# Resolving Some Critical Issues in the Prevention, Diagnosis, Treatment and Management of Covid-19 Using Machine Learning

Dipo Theophilus Akomolafe[1], Oluwatoyin Mary Yerokun[2], Ayo Fasakin[1]

[1] *Department of Mathematical Sciences, Olusegun Agagu University of Science and Technology, Okitipupa, Nigeria*

[2]*Department of Computer Science Education, Federal College of Education (Technical), Asaba, Nigeria*

**ABSTRACT:** *COVID-19 is a highly transmittable viral infection with symptoms similar to some common diseases like malaria, diabetes, asthma and viral pneumonia. The global spread of the disease has made government of different nations to put measures in place to curtail its spread within their territories. Critical issues were raised as a result of these measures especially with mode of prevention, diagnosis and treatment. There is currently no cure found yet for the virus but health administrators isolate suspected COVID-19 patients and treat with various combinations of drugs and therapy. The confusing symptomatic resemblance with other diseases makes it extremely difficult to precisely diagnose its infection in patients. The high rate of spreading also made it imperative to isolate any person presenting any of the symptoms listed as COVID-19 patients; therefore, mistakes are bound to be made with this nonspecific diagnosis. This paper is proffering a technological way of resolving these critical issues by the application of Machine Learning, an Artificial Intelligent tool in the diagnosis of the disease. Python is herein used to build a system in pytorch and jupyter environment. The system successfully separated and classified the critical symptoms from general and common illnesses before following up on other tests while cross-referencing with laboratory and scan test results in the database, all with monitored consideration of the similarities in their symptoms*

**Keywords** - *Coronavirus, COVID-19, Machine Learning, Malaria, Asthma, Viral Pneumonia, Social distancing, Physical distancing*

## I. INTRODUCTION

COVID-19 is an infectious disease caused by a newly discovered coronavirus. It belongs to the Coronaviridae family in the Nidovi-rales order. Corona represents crown-like spikes on the outer surface of the virus, thus, it was named coronavirus (17). It is a highly transmittable and pathogenic viral infection caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2).

## II. ORIGIN AND SPREAD OF COVID-19

COVID-19 was first found in Wuhan, an emerging business hub in China in late 2019.More than eighteen hundred people died and over seventy thousand individuals were infected within the first fifty days. Wuhan is a seafood market where live animals such as bats, frogs, snakes, birds, marmots and rabbits are sold. On January 12, 2020, the National Health Commission of China released further details about the epidemic, suggested viral pneumonia (20). (17) stated that, from the sequence-based analysis of isolates from the patients, the virus was identified as a novel coronavirus. Moreover, the genetic sequence was also provided for the diagnosis of viral infection. Initially, it was suggested that the patients infected with the virus may have visited the seafood market or may have used infected animals or birds as a source of food.

However, it was observed that some individuals were infected with no record of visiting the seafood market. This observation indicated a human to the human spreading capability of this virus. The human to the human spread of the virus was confirmed to be from close contact with an infected person, exposure to coughing, sneezing and respiratory droplets or aerosols. These aerosols can penetrate the human body (lungs) via inhalation through the nose or mouth (17) as previously seen in SARS-CoV and MERS-CoV, the two other zoonotic coronaviruses.

In healthcare settings, this highlights the necessity of practicing respiratory hygiene and hand hygiene, and using appropriate personal protective equipment (12, 15). It has reportedly spread to almost all parts of the world. Given the rapid spread of this virus with consequences on an international scale, COVID-19 was declared a pandemic by the World Health Organization on March 11, 2020 (21). It therefore becomes imperative that health care workers and researchers across all disciplines be aware of the potential impact that this disease can have on their respective fields and the medical community at large (7).Genomic analysis showed that SARS-CoV-2 is phylogenetically associated with severe acute respiratory syndrome-like (SARS-like) bat viruses

and many believed that bat could be the primary source of origin of the virus (17). However, the intermediate source of origin and transfer to humans are yet to be scientifically confirmed. According to (17) Coronaviruses are minute in size (65–125 nm in diameter) and contain a single-strand RNA as a nucleic material, size ranging from 26 to 32kbs in length as illustrated in (17). The subgroups of coronaviruses family are alpha (a), beta (b), gamma (c) and delta (d) coronavirus. The severe acute respiratory syndrome coronavirus (SARS-CoV),H5N1 influenza A, H1N1 2009 and syndrome coronavirus (M ERS-CoV) caused an endemic in Middle Eastern countries[21].The International Committee on Taxonomy of Viruses (ICTV) named the virus as SARS-CoV-2 and the disease as COVID-19[3,10,14].

As a result of the fast spread of COVID-19, various countries put in different, specific and critical measures in place for the prevention, diagnosis, treatment and management of the virus. Examples are closure of public places, suspension of academic calendars, curfew in populated cities and order to arrest and prosecute defaulters. These measures became associated with a lot of misgivings, confusions, conceptions and realities.

The primary objective of this research therefore, is to attempt to resolve some of the conflicts and confusion associated with the, prevention, diagnosis, treatment and management of COVID-19 using Artificial Intelligent tool (AI) called Machine Learning (ML).

## III. DIAGNOSIS AND TREATMENT

**Diagnosis:**

Diagnosis of the virus can be done by:

i. Laboratory test
ii. CTScan

**Treatment:**

Prevention: One of the prominent measures reeled out by (22) and adopted globally is to keep social distancing. Social distancing refers to staying at least 6 feet apart whenever two or more people are in a place to prevent spreading the infection. Social distancing alone is not enough to keep or curtail the spread of the virus but it is intended to flatten the curve i.e. slowing down the spread of the virus to prevent an increase in the number of people getting sick. Although social distancing and isolation have unseen impact on the mental health and emotional wellbeing of those that have put them into practice, but it has proved effective. Social distancing in concept is separation from family, friends and associates. Physical distancing simplifies the concept with the emphasis on keeping a minimum of four feet away from others irrespective of their social status. It lays emphasis on the fact that people have to responsibly maintain a physical distance from each other and don't gather in large groups at any given time or place; be it a place of worship, meetings etc. The efficient and effective measure that can curtail the spread of COVID-19 without injury to our mental state and well-being is physical distancing and not social distancing.

**Components of Physical Distance:**

a. **Reduce time spent in public places:** Avoid going outside your homes, but if necessary, minimize the time spent in company of other people.
b. **Keep a safe distance:** Maintain a safe distance of six feet to avoid contact with person and render impotent any cough or sneeze droplets released by any close persons.
c. **Use of hand sanitizer:** Practice hand hygiene with alcohol-based hand rub (ABHR).It is widely encouraged as a most effective, simple and low-cost procedures against COVID-19 cross-transmission [23]. By denaturing proteins, alcohol inactivates enveloped viruses, including coronaviruses, and thus ABHR formulations with at least 60% ethanol have been proven effective for hand hygiene [4]. Before entering and after coming out of a house, store, or any public place, it is necessary to use a hand sanitizer to prevent the spread of any viruses one may have come into contact within the building [11].
d. **Washing of hands:** Whenever possible, it is advisable to use soap and running water to wash hands instead of hand sanitizer. While hand sanitizer is a great option when it is difficult to get running water for thorough hand washing, the hand must be washed for a minimum of twenty seconds under running water
e. **Covering of mouth:** Physical distancing requires that the mouth must be covered when a sneeze or coughs. The mouth should be covered with a tissue or the inside of the elbow. If tissue is issued, it should be disposed immediately and wash or sanitize the hands.

### *A. Diagnosis of COVID-19*

The main clinical symptoms of COVID-19 are fever, fatigue, and a dry cough. [8] argued that Laboratory examination in the early stage of the disease shows a normal or decreased white blood cell count, and a decreased lymphocyte count. While CT examination serves as the screening and diagnostic basis for

COVID-19, its accuracy is limited. The name of the infection and illness is COVID-19 and is caused by the new strain of coronavirus called SARS-Cov-2. One type of the infection detects the genetic material (RNA) of the virus present in a sample from the respiratory tract and the other type which is serology blood tests detect antibodies that are produced in response to the infection. [16] declared that the disease evolution and the symptoms vary from asymptomatic patients to severe cases of respiratory failure, which can lead to death, confirming that some risk factors may be associated with the evolution and severity of the disease. The presence of COVID-19 can be determined and confirmed in a person by subjecting the person to any of the two methods of laboratory test and scanning. The presence of the virus in a person is confirmed if the person tests positive to it, such person is moved immediately to an isolation centre for necessary treatment. [6] observed that patients with metabolic disorders like obesity, diabetes, cardiovascular and liver diseases may face a higher risk of infection of COVID-19, greatly affecting the development and prognosis of the disease and eventually making the outcome significantly worse in such patients. Furthermore, [2] opined that many patients of COVID-19suffer cardiovascular (CV) disease or develop acute cardiac injury during the course of the illness.

## IV. CHALLENGES OF METHODS OF DIAGNOSIS

The result of the research carried out by [2] indicated that respiratory illness is the dominant clinical manifestation of COVID-19; CV involvement occurs much less commonly. [9] opined that Cardiac manifestations etiology seems to be multifactorial, comprising direct viral myocardial damage, hypoxia, hypotension, enhanced inflammatory status, ACE2-receptors down regulation, drug toxicity, and endogenous catecholamine adrenergic status, among others. [9] reiterated that studies evaluating patients with COVID-19 presenting cardiac injury markers show that it is associated with poorer outcomes, and arrhythmic events are not uncommon. [5] stated that those with COVID-19 and pre-existing cardiovascular disease have an increased risk of severe disease and death and that the infection has been associated with multiple direct and indirect cardiovascular complications including acute myocardial injury, myocarditis, arrhythmias, and venous thromboembolism. In view of the similarities in the symptoms of COVID-19 and these diseases, there is likelihood that anybody suffering from any of these diseases can be assumed to be a carrier of COVID-19. This is a critical issue that needs to be resolved to prevent wrong assumption. One way to resolve this critical issue is the application of Machine Learning in the diagnosis and treatment of COVID-19.

According to [13], two kinds of tests are available for COVID-19: viral test and antibody test.

- A viral test tells if a person is having a current infection.
- An antibody test might tell if a person had a past infection. An antibody test might not show if you have a current infection because it can take 1–3 weeks after infection for your body to make antibodies. Having antibodies to the virus that causes COVID-19 might provide protection from getting infected with the virus again. If it does, we do not know how much protection the antibodies might provide or how long this protection might last.

Testing Procedures; the most effective procedure involves proper collection of the appropriate sample. For RT-PCR Testing, the preferred sample is a swab from the back of the nose and is called Nasopharyngeal Swab i.e. NP swab. Sample can also be collected through a swab from the back of the throat (or pharyngeal swab) or a swab from the front of the nose (nostril). Sometimes an NP swab and a throat swab are both collected to increase the chances of getting enough viruses for the test.

For Antibody Testing: A blood sample is obtained by inserting a needle into a vein in the arm or by pricking a fingertip and collecting a few drops of blood.

This was underlined in [5]where it was observed that the unprecedented challenge presented by COVID-19 has brought novel and dramatic ethical dilemmas, ranging from policy issues (e.g., focusing on containment and mitigation vs. herd immunity), as well as clinical dilemmas (e.g., considering all patients alike vs. triaging patients according to age, co morbidities, and expected prognosis, similar to other catastrophic circumstances). It is therefore likely to confirm any person with any or all of these other diseases (malaria, viral pneumonia, asthma etc.) as COVID-19 carriers. These similarities and resemblance have brought about critical issues and confusion in the process of diagnosis of COVID-19. Therefore, there is the need to resolve this issue and knows who actually is suffering from which disease or not hence Machine Learning.

## V. MACHINE LEARNING (ML)

ML is a subset of Artificial Intelligence (AI) and it is a science of designing and applying algorithms that are able to learn things from past cases. ML enables IT systems to recognize patterns on the basis of existing algorithms and data sets and to develop adequate solution concepts. [19] revealed that ML has the potential to improve hypothesis generation

and testing tasks within a health system by revealing previously hidden trends in data, and thus has the potential for substantial impact both at the individual patient and system level. According to [1], healthcare service providers generate a large amount of heterogeneous data and information daily, making it difficult for the "traditional methods" to analyse and process it. ML methods help to effectively analyse this data for actionable insights.

ML is a tool that can be used to enhance humans' abilities to solve problems and make informed inferences on a wide range of problems, from helping diagnose diseases to coming up with solutions for global climate change, therefore ML is presented here to resolve the issues involved in the diagnosis and treatment of COVID-19

The table below shows the comparison between COVID-19 to other diseases

**Table 1. COVID-19 compared to other diseases**

| SYMPTOMS | COVID-19 | COMMON COLD | VIRAL PNEUMONIA | FLU | ASTHMA | ALLERGIES |
|---|---|---|---|---|---|---|
| | | | | | | |
| Fever | Common | Rare | Common | Common | Rare | Sometimes |
| Dry cough | Common | Mild | Common | Common | common | Sometimes |
| Shortness of breath | Common | No | Common | No | common | Common |
| Headaches | Sometimes | Rare | Common | Common | Rare | Sometimes |
| Aches and pains | Sometimes | Common | Common | Common | common | No |
| Sore throat | Sometimes | Common | No | Common | Sometimes | No |
| Fatigue | Sometimes | Sometimes | Common | Common | common | |
| Diarrhoea | Rare | No | No | Sometimes | Rare | No |
| Runny nose | Rare | Common | No | Sometimes | Rare | Common |
| Sneezing | No | Common | Common | No | | Common |

In order to resolve the issues associated with the similarities between COVID-19 and other diseases which in some cases had led to wrong and faulty diagnosis, ML is used to study and process the patterns and components of these diseases. Fundamentally, it is essential to first identify and confirm all diseases the person has been exposed to and which bears true resemblance to COVID-19 to enable the software to independently generate solutions. These are the required data that will be fed into the systems in advance and the respective analysis rules for the recognition of patterns in the data stock must also be appropriately defined. Once these two steps have been completed, the system will then perform the following tasks:

- Finding, extracting and summarizing relevant data
- Confirm specific illness
- If negative, recommend next test
- If positive, recommend CCT Scan
- Recommend appropriate treatment

## VI. METHODOLOGY

The system is a computer vision task (object recognition), written purely in Python 3.x.x from python.org. and run inside ***jupyterlab*** environment. The Model was built using a deep learning

framework called ***Pytorch*** from pytorch.org and others like tensorflow, keras, caffe2, etc. The web application made with a python "flask" as the backend server and Html, css, javascript, bootstrap4 for the frontend.

## VII. SYSTEM ARCHITECTURE

The system's architecture is simple, flexible and robust. It involves the two methods of diagnosis. The first method/process is diagnosis through CTScan and the second method/process is diagnosis through laboratory test. The results of these two processes will confirm the presence or otherwise of the virus. This is illustrated in Fig.8 below.

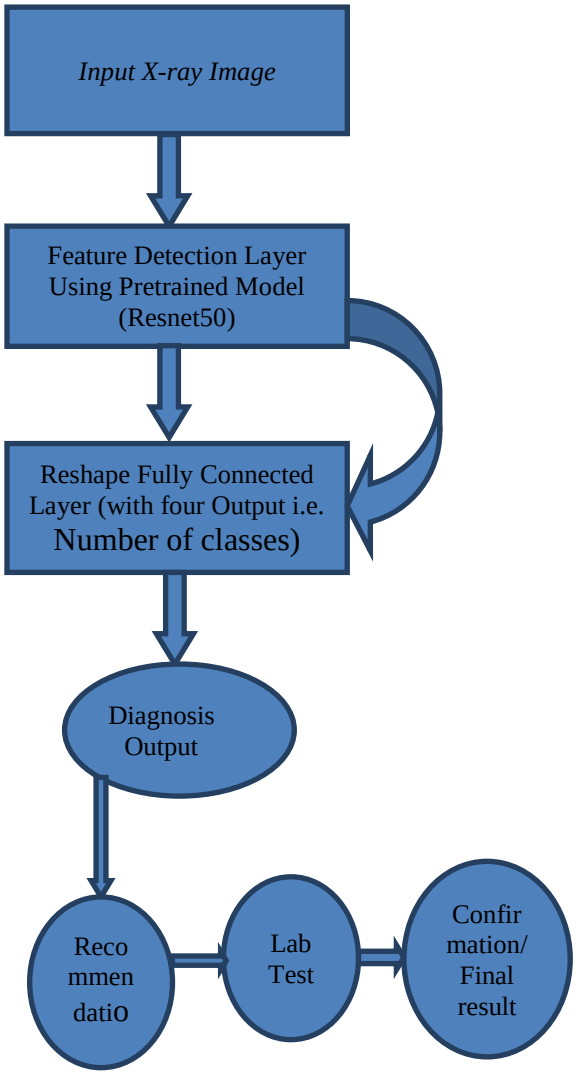


Fig. 8: System Architecture

## VIII. DESCRIPTION AND WORKINGS OF THE SYSTEM

- 


Fig. 1 Home Page

The system is named Machine Learning Critical Issues Resolution (MLCIR). It was created to resolve critical issues in the diagnosis and treatment of COVID-19. The aim is to erase the confusion and assumptions between the infection and other diseases with similar symptoms.

Dataset: Datasets used for development of this system is from CTscan and Laboratory test results. Four common diseases with similar symptoms were selected and the results from their tests were compiled. They are Asthma, COVID-19, Malaria and Viral Pneumonia.

CT scan

[18] showed that chest computed tomography (CT) is important in the diagnosis of COVID-19, as increasing pieces of evidence suggest that chest CT could prove useful in the clinical pathway in diagnosing COVID-19. One of the methods that can be used to diagnose diseases is the use of CT scan. CT scan is an X-ray image made using a form of tomography in which a computer controls the motion of the X-ray source and detectors, processes the data, and produces the image. CT scans can detect bone and joint problems, like complex bone fractures and tumours and it can spot or help doctors to see any changes in conditions like cancer, heart disease, emphysema, or liver masses. It is possible for a laboratory test to confirm a person a carrier of the virus because of one of similar diseases such person had been exposed to prior to the test. Therefore, it is important to carry out scan test on such person.

Dataset:


Fig. 2: Dataset entry page.

The dataset here is exclusive of malaria because laboratory test only is sufficient to confirm the present or otherwise of malaria. The dataset is restricted to Asthma, Covid-19 and Viral Pneumonia. As shown in Fig 2, the state of a patient health, the model is being diagnosed or predicted from medical image X-ray scans of;

- Asthma
- Covid-19
- Viral Pneumonia
- Normal

Diagnosis Page


Fig. 3

This page was created for the purpose of diagnosis. Diagnosis is done by uploading appropriate scan into the system. The system will confirm the type of disease the person is suffering from.

This process of uploading the scan result is further demonstrated by Fig 4 below

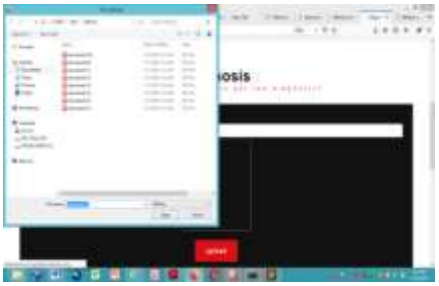

Fig. 4 Uploading of Scan Result

The system will match the uploaded scan with the normal composition and symptoms of that particular disease and confirm appropriate result and show drug indication. In the case of Covid-19, further tests may be required because of the similarities in the symptoms of the virus and other health conditions

Laboratory Test Page: The figure below displays the various tests that can be fed into the system and they are mostly diseases with similar symptoms.


Fig. 5. Laboratory Test

Asthma

Fig. 6 shows the laboratory test for Asthma

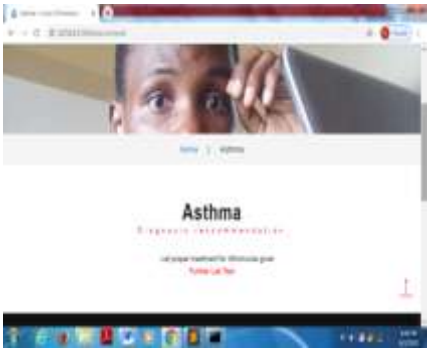


Fig. 6: Test for Asthma

Similar page will show for other diseases showing the type of disease and the result of the test i.e. either positive or negative and will recommend appropriate drugs that can be used to cure the disease.

### COVID-19 Laboratory Test

In the case of COVID-19, the laboratory cannot indicate appropriate drug because presently, there is no cure for it. The system will however go a further step to confirm if the person is actually a carrier of the virus by recommending scan. This is illustrated in Fig. 7

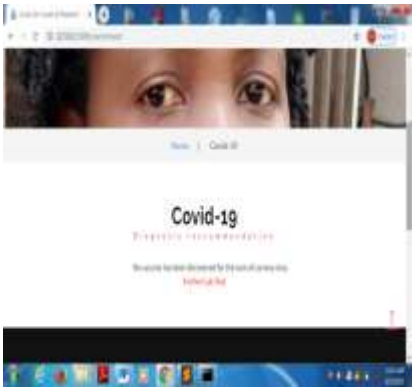


Fig: 7: Test for COVID-19

## IX. CONCLUSION

It is widely acknowledged that COVID-19 is spreading at alarming rate and yet there are no scientific recommendations for its cure presently. It is also a known fact that the preventive measures and diagnosis systems are laced with some issues which are prompting individuals to have second thought about the reality and existence of the dreaded virus. However, the virus is real and is spreading at alarming rate.

In this research, Machine Learning was used to develop a system to address critical issues in the prevention, diagnosis and management of Covid-19. The system was tested using live data. It showed that the similarities in the symptoms of some diseases with covid-19 could make it difficult to precisely diagnose covid-19 if only one method was used to diagnosis the virus. It recommended the use of more than one method to diagnose the virus and appropriate treatment for the underlying diseases with similar symptoms of COVID-19 in order to reduce the death toll associated with the virus.

## REFERENCES


[1] Adnan Qayyum1, Junaid Qadir1, Muhammad Bilal2, and Ala Al-Fuqaha3 (2020) "*Secure and Robust Machine Learning for Healthcare: A Survey* "https://tinyurl.com/FDA-AI-diabetic-eye

[2] Bansal M. "*Cardiovascular disease and COVID-19*" *Diabetes Metab Syndr*. 2020;14(3):247-250. doi:10.1016/j.dsx.2020.03.013

[3] Cui J., Li F., Shi Z.-L. "*Origin and evolution of pathogenic coronaviruses. Nat Rev Microbiol*. 2019;17(3):181–192. [PMC free article] [PubMed] [Google Scholar]

[4] D. Kamming, M. Gardam, F. Chung Anaesthesia and SARS Br J Anaesth, 90 (6) (2003), pp. 715-718

[5] Driggin E, Madhavan MV, Bikdeli B, et al. *"Cardiovascular Considerations for Patients, Health Care Workers, and Health Systems During the COVID-19 Pandemic*". *J Am Coll Cardiol*. 2020;75(18):2352-2371. doi:10.1016/j.jacc.2020.03.031

[6] Fernanda Farias Costa,[a]Wilian Reis Rosário,[a]Ana Cláudia Ribeiro Farias,[a]Ramon Guimarães de Souza,[b]Roberta Sabrine Duarte Gondim,[c] and Wermerson Assunção Barroso[a,*] Metabolic syndrome and COVID-19: An update on the associated comorbidities and proposed therapies Diabetes Metab Syndr. 2020 Jun 11 doi: 10.1016/j.dsx.2020.06.016 [Epub ahead of print]

[7] G. Biondi-Zoccai, G. Landoni, R. Carnevale, E. Cavarretta, S. Sciarretta, G. FratiSARS-CoV-2 and COVID-19: facing the pandemic together as citizens and cardiovascular practitioners,Minerva Cardioangiol (2020 Mar 9) [E-pub ahead of print] Google Scholar

[8] Haixia Chen, Li Ai, Hong Lu, Hongjun Li, "*Clinical and imaging features of COVID-19, Radiology of Infectious Diseases"*, 2020, https://apps.who.int/iris/bitstream/handle/10665/331215/WHO-2019-nCov-IPCPPE_use-2020.1-eng.pdf. Accessed March 6, 2020.

[9] Kochi AN, Tagliari AP, Forleo GB, Fassini GM, Tondo C. "*Cardiac and arrhythmic complications in patients with COVID-19". J Cardiovasc Electrophysiol*. 2020;31(5):1003-1008. doi:10.1111/jce.14479

[10] Lai C.-C., Shih T.-P., Ko W.-C., Tang H.-J., Hsueh P.-R. "*Severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) and corona virus disease-2019 (COVID-19): the epidemic and the challenges*". Int J Antimicrob Agents. 2020;105924 [PMC free article] [PubMed] [Google Scholar]

[11] Lotfinejad N, Peters A, Pittet D, "*Hand hygiene and the novel coronavirus pandemic: The role of healthcare workers*", Journal of Hospital Infection, https://doi.org/10.1016/ j.jhin.2020.03.017

[12] Nagata N., Iwata N., Hasegawa H., Fukushi S., Yokoyama M., Harashima A. "*Participation of both host and virus factors in induction of severe acute respiratory syndrome (SARS) in F344 rats infected with SARS coronavirus"*. J Virol. 2007;81(4):1848–1857. [PMC free article] [PubMed] [Google Scholar]

[13] "*National Center for Immunization and Respiratory Diseases (NCIRD)*", Division of Viral Diseases

[14] "*Organization WH. Laboratory testing for coronavirus disease 2019 (COVID-19) in suspected human cases: "*interim guidance, 2 March 2020. World Health Organization, 2020.

[15] Peiris J., Guan Y., Yuen K. "*Severe acute respiratory syndrome*". Nat Med. 2004;10(12):S88–S97. [PMC free article] [PubMed] [Google Scholar]

[16] Rothan H.A.1, Byrareddy S.N. "*The epidemiology and pathogenesis of coronavirus disease (COVID-19) outbreak*". J Autoimmun. 2020 May;109:102433. doi: 10.1016/j.jaut.2020.102433. Epub 2020 Feb 26.

*[17]* Shereen M.A., Khan S., Kazmi A., Bashir N., Siddique R. "*COVID-19 infection: origin, transmission, and*

[18] *characteristics of human coronaviruses*". J Adv Res. 2020;24:91–98. [PMC free article] [PubMed] [Google Scholar]
[19] Tenda ED, Yulianti M, Asaf MM, et al. "*The Importance of Chest CT Scan in COVID-19"*. Acta Medica Indonesiana. 2020 Jan;52(1):68-73.
[20] Trishan Panch, Peter Szolovits &Rifat Atun 2018 *"The recent explosion in Artificial intelligence, machine learning and health systems"* www.jogh.org• doi: 10.7189/jogh.08.02030
[21] Wang C, Horby PW, Hayden FG, Gao GF. "*A novel coronavirus outbreak of global health concern*." The Lancet 2020.
[22] "*WHO Director-General's opening remarks at the media briefing on COVID-19*" - 11 March 2020. https://www.who.int/dg/speeches/detail/who-director-general-s-opening-remarks-at-the-media-briefing-on-covid-19---11-march-2020
[23] WHO. "*Infection prevention and control during health care when novel coronavirus (nCoV) infection is suspected*". Interim guidance. 25 January 2020. WHO 2020. Available at: https://apps.who.int/iris/rest/bitstreams/1266296/retrieve [last accessed March 2020]. Google Scholar
[24] WHO. "*Infection prevention and control during health care when novel coronavirus (nCoV) infection is suspected*". Interim guidance. 25 January 2020. WHO 2020. https://apps.who.int/iris/rest/bitstreams/1266296/retrieve. Accessed March 6, 202
[25] WHO. "*Rational use of personal protective equipment for coronavirus disease 2019 (COVID-19)"*. Interim guidance. 27 January 2020. WHO 2020.