AI is a class of PC algorithm that can comprehend human types of activities and insightfully use them to settle on decision or expect what's to come. The AI algorithms vigorously depend on the accessible information from past perceptions, which incorporate data given by the doctor, staff, drug store and other medical care people (12). CDSS controlled by AI Machine Learning (ML) ideas have been a long quest for future-arranged specialists, patient integrity specialists, information researchers, and operational masters the same. AI algorithms, unhampered by predisposition and rationale, can see and instruct affiliations that may not be generally clear. A guide that could improve the separating capacity of a doctor to locate the notorious needle in the pile is positively invited (13). DSS contains numerous activities to make arrangement's other options (for example investigation, allowance, projection, correlation, recreation, advancement). In performing these fundamental exercises, DSS uses numerous kinds of the quantitative models. Also, it uses direct programming, number programming, network models, objective programming, reproduction, and measurable models (14).

CDSS comes in numerous structures and capacities, yet all offer the point of producing

clinically significant results dependent on input information. A decision can be upheld by a standard or a model as straight forward as an on the if-then standard (eg, worked in reference esteems for research centre estimations) or an intricate expectation model (eg, [AI] directing radiologists toward conceivable accidental discoveries). The response output of a CDSS from indicating the created forecast as contribution for a clinical (15).

There are some main classifications to be considered while making progress towards a great decision making: a- precise information, b- relevant information, c- fitting problem-solving abilities (16). Infection information must be sufficient to settle on a substantial choice. The issue emerges, when the doctor is met with a mind-boggling measure of explicit and vague information, where he/she can't agreeably measure. Consequently, it is critical to survey when extra realities will be fuddle instead of explaining the patient's case. For instance, common settings for such an issue are escalated care units, where specialists must retain a lot of information from different screens and know about the clinical status, infected history, going with constant diseases, patient's prescription and unfavourable medication communications, and so on, but on head of that, it is settled on a fitting choice about the strategy. The goodness of accessible information is of equivalent significance. Estimating tools and screens ought to be as precise as innovatively conceivable, since wrong information could have genuine unfriendly impact on infected consideration choices. Information utilized in decision making must be precise and current. It is critical that the choosing doctor has an expansive range of clinical information and admittance to data assets, where it is conceivable to continually update and approve that information. For a patient to get fitting consideration the doctor must know about the most recent proof based rules and advancements in the area of the case question (4).

### Clinical Decision Analysis (Problem Solving)

The domain of clinical issues fitting for decision analysis is immense. Such issues fasten upon a particular decision, where there is a compromise included, which implies that one of the decisions considered isn't really unambiguously predominant. Decision investigations have been created to:

- ❖ Help in clinical decision-making for a particular person patient.

- ❖ Estimate ideal strategies for types of infected with explicit clinical attributes in given circumstances.
- ❖ Provide assessments of expected results in circumstances where old style techniques, for example, randomized preliminaries are either inconceivable or unreasonable. Choice investigations can straightforwardly consolidate issues with respect to personal satisfaction and how the specific patient qualities different results (17):
- ❖ Frame the inquiry – The way towards characterizing the range and limits of the specific clinical circumstance to be investigated.
- ❖ Framework the clinical issue – Structuring the issue essentially implies developing a choice model that speaks to the significant parts of the issue.
- ❖ Evaluate the important probabilities – Once a decision tree is organized, the numeric estimations of different probabilities should be resolved. There are numerous sources of information that can be utilized to make these conclusions (18).
- ❖ Evaluate the estimations of the results – Different answers for an issue have various results. The framework of the issue characterizes the particular result measure to be utilized. A helpful attributes of choice examination is that a given model can be assessed utilizing diverse result measures.
- ❖ Analyse the tree – The favoured kind of investigation of an issue uses the methodology that boosts the normal estimation of the result.
- ❖ Test the design's suspicions – The outcomes got from a choice investigation rely on the precision of the information used to appraise the probabilities and results. One of the significant focal point of choice examination models is their capacity to quickly test their presumptions and insert data – to approve the decision model by applying out an affectability investigation (19).

### Related Work

Authentic models: Leeds stomach torment, MYCIN, HELP, Internist-I There were numerous endeavours through history to build a PC or program, which would help doctors with their choices concerning determination and treatment. The first truly useful clinical decision support system was not shown up until the 1970s. We will audit the accompanying recorded frameworks:

Leeds stomach torment, MYCIN, HELP and Internist-1. Leeds is a stomach torment. It has utilized Bayesian thinking on premise of careful and neurotic judgments. These snippets of data were accumulated from a large number of patients and placed into frameworks' data base. The Leeds stomach torment framework was utilized affectability, particularity and ailment predominance information for different signs, side effects and test outcomes. The framework has accepted that every patient with stomach torment had one of these 7 conditions where in this manner, they chose the most probable analyse based on recorded perceptions. MYCIN was a consultation framework that underscored suitable administration of patients who had diseases as opposed to simply finding their determination. The designers of this framework have shaped creation rules (IF-THEN principles), on premise of momentum information about irresistible ailments. The MYCIN program was figured out which the rules to utilize and how to series them together so as to settle on choices about a particular case. The HELP framework is really an incorporated medical clinic data framework with the capacity to produce cautions when information irregularities in the infected record are printed. It can yield information either naturally, in type of printed reports, or it can show explicit data, if so mentioned. Moreover, the framework has an occasion driven component for age of specific admonitions, cautions and reports. Internist-I was a trial clinical decision support system. It was a rule based expert system fit for making various, complex conclusions inside medication dependent on understanding perceptions. The Internist-I was utilizing a tree-organized data base that connected side effects with sicknesses. The assessment of the framework uncovered that it was not adequately dependable for clinical application (12). Now, a few investigations have been accounted for that have zeroed in on clinical determination. These investigations have applied various ways to deal with the given issue and accomplished high grouping correctness's, of 77% or higher, utilizing the dataset taken from the user computer interface AI archive (20). Here are a few models: L. Ariel (21) has utilized Fuzzy Support Vector Clustering to distinguish coronary illness. This algorithm has used a part initiated measurement to relegate each bit of information and exploratory outcomes were acquired by utilizing a notable benchmark of coronary illness. In this, tree based: classifier utilizes nonlinear proximal help vector machines. Authors in (22) have structured a specialist framework to analyse the diabetes illness depending on synthesis analysis. He built up a

course learning framework to analyse the diabetes. Campos-Delgado et al. have built up a fluffy based regulator that fuses expert knowledge to manage the blood glucose level.

Different distributed researches have examined the clinical decision support system adequacy. The framework and the analytic projects advice the doctors about the risky collaborations of medications. These projects can limit the issues and mistakes, forestall confusions and accordingly improve the doctors' analysis. Early admonition on the event of harm may influence the nature of care and the cost included (23). As an investigation in England, the scientists have found that executing the PC based rules can achieve an adjustment in the health results and the unanswered inquiries looked by the doctors during the clinical experience will offer an opportunity for utilizing the clinical decision support system (24). They have consolidated the four factors linked with executing fruitful CDSS from different examinations. The elements were 1-robotizing alarms and updates, 2-giving proposals at choice area and time, 3-offering significant suggestions, and 4-mechanizing the entire activity. These components influence the process of care and treatment of crisis circumstances. A contextual analysis approach was utilized to show how quick the crisis DSS conveyed. The sharing of data is a significant factor to actualize the clinical decision support system adequately (25). The discoveries show that following the counsel is given by clinical decision support system and the doctors accept losing control of their work and losing specific aptitudes and information where any non-expert can admittance to clinical information that is selected to the doctor. So, proficient self-sufficiency assumes a significant part in doctors' choice in receiving clinical decision support system. Furthermore, this examination improves 1-structure that urges the chief to give a domain to doctors to have effective information sharing and actualize intuitive clinical decision support system, 2-the nature of administrations is given to the patient by utilizing proper clinical Information Technology (IT) frameworks in clinics. (26) Has examined the primary troubles related with CDSS. These are computerization of the entire CDSS, joining in clinical work process, extensibility and viability of the framework, ideal advising, assessment of impacts and expenses, and prerequisite for structures that grant reusing and sharing of clinical decision support system administrations and modules .

Coronavirus pandemic, named by the International Committee of Taxonomy of Viruses as SARS-CoV-2, is a recently recognized Covid-19

contamination in people that causes flare-ups of respiratory ailment. This ongoing COVID-19 contamination was perceived as a genuine general health danger by the US centres for Control and Prevention of Diseases. The main instance of this novel Covid-19 contamination was recognized in Hubei Area, Wuhan City, China, by the end of December 2019, therefore, it has spread out universally (27). A World Health Organization (WHO) as of late (March 2020), the perceived this contamination, which can initiate extreme pneumonia, as a pandemic viral ailment after recognizable proof of gigantic quantities of cases in Iran, Italy, Spain, France, Germany, other European nations, USA and universally the numbers are rising each day (27,28).

Covid-19 appears to be an enormous group of wrapped RNA infections found in an expansive scope of creatures including fowls, camels, cows, felines, and bats. It has been generally announced that this new Covid-19 virus spread from other creatures to people with proceeded with dissemination coming about because of human-to-human introduction. At first, patients of COVID-19 appeared to have some connections to an enormous fish and live creatures market in Wuhan, China, suggesting creature to-human transmission. Be that as it may, ensuing cases seem to have come about because of communication between human beings, as later patients were not presented to creature markets (28, 29). Covid-19 is the third Covid to rise in the human populace in the previous twenty years, gone before by the SARS-CoV episode in 2002 and the MERS-CoV flare-up in 2012. This has put world health organizations on high ready. The US Centres for Control and Prevention of Diseases and World Health Organization have built up a readiness and avoidance agenda for Covid-19 pandemic for use by the general population and medical services experts (30). Currently, no antiviral vaccine or antibody is accessible for handling Covid-19 outbreak. Affected patients are taken with strong consideration, albeit a few prescriptions, alone or in blend with different medications, have been recommended (31, 32). At an early point the authors in (33) provided a tool can diagnose voice pathologies and suggesting a suitable treatment. Developing a strong feature detection method for voice pathology processing based on the deep Learning (33). In order to obtain better performance for a transparent, continuous, and ubiquitous system, the integration of cloud technology with the Internet of Things is necessary in the healthcare industry; IoT has several uses, one of which is Speech Pathology Control (34). Machine learning (ML) has been one of the smart

techniques capable of predicting the situation with fair precision depending on the knowledge and learning process automatically. A fast number of different classifiers for the prediction of COVID-19 instances have been suggested for now; the authors in (35) suggested an intelligent approach to assist health institutions in the diagnostic device selection of COVID-19. The proposed methodology was building a multi-criteria decision matrix (DM) on the basis of identified assessment criteria for the treatment model of COVID-19. There are various specifications that need to be defined, and some of the requirements conflict with each other. This analysis is organized as a decision matrix (DM) that incorporates a mix of ten assessment criteria for COVID19 and 12 diagnostic models. The multi-criteria decision-making (MCDM) approach is used in order to assess and benchmark the different diagnostic models for COVID19 with respect to the evaluation criteria. Designed MCDM systems are described where for the purpose of benchmarking and rating, TOPSIS was applied while Entropy required variable weights to calculate. Suggested approach has a new measurement and optimization approach focused on Entropy and TOPSIS approaches for selecting the best COVID-19 diagnostic method. Test the suggested Optimization Technique using 50 COVID-1919 Chest X-ray Dataset measurements (36). One of the standard statutes is Polymerase Chain Reaction (PCR) used to diagnose COVID-19. PCR specifically detects SARS-CoV-2 RNA from experiments conducted typically obtained from previously infected individuals via different test methods, either oropharyngeal or nasopharyngeal . Although the Polymerase Chain Reaction is an effective method of inspection, it involves resources and really quite long-term manual execution of such a complex procedure. COVID-19 is identified by the chest radiographic imaging panel. In particular, radiologists view and examine any anomalies that might be detected in the picture of the chest. The anomalies observed in chest imaging are closely linked to the presence of COVID-199 in preliminary tests. (37, 38). A guideline urges medical practitioners when using radiography imaging as the primary means of diagnosing such infectious disease like COVID-19 and SARS-CoV-22 (39). In several medical hospitals or clinics, the radiography imaging method is fast, effective and accessible. (40) Radiographic review, however, depends on the expertise and understanding of the radiologist for analysis and interpretation of data, as certain visible measures are fuzzy. The use of a quick computer-based Artificial Intelligence technology way of helping physicians evaluate

COVID-19 chest radiography image analysis and achieve an early diagnosis in a short period is a way to solve this situation. There are current studies that suggested many DSS for COVID-19 virus. In (41) proposed Biomarker measurements of C-reactive protein (CRP), N-terminus pro B type natriuretic peptide (NT-proBNP), myoglobin (MYO), D-dimer, procalcitonin (PCT), creatine kinase myocardial band (CK-MB) and cardiac troponin were presented the integrated point-of-care COVID-19 Severity Score and clinical decision support framework (cTnI). In a statistical learning algorithm, the COVID-19 Severity Score blends multiplex biomarker measures and risk factors to predict mortality. The COVID-19 System Composed was developed and assessed using data from 160 cases from Wuhan, China, diagnosed with COVID-19. During the COVID-19 pandemic, (42) treated the planning of a physician change schedule for a hospital in Turkey. Three new COVID-19 related divisions have been developed by the hospital and the objective is to provide continuous support in the new divisions while retaining the efficiency in the existing departments. The suggested scheme is a mixed integer programming (MIP) model that solves the problem of shift scheduling and transforms it into a decision support system (DSS). The resulting arrangements reduce physicians' access to the virus with a reasonable workload while protecting the medical system in all units. The authors in (43) were used 725 patients to train and validate the model. This included a retrospective cohort of 299 COVID-19 hospitalized patients from Wuhan, China from 23 December 2019 to 13 February 2020 and five cohorts of 426 patients from 8 centers in China, Italy and Belgium from 20 February 2020 to 21 March 2020, respectively a research to determine the COVID-19 treatment choices using multi-criteria decision-making (MCDM) techniques was suggested. The available COVID-19 treatment options via MCDM techniques, namely fuzzy PROMETHEE and VIKOR, were evaluated in this review. This approach focused on the assessment and comparison of complex and multiple parameters in order to determine the most suitable alternative. This research evaluated the treatment methods used in COVID-19 therapy with MCDM approaches between December 2019 and March 2020. It has been proposed that for therapy, plasma from healed patients should be used.

### **The Proposed Model Components of Covid-19 DSS**

This article has suggested a DSS depending on doctors' information and decision tree (C4.5)

algorithm inference framework so as to classify the infected individuals as the type of their coronavirus infection with the target of this article is to build up a system that can help individuals and doctors' to promptly recognize the status of people experiencing indications of Covid-19 and overseeing request in a medical care flexibly to give fitting therapies (choose the suitable protocol as the case of patient). As an exceptionally useful apparatus, DTCIS has been proposed based on technical experience in the domain of decision tree and C4.5 algorithm set hypothesis so as to manage the input nonlinear mapping to output variables.

Since Corona virus 19 diseases is a new pandemic and solid datasets relating it is not for this disease accessible where it is preferred to utilize the DTCIS way, which depends on the experience of experts. Also, the variables for I/O in this methodology do not follow a straight assignment; subsequently, DTCIS produce it conceivable to characterize the correct assignment (rules) for various conditions. This is another justification for the work of DTCIS in this paper. The medical care suggested in this article is a two-framework containing group individuals (service recipients) and a medical services framework (service providers). In this gracefully, medical care gear and administrations given by the medical care framework are considered as the item.

The model (Covid-19DSS) is under investigation of the medical care flexibly and it appears in Fig. 1. In the suggested approach, any unexpected increment of requests in the medical services gracefully is first forestalled dependent on guidelines advised to each class. Besides, disturbances must be relieved. Also, people group individuals' pressure is diminished when the compass of the Covid-19 infection diminishes. To expand the precision of the suggested DSS, measures including age and prior sickness, (for example, diabetes, heart issues, or hypertension) have been considered notwithstanding the three primary rules of dry cough, tiredness, and fever. For the generality part, the commitments of this investigation can be summed up as follows:

- ❖ Improving a DSS dependent on DTCIS (Decision Tree C4.5 Inference System) to oversee request in a medical care gracefully to decelerate the COVID-19 virus symptoms and to control the flare-up of a pandemic to moderate its effect on the medical care flexibly to provide a suitable treatment by using a good treatment protocol.
- ❖ Grouping individuals (service recipients) in view of two rules, including age and

previous health condition, (for example, diabetes, heart issues, or hypertension) and giving a free arrangement technique to every gathering.

❖ Assessing the productivity of the suggested way by utilizing the information in the real world and its legitimacy following an affectability investigation method (44).

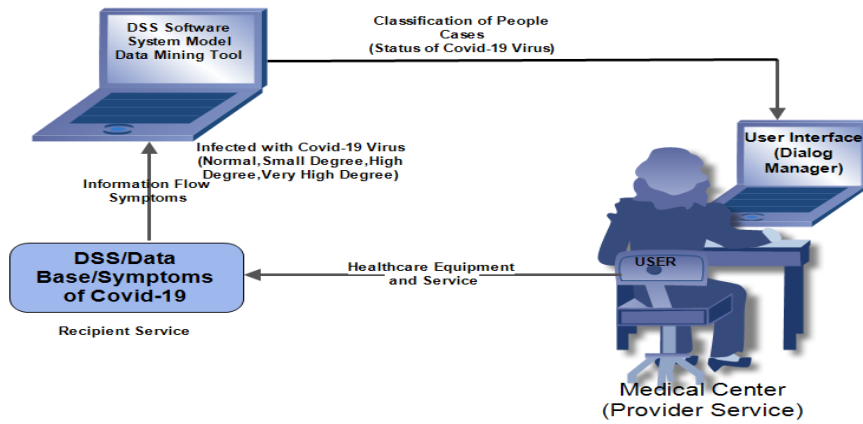


Figure 1. System architecture of COVID-19 decision support system.

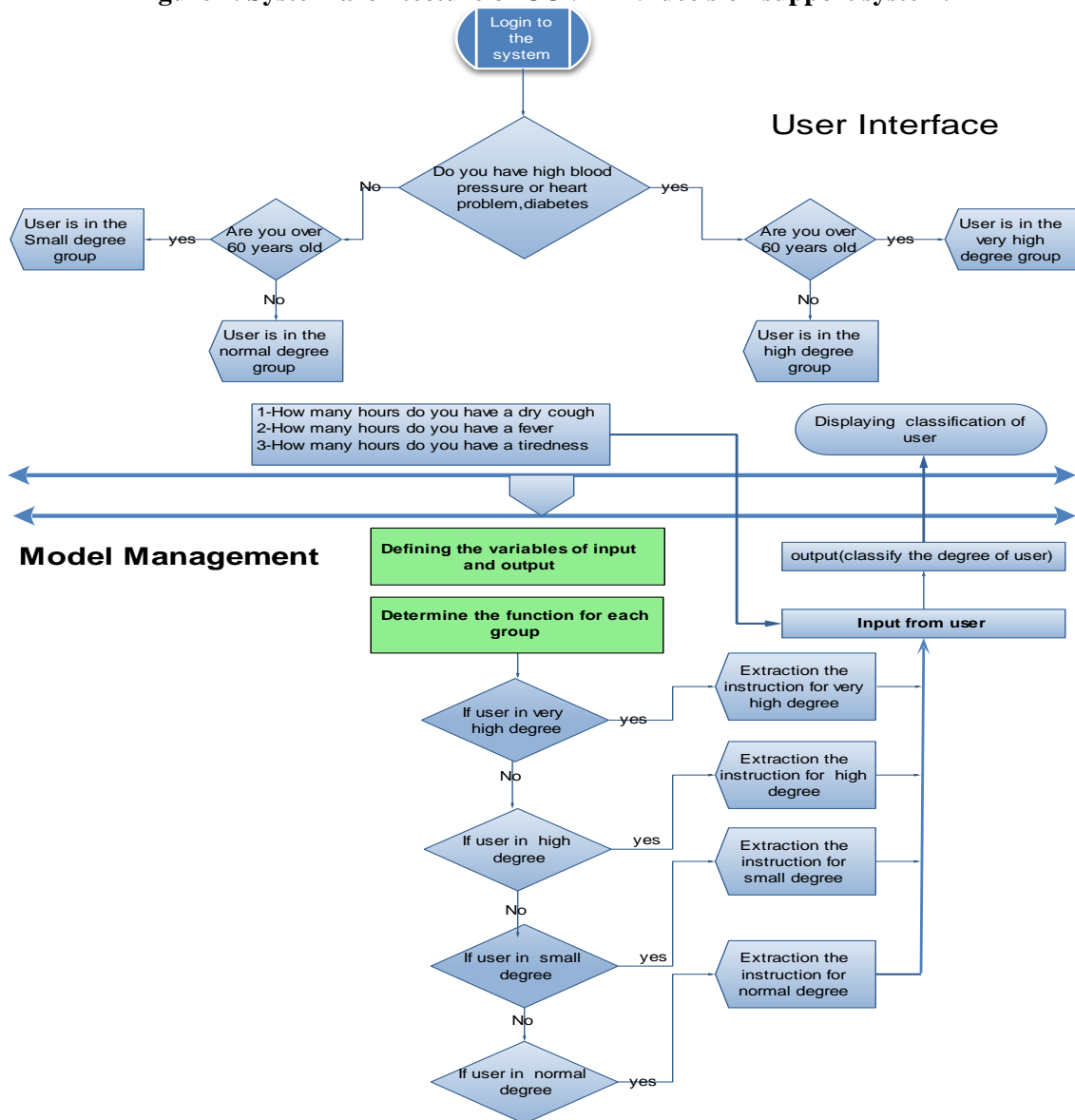


Figure 2. Data Flow in the Proposed System



The suggested DSS (Fig. 2) targets utilizing moderation exercises to diminish the impacts of Covid-19, decrease interruptions in the medical care flexibly to offer better assistance to distraught communities, and, at last, to deal with the expanded interest in the medical care gracefully. Notwithstanding, it ought to be seen that it is preposterous to expect and to give all individuals in a single community a similar remedy. As such, each gathering of the general public has explicit attributes that separate their needs from those of another gathering. Hence, more seasoned occupants and those with previous diseases, (for example, diabetes, heart issues, or hypertension) are more defenceless as per the reports of (WHO/World Health Organization). Likewise, the society individuals are partitioned inside four gatherings depending on their degree of weakness in Corona virus disease 2019 (Covid19):

- Very high degree category: individuals more than 60 years old that has fully one of the sicknesses (1-diabetes, 2-heart issues, or 3-hypertension).
- High degree category: individuals below 60 years old that has fully one of the sicknesses (1-diabetes, 2-heart issues, or 3-hypertension).
- Small degree category: individuals over 60 years old with no sicknesses.
- Normal category: individuals less than 60 years old with no sicknesses (44).

With regards to the classification of the individuals from the previously mentioned gatherings, different methodologies dependent on DTCIS can achieve that. Which, the DTCIS is utilized to order people of the general public, however for every gathering of individuals in the general public, the decision tree inference rules will be diverse. In Fig. 2, DSS structure for request of the executives in the medical care flexibly has been portrayed. In the medical care flexibly this proposed DSS, surely, goes represents as an associating span between service providers and service recipients. The data of the service recipients are grouped by inputting and reacting to the inquiries introduced by the framework; at that point, they are educated about the kind of service that they ought to get from service providers.

Along these lines, this DSS gives the grounds to request the board in the medical care flexibly by arranging the service recipients. The suggested way is likewise portrayed in the accompanying advances:

**Step 1:** The evaluation specifications of people's corporeal condition in the society are resolved. Regarding WHO reports, three specifications, to be specific fever, tiredness, and dry cough are the early

manifestations of Corona virus19. They are regarded to be the primary input variables of the DTCIS. Additionally, the characterization of the community individuals acts the output variable of this framework, at that point, the participation elements of the I/O variables ought to be characterized. The input factors comprise of three individual's functions, (low, mild, and high). The output factor is made out of five individual's categories as below:

- Type 1: Includes here, people that don't display infection indications and have typical conditions are put. These people are needed to watch the medical care tips and doing their day by day exercises as per the limitations and rules collection by their legislators.

- Type 2: This gathering containing the people collection that are dubious of the infection and, treatment, ought to be isolated and confined before their situation in their partnership with others is recognized in spite of the fact that perhaps they have a typical condition.

- Type 3: This gathering incorporates people that are associated with low infection's people and, on the off chance that they are demonstrated to be tainted; they don't necessity to going to the hospital and ought to be isolated at home.

- Type 4: In this gathering comprises of individuals that are associated with an extreme sickness and should be going to the hospital when their infection is affirmed; be that as it may, they don't need escalated care.

- Type 5: In this gathering contains those people who are associated with critical sickness and ought to be held under serious consideration in an emergency clinic if their ailment is demonstrated. In view of the suggested participation works, the evaluated people can be categorized as one of these five types.

**Sep 2:** In this progression, the decision tree C4.5 inference conditions (DTCIS) are controlled by concerning specialists and doctors for providing a connection between the I/O factors. It is significant that an alternate arrangement of decision tree C4.5 derivation conditions must be characterized for every gathering of individuals of general public.

**Sep 3:** This progression presents, the society individuals are surveyed. For this reason, the client enters the framework; at that point, the suggested DTCIS is initiated for the gatherings after it is resolved to which bunch the client has a place. At last, the client is assessed and characterized by reacting to three primary inquiries regarding fever, tiredness, and dry cough.

### Algorithm and System Flow of COVID-19DSS

The main problem of DSS is that they are not truly separated in their execution from the platform. The design of the Corona Virus Disease-19 Decision Support System (COVID-19DSS) platform architecture can define the object of

clarifying something which exists in the real world, such as (user) and in the present development which belongs to the system architecture model. The tasks of the COVID-19DSS flow are presented in the algorithm below.

#### Algorithm C4.5

**Input:** an attribute-value dataset (parameter value ,Age ,current health status (diabetes, heart disorders, or hypertension), primary symptoms ( dry cough, tiredness and fever)) D, C

**Where D=** parameter value ,Age ,current health status (diabetes, heart disorders, or hypertension).

**Where C=** primary symptoms ( dry cough, tiredness and fever).

**Where a = status of infections**

- 1: Tree = { }
- 2: **if** D is less than 60 and C parameters are normal **then**
- 3: terminate
- 4: **end if**
- 5: **for all** parameters  $a \in D, C$  **do**
- 6: Covid19 diagnosis calculation of a
- 7: **end for**
- 8: a over 60 and have diabetes, heart disorders, or hypertension and dry cough, tiredness and fever = very high degree group according to above calculation
- 9: a less than 60 and have diabetes, heart disorders, or hypertension and have dry cough, tiredness and fever = high degree group according to above calculation
- 10: a over 60 and have not diabetes, heart disorders, or hypertension and have not dry cough, tiredness and fever = small degree group according to above calculation
- 11: a less than 60 and have not diabetes, heart disorders, or hypertension and have not dry cough, tiredness and fever = normal degree group according to above calculation
- 12: Tree = Create a decision node that tests a  $a_{infection\ status}$  in the root
- 13:  $D_v$  = Induced sub-datasets from D based on  $a_{infection\ status}$
- 14: **for all**  $D_v$  **do**
- 15:  $Tree_v = C4.5(D_v)$
- 16: Attach  $Tree_v$  to the corresponding branch of Tree
- 17: **end for**
- 18: **return** Tree

Figure 3. C4.5 algorithm for COVID19DSS

Figure 3 Shows the concept of information entropy, the C4.5 algorithm builds decision trees from a set of training data in the same way as ID3 algorithm. The training data is a set of already classified samples. Each sample consists of a dimensional vector, where represents the sample's attribute values or features, as well as the class in which it falls. At each node of the tree, C4.5 chooses the attribute of the data that most effectively splits its set of samples into subsets enriched in one class or the other. The splitting criterion is the normalized information gain (difference in entropy). The attribute with the highest normalized information gain is chosen to make the decision. The C4.5 algorithm then recurs on the smaller sub lists.

### COVID-19 DSS Implementation

The implementation of Covid-19 DSS is based on the information that available in Tables 1 - 6 for the Covid-19 disease action when infected people cases are happened, and the appropriate action is taken, when assess the status of Covid-19 symptoms as described above. The results are available for the program user is shown in (Fig. 3). Decision tree models can be effectively used to determine the most important attributes in a dataset. The figure above (Fig. 3) exemplifies the use of a decision tree (in this case a C4.5 algorithm), to identify the most important distinctive 6 cases to diagnose the symptoms to determine the degree of Covid -19 virus infection to take a suitable action and to give the patient a suitable treatment as the degree of infection, for each individual situation, standard characteristics and attributes have been established.

(See Tables 2, 3, 4 and 5). With regard to them, you may determine the kind of Covid -19 virus infection treatment and therefore, we should decide on an option providing appropriate guidelines for the specific type of an action for Covid -19 virus infection. Consequently, the application sends an email to an authorised person / gathering of individuals with data in relation to the responsible

of medical centre occasion (provider service). Data is included in the email message to the emergency diseases, the source of this dangerous situation, and also the suggested treatment. The COVID-19DSS is developed on a .Net platform, using Visual Basic for the computation and DBMS (MySQL) database. All these data are put in a method as a meta-database.

**Table 1. The classification of diagnosis and symptoms of COVID-19 (45,46).**

No	Diagnosis	Symptoms
1	Epidemiological history	<ol style="list-style-type: none"> <li>1. Kids with a movement or habitation history in the town of Wuhan and surrounding zones, or different territories with constant nearby transmission inside 14 days preceding infection beginning;</li> <li>2. Kids with a background marked by reaching fever or critical patients side effects who have a background marked by touch with Wuhan City patients, and neighboring territories, or different regions with tenacious nearby transmission inside 14 days before infection beginning;</li> <li>3. Kids who are connected with a group episode or close contact with COVID-2019 contaminated cases;</li> <li>4. Infants conveyed by affirmed COVID-2019 -tainted moms.</li> </ol>
2	Clinical manifestations	<ol style="list-style-type: none"> <li>1. High heat (Fever), weariness, dry cough; there could be several pediatric patients that have second rate fever or no fever.</li> <li>2. According to previously specified chest imagery discoveries (allude to the area of Chest imaging assessment).</li> <li>3. First stage of the sickness, white platelet check is typical or diminished, or with diminished lymphocyte tally;</li> <li>4. There is no different microbe is distinguished where can completely clarify the clinical appearances.</li> </ol>
3	Confirmed cases	<ol style="list-style-type: none"> <li>1. Respiratory plot or blood tests tried positive for COVID-19 nucleic corrosive utilizing RT-PCR;</li> <li>2. Hereditary respiratory screening parcel or blood tests are profoundly homologous with the known COVID-19.</li> </ol>
5	Early identification of critical cases	<ol style="list-style-type: none"> <li>1. Dyspnea: respiratory rate &gt; 50 multiple times/min for 2 -12 month age&gt;40 times/min for 1-5 years age&gt;30 times/min in infections more than 5 years of age (subsequent to precluding the effects of fever and crying);</li> <li>2. Relentless high fever for 3-5 days;</li> <li>3. Poor mental reaction, laziness, unsettling influence of awareness, and different changes of cognizance;</li> <li>4. Anomalous expanded enzymatic lists, for example, myocardial catalysts, liver proteins, lactate dehydrogenase;</li> <li>5. Metabolic acidosis Mysterious;</li> <li>6. Chest imaging findings showing two-sided or multi-projection infiltration, pleural effusion, or fast movement of conditions during an exceptionally brief period;</li> <li>7. Babies more youthful than 3 months;</li> <li>8. Outpulmonary confusions;</li> <li>9. To conflict with different infections as well as microorganisms.</li> </ol>
6	Differential diagnosis	Differential Analysis ought to be made to recognize from influenza infection, parainfluenza infection, adenovirus, Breathless Syncytial infection, human rhinovirus metapneumo virus, SARS Covid, And other viral known diseases, just Pneumonia and bacterial pneumonia, as mycoplasma pneumonia and chlamydia. The Co- infection COVID-19 with different infections or potentially microscopic organisms ought to be considered in diagnosis .

**Table 2. The general treatment protocol of COVID-19 (45-51).**

No	Treatment/ children	Dosage
1	Treatment locations	1. In light of their ailments, suspected patients ought to be disengaged into a solitary room or self-confined at house after a specialists' recommendation. 2. Affirmed situations can be conceded in a similar keeping. 3. Basically situations ought to be accepted to ICU as quickly at time permits.
2	General treatment	An overall therapy systems incorporate the rest on the bed and strong handling; guaranteeing adequate calorie with water consumption; keeping up the water electrolyte equalization and establishes; observing fundamental the oxygen and signs immersion; protection aerobic plot unhindered and breathing in oxygen when essential; estimating blood schedule, pee schedule, C-receptive Protein, and Synthetic Blood records including liver and kidney work, myocardial compound range, and coagulation work as per infections rules conditions. Blood gas investigation and ideal revaluation of chest imaging ought to be carrying out vital.
3	Symptomatic treatment	An infected with high heat (fever) ought to be effectively striped. On the off chance that infected' internal heat level surpasses 38.5 °C with evident uneasiness, patients' body cooling (warm water shower, utilization of antipyretic fix, and so on.) or antipyretic medication treatment ought to be performed. Normal medications Includes: Oral ibuprofen, 5–10 mg / kg without fail; Oral acetaminophen: 10–15 mg / kg unflinchingly. Keep kids calm and administrate narcotics promptly when spasms or seizure happen .
4	Oxygen therapy	At the point when hypoxia shows up, viable oxygen treatment ought to be given quickly containing the catheter nasal, veil oxygen. Nasal high-barely any oxygen treatment and non-intrusive or obtrusive ventilation mechanics ought to be attempted when fundamental.
5	Antiviral therapy (Interferon- $\alpha$ )	In the initial stage of contamination, interferon- $\alpha$ can minimize viral burden, which can help with minimizing indications and abbreviate the course of infection. In view of our clinical trials and interferon - $\alpha$ use experiences in the treatment of bronchiolitis, viral pneumonia, extreme upper respiratory plot contamination, hand foot mouth disease, SARS, and other viral diseases in young people, the proposed use is as follows: Interferon- $\alpha$ nebulization: interferon- $\alpha$ 200,000-400,000 IU / kg or 2-4 $\mu$ g / kg in 2 mL .1 'of sterile water, 5-7 days of nebulization twice a day Interferon- $\alpha$ 2b splash: added to high-risk populations with close association with .2 suspected COVID-19 patients with blemish or other early-stage upper respiratory plot symptoms. Patients should use 1-2 8-10 nasal cavity splashes on either side of the oropharynx, the portion of interferon- $\alpha$ 2b per infusion is 8000 IU, when each 1–2 hours, 8–10 showers/ day for 5–7 day course .
6	Usage of other agents (Antibiotics)	Maintaining a strategic distance from silly utilization of antibiotics, particularly in mix with expansive range antibiotics. Giving close consideration to the progressions of conditions in kids with dessert of bacterial or parasitic contamination; effectively gathering tests for microbe investigation and opportune or levelheaded utilization of anti-infection agents or against contagious medications.
	Arbidol, oseltamivir and other anti-influenza drugs.	Arbidol is administrated for grown-ups contaminated with COVID-19; notwithstanding, its efficacy and security stay muddled. Oseltamivir and other enemy of flu operators can be applied for patients confected with other flu infection.

**Table 3. Chinese Treatments Protocol of COVID-19 (52).**

No.	Chinese Protocol Treatments	Dosage
1	Clinical treatment period	
	1. Asymptomatic infection:	(1) Restorative techniques: reinforcing the solid and dispersing pathogenic elements; (2) Suggested solution and medications: changed Yupingfeng powder combined with Buhuanjin Zhengqi powder consist of 9–12 g of Zhihuangqi (Arranged Astragalus), 6–9 g of Chaobaizhu (Simmered Rhizoma Atractylodis Macrocephalae), 3–9 g of Houpo (Ofcinal Magnolia Bark), 6–9 g of Cangzhu (Atractylodes lancea), 6–9 g of Chenpi (Pericarpium citri reticulatae), 3–6 g of Jiangbanxia (Ginger handled pinellia), 6–9 g of Huoxiang (Agastache rugosus), 6 to 9 g of Fuling (Poria cocos), and 3–6 g of Zhigancao (Arranged Liquorice Root).
	2. Wintry and humid tightening the lung:	(1) Clinical signs: abhorrence for coldness, high heat( fever) or no fever, dry cough, sore stomach, nasal clog pain, sleepiness and exhaustion, sickness and regurgitating, free stool, pale tongue or rosy tongue with whitish greasy hide, floating, and delicate heartbeat;  (2) Helpful techniques: scattering bellows to advance pathogenic factors, remove toxic substances, and dissipate sogginess; (3) Solution and medications: modified Qingqi decoction made out of 6–9 g of Cangzhu, 3–9 g of Houpo, 6–9 g of Chenpi, 6–12 g of Huoxiang, 3–9 g of Banxia, 3–9 g of Xingren, 9–15 g of Suye, 6–9 g of Jiegeng, 6–9 g of Guanzhong, 6–9 g of Fuling, 3–6 g of Shengjiang, and 3–6 g of Gancao.
	3. Pest venom obstructing lungs:	(1) The sign of clinical: fever continues or chill and fever substitute; cough with close to nothing or yellow mucus; windedness keeps down; stomach distension stoppage. The tongue is red, while the greenery is yellow and oily or yellow and dry. Slide number of corridors and veins. (2) Helpful techniques: detoxification, inauguration and shutting, scrub the bellows, and moistness; (3) Solution and medications: adjusted Xuanbai Chengqi decoction made out of 6–9 g of Huoxiang, 10 g of Cangzhu, 3–6 g of Zhimahuang, 3-9 g of Chaoxingren, 15–30 g of Shengshigao, 10 g of Gualou, 3–6 g of JiuJun (to be included later in arrangement), 6–9 g of Huangqin, 6–9 g of Fuling, 6–9 g of Danpi, 6–9 g of Shichangpu, and 3–6 g of Chuanbei.
	4. Inner blocking causing unconsciousness and collapse:	(1) Clinical appearance: dyspnea, dormancy, eagerness, cold and strain in appendage, dim purplish tongue, thick and disgusting hide or dry hide, enormous floating and shaky heartbeat, cyanosis in finger prints, and going after the Ming guan point (distal phalanx);  (2) Restorative strategies: inauguration the impeding and solidification brokenness, detoxifying, and resuscitating the oblivious. (3) Remedies and medications: modified Shenfu decoction in addition to Shengmai drink made out of 3–6 g of Renshen (radix ginseng), 6–12 g of fuzi (radix aconiti Praepareta) (to be decocted 60 minutes frst). 6–12 g of Shanzhuyu (Fructus Corni), 10 g of Maimendong (Radix ophiopogonis), and 3–6 g of Rougui (Cinnamomum cassia), to be taken with Angong Niu Huang Pill.
	5. Both lung and spleen Qi deficiency.	(1) Clinical appearance: weak cough, stupor and asthenia, unconstrained perspiring, helpless hunger, free stool, pale tongue with whitish and elusive hide, weakly, and powerless heartbeat; (2) Restorative techniques: feeding the bellows and reinforcing the spleen, supporting qi, and remove moisture (dehumidifying). (3) Remedy and medications: modifed LiuJunZi decoction made out of 15 g of Zhihuangqi (Arranged Astragalus), 10 g of Xiyangshen (American Ginseng), 10 g of Chaobaizhu (Simmered Rhizoma Atractylodis Macrocephalae), 6 g of Fabanxia (Rhizoma Pinelliae preparatum), 6 g of Chenpi (Pericarpium citri reticulatae), 3 g of Chuanbei (Ring leaved fritillary bulb), 15 g of Fuling (Poria cocos), 6 g of Huoxiang (Agastache rugosus), and 3 g of Sharen (Fructus amomi) (to be included later).

**Table 4. Another protocol of treatment/Adult for COVID-19. Medicine with their potion and the interval of therapy (53).**

No.	Medicine	Potion	The way of administration	Interval of therapy
1	IFN- $\alpha$	5 ,000,000 Unit or tantamount dose each time, 2 times per day	Vapour inspiration	Maximum ten days
2	Lopinavir/ritonavir	200 mg/50 mg/capsule, 2 capsules every time, 2 times per day	Via drink	Maximum ten days
3	Ribavirin	500 mg every time, 2 to 3 times per day in mix with IFN- $\alpha$ or lopinavir/ritonavir	Vascular casting	Maximum ten days
4	Chloroquine phosphate	500 mg (300 mg for chloroquine) every time, 2 times per day	Via drink	Maximum ten days
5	Arbidol	200 mg every time, 3 times per day	Via drink	Maximum ten days

**Table 5. Iraqi Treatment Protocol of COVID-19 (45).**

No.	Dosage
1.	Oxygen treatment acts to the primary treatment mediation for infections with serious contamination. Breathing mechanics might be wanted in instances of aerobic disappointment headstrong to oxygen treatment.
2.	Use the drug Chloroquine and its subordinates (Hydroxy-chloroquine), in tablet structure, have been proposed for those tainted with the Covid-19. The results with chloroquine have demonstrated a specific remedial impact in diminishing the recuperation time frame, and diminishing the combustible time in the medical clinic.
3.	Arbidol, which has been utilized to treat flu infection contaminations, has additionally been accounted for to go about as a Covid-19 disease restraint at 10-30 mM focuses.
4.	The antiviral medication Favipiravir can be utilized versus unfamiliar flu strains and an expansive scope of RNA infections. In another way, clinical preliminaries are being directed to evaluate its adequacy in handling SARS-COV-2. When favipiravir is in the cells, it will change over to its dynamic phosphoribosylated structure which is perceived as a viral substratum, RNA subordinate polymerase RNA, prompting a lessening in the movement of RNA polymerase.
5.	Lopinavir-ritonavir has additionally been referenced into writing as if it had been utilized to hindrance of SARS-COV-2. This medication was providing to a Coronavirus tainted infections in republic of Korea, by giving tow tablets for each day.
6.	Another treatment indicated for reducing coronavirus infections as well as inflammation is baricitinib.
7.	In French patients, the mixture of azithromycin with hydroxyquinone was analyzed and a crucial reduction in viral load was observed on day 6.
8.	In patients with SARS-CoV and MERS-CoV, corticosteroids have usually been used to curb upgraded cytokine levels, but are not recommended for basic use in the treatment of SARS-CoV-2 infected patients.

**Table 6. The Prevention Protocol for COVID-19 (54,55).**

1.	Wash your hands routinely and altogether with cleanser and water for in any event 20 seconds or with a liquor based hand rub (hand sanitizer that contains at any rate 60% liquor) totally spread your hands and rub them together until they don't dry particularly after you have been visited an open spot, or subsequent to cleaning out your nose, wheezing or hacking.
2.	Keep up social removing (keep up at any rate 1 meter or 3 feet separation among yourself and anybody) and stay away from close contact with individuals who are debilitated (who is hacking or wheezing).
3.	Take measures to protect others by avoiding big events and public gatherings. If you're going to get medical attention, stay home if you feel unwell.
4.	When you have a high heat (fever), cough and trouble breathing, contact your doctor online for EJMO 123 medical treatment.
5.	Avoid using public transit if you're sick.
6.	Tissue paper protects your mouth and nose if you cough or sneeze.
7.	Immediately wash your hands with antiseptic soap and water if you used tissues in the trash.
8.	On the off chance that conceivable, remain disengaged in a different family and pets' room and wear a facemask when you are around others.
9.	Limit the quantity of people entering disconnection territories, containing the room of a suspected infection and affirmed Coronavirus. For the practice of healthy work, secure labourers to prevent touch with the tainted

individual by utilizing extra designing and regulatory control.

10. Most patients introducing in network drug stores are probably not going to have Coronavirus. In the event that they have coughs, colds or influenza like side effects yet not applicable to Coronavirus, travel or contact history, drug stores ought to continue in accordance with their best practice and routine administration of the cross-disease dangers to staff and different patients.
11. Keep away from physical touch directly (counting bodily assessment and introduction) to aerobic and other person discharges.
12. Before clinical consideration is begun, Distinguish the expected cases as quickly as time permits and disengage the speculated individuals independently from the individuals who affirmed instances of the infection Coronavirus, to Forestall the likely transmission of contamination to different patients and medical services staff.
13. Apply disinfectant every day on oftentimes contacted surfaces. This incorporates work areas, telephones, consoles, latrines, fixtures, tables, door handles, light switches, ledges, handles, and sinks.
14. Prevent sharing bedding, plates, glasses and other household products if you're have a corona viruse19 infected.
15. It is better If you use a split bathroom and toilets from the family.
16. Must stay at home for a period of time and follow the advices of your doctor.
17. Determine and split Suspected Cases.



Figure 4. Primary window of the application (COVID-19 DSS).

Figure 4 demonstrates the principle window of an application (Covid -19 DSS). The parts of the Covid -19 DSS approach are numerous fields as buttons. Software of Covid -19 virus infection: contains information about the strategies to manage Covid -19 virus infection to protect human health (Provider Service). Sign in: contains the permission

to the authority of application. Send E-mail: The email message incorporates information regarding the emergency case reasons, the origin of this case, and the risks associated with this type of case, and in addition the proposed therapy. Exit: exit from the application.



Figure 5 . Authentication window to entre to the COVID-19 DSS application.

Figure 5 shows the login page to enter emergency case data. The user can enter secret key

and a user name (username: user1 and password: admin) as a default value, and can change it.

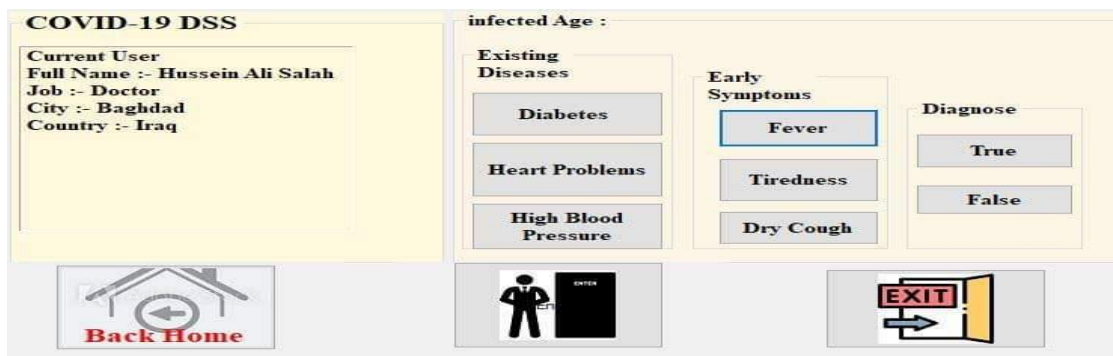


Figure 6. The dialog of primary test of COVID-19 DSS to detect the infection.

Figure 6 describes the reactive page. The user of an application (an authority of provider service) can enter the data of the suspect infected case and implement the test to have a best decision about each infection case. The Covid -19 DSS uses standard of Covid -19 virus infection information as

two questions (1-existing diseases, 2- early symptoms) an instance of any suspect circumstance to determine the infection case of Covid -19 virus. If there is an infection, then diagnose is true else false.



Figure 7. The diagnoses classification of COVID-19 infection virus.

Figure 7 describes the six diagnoses classification of Covid -19 infection virus in Covid -19 DSS application. There are six important Covid -19 virus infection different situations that should be having immediately action to save the life of peoples. From these, we can pick the information about each class, after making the primary test (Fig. 6) to detect the infection or not. When the test is true and the age of patient is entered we can chose one of the six

classifications depending on the patient symptoms to give her/ him the suitable treatment as appears in (Table 2). The data investigation and displaying restorative can be recovered through DBMS (MySQL) in order to demonstrate the really treatment, in other words it is provided as an input for analysing the medical model to acquire really advice and advantages of the unmistakable practices for evading the death.



Figure 8. The types of suggest treatment protocol of COVID-19 virus infection.



Figure 8 demonstrates the four types of suggest treatment protocol of Covid -19 virus infection in Covid -19 DSS application (Fig. 8). From these, we can choose the suitable treatment protocol

depending on the age of patient and the statue of infection, which can pick the dosage to give it to the patient as appears in Tables 2, 3, 4 and 5.



Figure 9. An example of COVID-19 treatment for children infection

Figure 9 demonstrates the dosage to treatment a children that has a COVID-19 virus by using a general protocol treatment as (Table 2). One of the

treatment types of this protocol is Antiviral therapy, which uses the dosage as seen in (Fig.9).



Figure 10. The degree of infection status and the suggest prevention protocol for COVID-19 virus.

Figure 10 shows the report of all information about any classification case of Covid -19 infection, where this report includes the status of patient (degree of infection) and the prevention protocol as in (Table 6). Finally, the program will send a reply email to the control centre (medical expert) where the report containing this information can be sent.

### Limitations

This virus spreads quickly, so any inability to deal with its distribution raises the number of people infected rapidly; therefore the datasets are changeable from community to others. The virus takes different forms depending on its severity (strong, normal and weak), and causes misdiagnosis. There is no 100% effective treatment protocol yet so that it can be adopted in the decision support system.

This study is limited to finding a unique way to address this specific class of problems and does not include such issues as distributed systems security and efficacy. Furthermore, the specific COVID-

19DSS scenarios described in this study are used for the purpose of this discussion, and are not intended to be an exhaustive generalization of any of the example problems. Other COVID19DSS problems exist with different seating rules and goals. It is not the intent of this study to account for all methods. Although the design and development of decision support systems (DSS) has been ongoing for more than 40 years, DSS has yet to overcome a number of limitations, some of which are, poor flexibility poor maintainability and limited reusability. Also, because the system is still in the implementation and application stage, it is not possible to obtain the related information of the patients in the application and in-hospital visits in a timely manner, so the diagnostic effects produced by the real system application cannot be assessed in a timely manner.

### Comparative Related Work

The primary tool being developed by the Sustainable and Healthy Communities (SHC) Research Program to enhance sustainable decision

making is called TRIO (Total Resources Impacts and Outcomes) (56). The authors (57) have suggested utilizing a combination of intelligent agents operating within an agent-based intelligent decision support system for clinical management and research. The IDSS intended purpose is the improvement of decision quality and its proposed use focuses on urgent cases. The decision making process system, namely the solution manager service, analyzes information from the information integrator layer and builds solutions, makes use of

the other layers in its operation, and of web services to display and supervise its operation. As all these works have demonstrated novel and promising practical and theoretical outcomes, it seems to be important to create an agent-based decision support system (ADSS) for knowledge discovery and assessment of environmental tension on the population through detailed analysis of endogenous and exogenous disease cases. (Table 7) shows some examples of DSS and their corresponding environments, sensors and actuators.

**Table 7. Example of conventional systems and their environments (58)**

No.	DSS Type	Environment	Actuators	Sensors
1.	Medical Diagnosis System	Patient, hospital, staff	Display questions, tests, diagnoses, treatments, referrals	Keyboard entry of symptoms, findings, patient's answers
2.	Satellite Image Analysis System	Downlink from orbiting satellite	Display categorization of scene	Color pixel arrays
3.	Part-Picking Robot	Conveyor belt with parts; bins	Jointed arm and hand	Camera, joint angle sensors
4.	Refinery Controller	Refinery, operators	Valves, pumps, heaters, displays	Temperature, pressure, chemical sensors
5.	Interactive English Tutor	Set of students, testing agency	Display exercises, suggestions, corrections	Keyboard entry

Thus, the main practical aim of the research is to create a situation assessment medical DSS that diagnosis, treatment and prevention COVID-19 disease and follows the correspondent changes in human health, generating a set of alternatives for successful and sustainable situation management.

### Conclusion:

Coronavirus19 Decision Support System (COVID-19 DSS) was suggested to help individuals and labourers in the field of clinical administration in utilizing a total "one-bundle" strategy to deal with basic crisis cases and to take vigorous activities if there should develop an occasion of risky instances of Covid -19. The DSS is appropriate for managing kinds of issues that don't have an unmistakably depicted structure, since a standard synthesis of PC programs is hard to apply for Covid -19 conditions. Various causes are watched and organized by utilizing a logical model. The application considers the real assessment of Covid -19's standard symptoms, which focuses on a definitive destination of perceiving the instance of Covid -19 infection and giving a suitable proposition for a treatment protocol. COVID-19DSS is an aggregation of programming tools, for example, models, records, data bases, and information organization programs that are gathered

along with an easy to-use interface. COVID-19 DSS gives all the significant strides to a standard decision making procedure which utilizes a decision tree C4.5 algorithm. The levels of the system plan, practically and logical affiliation were presented. Real-time effort with the client gives an extent of possible results in choosing one activity from some decisions, which are made by the system through guided data mining and PC simulation. The proposed system contains almost comprehensive information. Firstly, it needs to determine the three early symptoms of COVID-19 pandemic criteria (fever, tiredness, dry cough and breathing difficulty) used to diagnose the person being infected by COVID-19 virus or not. Secondly, this approach divides the infected peoples into four classes, based on their immune system risk level (very high degree, high degree, mild degree, and normal), and using two indices of age and current health status like diabetes, heart disorders, or hypertension. Where, these people are graded and expected to comply with their class regulations. There are six important COVID-19 virus infections of different classes that should receive immediate health care to save their lives. When the test is positive, the patient age is considered to choose one of the six classifications depending on the patient symptoms to provide him the suitable care as one of the four

types of suggested treatment protocol of COVID-19 virus infection in COVID-19 DSS application. Therefore we expected the accuracy of the system will be effective 90% for the doctors to save the life of COVID-19 infections. In the future we can develop the proposed system to make it a website under name (Human Health Center (HHC)) in order to evolve it into a clinical database, where patient history is stored, enabling us to know the effect of the environment diseases (the epidemic) on human health by using a new architecture to store the medical records in a XML database, which stores a set of annotated files. Our framework will attempt earlier diagnosis and triage support approaches with more collection of relevant clinical data, and we can also address and examine the effect of dynamic differences in the clinical details of patients on their COVID-19 primary prevention. In the future, COVID-19DSS as a medical system will be the core component for an online prediction system. Such a system will be able to predict the diagnosis and provide the treatment for more than one disease; this system will also be able to predict adding a prediction module (PM) with a learning module (LM) to the COVID-19DSS model. The LM's purpose is to learn from historical stored data.

#### Authors' declaration:

- Conflicts of Interest: None.
- We hereby confirm that all the Figures and Tables in the manuscript are ours. Besides, the Figures and images, which are not ours, have been given the permission for re-publication attached with the manuscript.
- Ethical Clearance: The project was approved by the local ethical committee in Technical Institute-Suwaira, Middle Technical University

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## نظام اتخاذ القرار لتشخيص وعلاج والوقاية لمرض كورونا فيروس 19

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### الخلاصة:

تم عمل نظام دعم القرار السريري الآلي (CDSS) كنموذج جديد في الخدمات الطبية. بحيث يتم استخدام CDSSs لمساعدة الأخصائيين (الأطباء) في اتخاذ قراراتهم المحيرة. ولهذا السبب، تم بناء DSS اعتماداً على معرفة الأطباء وباستخدام استخراج البيانات لمساعدة خلية الأزمة الطبية للسيطرة على جائحة فيروس COVID-19، وبشكل عام، لتحديد الفئة من العدوى وتقديم علاج بروتوكول مناسب حسب أعراض المريض. في البداية لتشخيص المرض تم الاعتماد على ثلاث أعراض أولية هي ( الحمى، التعب والسعال الجاف) لمعرفة الشخص المصاب وعند تحديد أي من هذه الأعراض يتم تقسيم الأشخاص المصابين إلى أربعة اصناف حسب مناعة الأشخاص ( إصابة طفيفة، إصابة عالية، إصابة شديدة جدا و طبيعى). وايضا يتم التشخيص باستخدام عاملين هما ( عمر المريض و الأمراض المزمنة للمريض مثل السكر ومشاكل القلب وضغط الدم ) ثم يتم تقدير حالة المصاب حيث توجد ستة مستويات للأشخاص المصابين بفيروس كورونا 2019 وتحتاج إلى عناية حسب حالة المصاب. عندما يكون الفحص موجب واعتمادا على عمر المريض والأمراض المزمنة يتم تحديد في أي مستوى من المستويات الستة يكون المريض حسب الأعراض. وبذلك يتم تحديد درجة حالة المريض من الدرجات الأربع ثم يتم اقتراح أربعة بروتوكولات للعلاج ويتم اختيار الأنسب حسب اختيار الأطباء وايضا يوفر النظام معلومات كاملة عن الوقاية وتجنب الوباء واخيرا يتم ارسال ايميل يحتوي جميع المعلومات من مركز السيطرة للأشخاص المسؤولين. تم اعتماد خوارزمية C4.5 في شجرة اتخاذ القرار لبناء هذا التطبيق.

**الكلمات المفتاحية:** خوارزمية C4.5، نظام دعم القرار السريري، جائحة كورونا 2019، نظام اتخاذ القرار، شجرة القرار.