Potential Drug Options for Treatment of COVID-19: A Review

Tinsae Kebede¹, Dharmendra Kumar²,* and Pramod Kumar Sharma²

¹Department of Veterinary Medicine, College of Veterinary Medicine, Haramaya University, Haramaya, Ethiopia; ²Department of Pharmacy, Galgotias University, G.B Nagar, India

Abstract: A virus known as novel corona (SARS-CoV-2) which causes COVID-19 pandemic disease is an invisible enemy, appeared for the first time in the world’s most populous country, China, and became a reason for causing death of many people all over the world. As a result of this, a remarkable investigation and clinical trials are ongoing to discover the treatment for this devastating pandemic disease. Effective vaccines and anti-viral treatments are immediately required in order to control and eradicate the disease. But still, neither vaccine nor any drug is approved for prevention and control of COVID-19 pandemic. Proper and well-designed strategies are needed to reduce social and economic consequences arisen due to this pandemic disease. There are some drugs that are used for other diseases which are showing valuable outcomes to elicit the virus causing COVID-19. However, there are no approved drugs full of clinical evidence. A systematic review literature search was carried out from different electronic databases to identify available articles on the effectiveness of drugs against COVID-19. Four therapies suggested recently via World Health Organization (abbreviated “WHO”) that were later incorporated for further spread to neighboring countries [6]. Then, by observing its transmission to most countries, the recent disease declared as global pandemic by director general of World Health Organization, on 11th March, 2020 [4].

At the moment, COVID-19 infected 6,875,191 individuals, killed 398,689 and at the same time only 3,368,999 patients have recovered world-wide as of today on 6 June, 2020 [5]. The mortalities are rising exponentially. Thus, there is a severe necessity of an approved and licensed drug to cure patients with confirmed clinical symptoms and help in reducing a period of survival of the virus so as to control and eradicate the pattern of transmission. The use of previously known drugs, which are approved and licensed for treatments of other disease conditions, is gaining attention by most researchers and different clinical trials are ongoing to confirm their importance on the current global pandemic disease [6].

On the viewpoint of the present outbreak of COVID-19, patients might take investigational drugs without clinical trials on an emergency condition as component of procedures for sympathetic use or as section of randomized clinical trial. World Health Organizations direction ‘Managing Ethical Issues in Infectious Disease Outbreaks’ expresses that sympathetic use of therapeutics that are not licensed, or Monitored Emergency Use of Unregistered Interventions, is only reasonable when clinical trials cannot be commenced instantly and where a set of well-defined ethical standards are fulfilled [7].

As a result of the long procedure for new drug advancement, the recent approach of using drugs which are previously known, approved and licensed for other diseases had turn into the selected solutions in Coronavirus pandemic diseased peoples. Long standing discovery of therapeutic targets in process of manufacturing comprises recognition of important factors based on genetic analyses, which are re-
sponsible for pathogenicity, biology and structure of coronavirus pandemic [8].

On January 25, 2020, thirty (30) drugs were proposed by cooperative research group of researchers in universities and institutes of Shanghai, the biggest city in China, with potential anti-viral action against COVID-19 [9]. Some of these include: anti-virals such as remdesivir, lopinavir, ritonavir and other categories of drugs. Other studies on Sophorae Tonkinensis (Chinese traditional medicines) might comprise active ingredients against Novel coronavirus disease (COVID-19) pandemic [10-11]. “Solidarity Response Fund” was formed (by WHO, UN and SPF) on March 13, 2020, so as to gather and raise money to assist research on COVID-19 [10]. The French Institute (INSERM) declared a European colleague, termed Discovery on March 22, 2020 and intended for study on four treatments on 3100 patients. Drugs mentioned included: Anti-viral drug like remdesivir, two drugs combination (lopinavir andritonavir), two drugs combination (lopinavir plus ritonavir) with interferon (beta), and anti-malarial drug (Hydroxychloroquine) [12]. However, on May 25, 2020. The WHO director general remarked suspension of Hydroxychloroquine and chloroquine from Solidarity trial due to reports of researchers on safety and efficacy concerns of the drugs [13].

Researchers and Scientists are strongly investigating vaccines and therapeutics, which are approved and important in prevention and control of the recent hazardous disease globally. During preparation of this review, there was no confirmed anti-viral drug specific to COVID-19. Drugs that are currently suggested by different researchers and organizations must be investigated and clinically confirmed before giving to COVID-19 patients.

This review concentrates on the articles published focusing on the effectiveness of drugs against COVID-19 and identifying previously known drugs for other disease conditions but suggested to use in COVID-19 pandemic.

2. MATERIAL AND METHODS

2.1. Search Strategy and Criteria for Inclusion

Internet based search, which is performed systematically for identifying information, was conducted in three electronic databases (Google Scholar, Embase and PubMed). Then, published articles gained were used for assessing current treatment process and drugs for COVID-19 pandemic. Key words like Treatment for COVID-19, Drugs for COVID-19 and Traditional Chinese Medicine for COVID-19 were manipulated to find out articles published related to drugs that used for COVID-19 pandemic. Studies which are not included were recognized by inspecting the reference list of the chosen articles.

Extra statistics are gained through searching on Google and also an exchange of information with senior researchers was undertaken to support recent information on therapeutics for COVID-19.

3. RESULTS

Upon searching and examining the selected three electronic databases, firstly, a total of 1220 articles were recognized. Then, after attentively examining all articles, different measures were undertaken in order to get articles which give sufficient information on the current treatment process and drugs for COVID-19 pandemic. Finally, duplicated articles, articles with insufficient information, articles which lack abstracts, articles which are not scientific, non-English and conducted on animals were excluded. Then, 30 approved articles were used to assess the current treatment process and drugs for COVID-19. The process is presented in Fig. (1) and drugs listed in Tables 1 and 2.

Results were not obtained up on searching on different databases regarding completed trials of COVID-19 therapeutics. There are fifteen ongoing therapeutic trials registered in the registry website, out of 30 clinical trials collected from systematic reviews. Ten studies commenced recruitment phase. Those studies focus on anti-malarial drug like hydroxychloroquine, anti-viral drug like lopinavir and itonavir and some types of Chinese treatment (traditional). Studies encompassing on anti-viral drug like remdesivir, darunavir (anti-retroviral), cobicistat, etc., are eight studies.

Fig. (1). Diagram showing study selection design.

4. DISCUSSION

Worthy clinical results can be gained if there is appropriate and timely diagnosis. In addition to this, timely treatment strategy also plays a major role in either prevention or control of different diseases. There is scarcity of clinical trials which guide to the successful drug invention. Most clinical trials on coronaviruses are not completed which means that they are in experimental phase. Therefore, strong and well-designed researches were needed in order to minimize the potential risk of coronaviruses. In order to treat and restore the affected population to their normal health, therapeutics play a major role. The source of COVID 19 is mentioned which is China trials to identify therapeutics options as
Table 1. Summary of Ongoing therapeutics trials of COVID-19 Pandemic.

| Treatment | Stage | Result | Refs. |
|-----------|-------|--------|-------|
| Lopinavir-ritonavir | Using in a clinical sets but not approved officially as a treatment for COVID 19 | Encouraging results and improved clinical symptoms in a patients treated with the drug | [19] |
| Remdesivir | Clinical trials is ongoing as an investigational treatment | The time from randomization to clinical improvement and high potency against RNA viruses | [24] |
| Chloroquine and Hydroxychloroquine | In vitro infected Verocells (Not approved officially as a COVID-19 treatment) | Substantially lower EC50 for hydroxychloroquine. Good result is expected | [20] |
| Ritonavir/lopinavir and interferon-beta | Adaptive, randomised open clinical trial | Subject clinical status on Day 15 and predicted as a beneficial treatment for COVID-19 | [18] |
| Azithromycin plus Hydroxychloroquine. | A prospective randomized Trial is ongoing | Predicted as an Improved efficacy to eradicate the virus | [25] |
| Galidesivir | Currently in a phase 1 clinical study but not completed. | Unknown if it could potentially target the coronavirus | [26] |
| Molecules that inhibit 2 coronavirus enzymes | Inhibit two coronavirus enzymes and prevent its replication | Uncertain to address the ongoing outbreak but they hope to make it accessible for future outbreaks | [27] |
| Umefinovir (arbidol)-NCT04260594 | Preliminary test in the in vitro cell. | Shows a significant inhibition to the cytopathic effect | [28] |
| Darunavir-NCT04252274 | Phase 3 for 2019-nCoV (NCT04252274). | Significantly inhibit the replication of the new coronavirus and Inhibits 3C Like protease | [28] |
| Oral liquid traditional Chinese medicine, | Preliminary testing identified but not finished yet. | Inhibit the new coronavirus. It was previously identified to have an antiviral effect for influenza virus, SARS and MERS. | [29] |
| Azithromycin plus Hydroxychloroquine. | Recruitment in process but not finished (Ongoing clinical trial) | Improved clinical trial but not approved | [30] |
| Darunavir & Cobicistat | Recruitment in process but not finished yet | Clinical improvement in patients | [31] |
| Mesenchymal Stem Cell (MSC) | Recruitment in process but not finished yet | Prediction of significant beneficial effects in the treatment of COVID-19 | [32] |
| Traditional Chinese Medicine | Recruitment in process but not completed | Prediction of significant beneficial effects in the treatment of COVID-19 | [33] |
| Methylprednisolone | Recruitment in process but not completed | Improved clinical trial | [34] |
| Monoclonal antibodies | Now being tested in early human studies | In a Clinical trial | [35] |
| Ritonavir + ASC09 combo | Not yet approved by regulators. (Ongoing clinical trial) | Applied to include in national emergency channel on 25 January 2020 | [36] |
| Janus kinase 2 (JAK2) Inhibitor fedratinib | In vitro murine TH17 cell Study (Ongoing clinical trial) | May be beneficial in reducing cytokine storm associated with COVID-19 infection | [37] |
| Cepharanthine, selamectin and mefloquine | Cell culture (Ongoing clinical trial) | Inhibition ofcytopathic effects | [16] |
| Lianhuaqingwen | Laboratory test (Ongoing clinical trial) | Protection against COVID-19 virus attract | [38] |
| Glucocorticoids, IL-6 antagonist, JAK inhibitors and chloroquine/ hydroxychloroquine | Clinical observation (Ongoing clinical trial) | Improved clinical result and prediction to be beneficial for treatment of COVID-19 | [39] |

(Table 1) contd….
| Treatment | Stage | Result | Refs. |
|-----------|-------|--------|-------|
| Ribavirin | Randomized trial for 2019-nCoV in combination with a pegylated interferon | Inhibits viral RNA synthesis and mRNA capping | [40] |
| ASC09F (HIV protease inhibitor) | Phase 3 for 2019-nCoV in combination with oseltamivir (NCT04261270) | Inhibits 3CLpro and good hope for future | [13] |
| Traditional Chinese Medicine | In a clinical trial (Not approved officially) | Improved clinical result in some patients of COVID-19 | [41] |
| Angiotensinconverting enzyme 2, fused to an immunoglobulin Fc domain. | Opinion from experts | ACE2-Fc has the potentiality to be the neutralizing antibody that can be used for the treatment of COVID-19 | [42] |
| Baricitinib, fedratinib, and ruxolitinib | In silico artificial intelligence prediction | Prediction of significant beneficial effects in the treatment of COVID-19 | [43] |
| Hydroxychloroquine, chloroquine and several other therapeutic agents | Opinion paper from experts | Prediction of significant beneficial effects in the treatment of COVID-19 | [44] |
| Remdesivir, umifenovir, oseltamivir and galidesivir, compound 3k, pyrazofurin and the helicase inhibitor SSYA10-001 | Opinion paper from experts | Inhibitors have appropriate potential biocontainment capability against covid-19 | [15] |
| Qingfeipaidu decoction | A single case study | Controlling of COVID-19 symptoms. | [45] |
| CRISPR/Cas13d strategy for treating 2019-nCoV(SARS-CoV-2) virus-infection | In vitro tests | Flexible potentiality for RNA virus treatment and prevention which may be used for the treatment of COVID-19 | [46] |

Table 2. Some noticeable characteristics of the four treatments considered in the Discovery project.

| Characteristics | Remdesivir | Lopinavir (2) Ritonavir (3) | 2 + 3 + IFNβ-1a | HydroxyChloroquine | Chloroquine |
|----------------|-----------|-----------------------------|-----------------|--------------------|------------|
| EC 50 (μM) SARS-CoV | 0.07 [6] | 17.1 [47] | - | 34 [19] 7.97 [48] | 6.5 [47] 6.54 [49] |
| EC50 (μM) MERS-CoV | 0.07 [6] | 8.0 [47] | - | 8.28 [19] | 6.28 [49] |
| EC50 (μM) SARS-CoV-2 | 1.76 [21] | - | - | 0.72 [48] | 5.47 [20] 6.9 [22] |
| Dosage for COVID-19 treatment following NCT04315948 [5] and [14] | 200 mg IV then 100 mg OD for 2–10 days | 400 mg (2) and 100 mg (3) every 12 h for 14 days | Same treatment as 2/3 + 3 doses of 44 μg IFNβ in 6 days | 400 mg then 400 mg 12 h later, then 200 mg BID for up to 4 days | 600 mg then300 mg 12 h later, then300 mg BID for up to 4 days |
understood from the previous outbreaks of SARS and MERS in different years. Till now, no drug is discovered and approved for the treatment of COVID-19.

Development of therapeutic options is immediately needed in order to control COVID-19 pandemic. Repurposing of existing anti-viral drugs which are used for different viral diseases is a significant approach to minimize the risks of this pandemic disease. Since the safety profile and efficacy of some drugs against closely related coronaviruses, this repurposing of existing drugs could be an important approach [13, 49]. In China, phase 3 clinical trials against remdesivir [14] and other trials are ongoing to test several drug choices, which include umifenovir, oseltamivir and ASC09F. As well as above 50 prevailing MERS or SARS inhibitors, for example, galidesivir, which is an analog of adenosine and originally developed for the treatment of hepatitis C and then for other diseases and pyrazofurin might be tested against COVID-19 by services that, had suitable bio containment proficiency [15].

A current investigation, based on clinical trials, stated that remdesivir was inhibited COVID-19 (EC50=0.77µM in Vero E6 cells), and patient from US with COVID-19 indicated change in clinical symptoms following administration of remdesivir intravenously. To assess clinical outcomes of remdesivir, patients received 200mg dose on the first day then followed by 100mg dose QD (once a day), for nine consecutive days, intravenously, initiation of two phase III trials were ongoing in patients infected by COVID-19 (NCT04252664 and NCT04257656) [16]. On a study conducted on 1,063 patients, upon administering remdesivir, patients recovered faster (in 11 days) than those who got a placebo (15 days). Lower death rate is also recorded compared to the placebo group. Emergency use authorization (EUA) of remdesivir was approved by United States Food and Drug Administration to treat severe COVID-19 by licensed health care practitioners on 1 May, 2020. This decision was made based on preliminary report collected showing a 31% faster recovery time than a placebo. Respiratory failure, increased level of liver enzymes, gastrointestinal distress, low albumin, low potassium, low count of RBC and jaundice were some of the possible adverse effects of remdesivir [17]. Triple combination of drugs consisting Interferon beta, Lopinavir/ritonavir and ribavirin have suppressed the amount of virus in the mild to moderate COVID-19 patients. It can also relieve symptoms of COVID-19[18].

Galidesivir (BCX4430) is presently in primary stage in clinical examinations and revealed anti-viral actions in preclinical testing on RNA viruses (SARS and MERS) [17]. There is a shortage of data on adverse effects of Galidesivir. On drugs, such as lopinavir and ritonavir, clinical trials (for example, ChiCTR2000029539in were ongoing on COVID-19 infected patients. In a non-randomized open label trial, lopinavir and ritonavir drugs show enhanced clinical results of patients with SARS. Nevertheless, it is not proved with high degree evidence for COVID-19 [18]. Umifenovir (Abidol) is antiviral drug with broad spectrum activity which is licensed in several countries for influenza treatment. Better viral suppression was reported in China upon retrospective cohort study on 50 patients infected with COVID-19. Then, the virus (SARS-CoV-2) is undetected at seven days in 50% of patients who got Abidol. Still efficacy of the drug towards COVID-19 pandemic diseases was not established [55]. Griffithsin has been tested in phase I for HIV prevention, spike inhibitors potency and assessment on the method of delivery should be investigated properly before using for COVID-19 [15]. Trials on interferons have been started and it is predicted that pegylated interferon alfa-2a and -2b may help to initiate some responses towards anti-viral in coronaviruses infected patients. But their mechanism of action is not clear whether they are useful or not towards coronaviruses [19]. Chloroquine is showing inhibitory effects against Novel coronavirus 2019 (COVID-19) and investigation is under process but outcomes of clinical trials are good (ChiCTR2000029609) [20]. However, the use of both Hydroxychloroquine and chloroquine was suspended from Solidarity trial by WHO due to their safety concerns reported by researchers. Retinopathy, allergic reactions, hypoglycemia and cardiomyopathy are some of the possible adverse effects of these drugs [13]. Nitazoxanide which is previously used for diarrhea treatment, could also in clinical trials and suggested to inhibit Coronavirus disease 2019 (COVID-19) (EC50=2.12µM in Vero E6 cells) [15,13]. Different clinical trials are initiated and underway to evaluate the safety and efficacy of nitazoxanide alone and in combination with other repurposed drugs such as Hydroxychloroquine, ivermectin, and chloroquine for discovering effective treatment for COVID-19 [52-54]. Favipiravir, Ribavirin, remdesivir and galidesivir could have potential efficacy towards COVID-19 and clinical trials to prove this efficacy were ongoing in different countries [21]. Favipiravir (T-705) is an important drug which inhibits viral ribonucleic acid (RNA) and used for most untreatable RNA viruses [21]. Currently, different studies in different countries are ongoing in order to identify its properties for supporting control of COVID-19 [22, 23]. Through combining favipiravir with another selected drugs in infected patients of coronavirus disease 2019, are being recruited in randomized trials [13]. In a study conducted in China on 240 mild COVID-19 patients, around 71% patients who got favipiravir recovered after seven (7) days. Another study also reported that favipiravir cleared the virus (on 4 days) faster than lopinavir/ritonavir (on 11 days) on 80 mild COVID-19 patients. By May 30, 2020, Favipiravir is proved to be effective in the first phase of clinical trial by the Russian ministry of health [53]. Ribavirin was assessed in patients infected with previously emerged coronaviruses (SARS and MERS), but it was suggested that it have severe side effects like in the reduction of red blood cell which circulates in the body (anemia) especially at high doses [50,51].

CONCLUSION

The invisible enemy, COVID-19, is causing death of many people all over the world. As a result, immediate development or discoveries of therapeutic options are necessary. A number of clinical trials are ongoing on the repurposing of existing anti-viral therapeutics to treat COVID-19. Up to now, there is no either specific drug or vaccine approved with high clinical evidence for patients infected with coronavirus disease. Researchers and scientists are examining for effective and appropriate therapeutics for controlling and eradicating the harm full COVID-19 pandemic, globally.
In the future, we have to harmful on actions that are useful for reduction of factors responsible for transmission of the invisible enemy, COVID-19. Clinical trials regarding drugs for coronavirus disease are ongoing and promising. Different well-organized researches supported with good clinical outcomes should be undertaken towards COVID-19 vaccines and drugs for appropriate eradication of this pandemic disease.

AUTHORS’ CONTRIBUTIONS
TK wrote the manuscript. PKS designed the manuscript. DK edited the manuscript.

CONSENT FOR PUBLICATION
Not applicable.

FUNDING
None.

CONFLICT OF INTEREST
The authors declare no conflict of interest, financial or otherwise.

ACKNOWLEDGEMENTS
Authors thank College of Veterinary Medicine, Haramaya University, Haramaya, Ethiopia and Galgotias University, Noida, India to provide facilities to do the work in healthy environment. We would also like to express our earnest thanks to Mr. GemedoRabo and Mr. KufaGadiso for their excellent cooperation.

REFERENCES
[1] Sahin AR, Erdogan A. Novel Coronavirus (COVID-19) outbreak: a review of the current literature. EJMO 2020; 4(1): 1-7.
[2] Wang LS, Wang YR, Ye DW, Liu QQ. A review of the 2019 novel Coronavirus (COVID-19) based on current evidence. Int J Antimicrob Agents 2020; 30(3): 269-71.
[3] Kumar D, Malviya R, Kumar Sharma P. Corona Virus: A Review of COVID-19. EJMO 2020; 4(1): 8-25.
[4] WHO Director-General's opening remarks at the media briefing on COVID-19 2020.

Coronaviruses, 2020, Vol. 1, No. 1 47

[10] Molina JM, Delaugerre C, Le Goff J, et al. No evidence of rapid antiviral clearance or clinical benefit with the combination of hydroxychloroquine and azithromycin in patients with severe COVID-19 infection. Med Mal Infect 2020; 50(4): 384. http://dx.doi.org/10.1016/j.medmal.2020.03.006 PMID: 32240719

[11] WHO. UN Foundation and Partners Launch First-of-its-kind COVID-19 Solidarity Response Fund https://www.who.int/news-room/detail/13-03-2020-who-un-foundation-and-partners-launch-first-of-its-kind-covid-19-solidarity-response-fund

[12] Launch of a European Clinical Trial against COVID-19 https://presse.inserm.fr/en-launch-of-a-european-clinical-trial-against-covid-19-38737/

[13] WHO Director-General opening remarks at the media briefing on COVID-19 2020.

[14] Wang M, Cao R, Zhang L, et al. Remdesivir and chloroquine effectively inhibit the recently emerged novel coronavirus (2019-nCoV) in vitro. Cell Res. 2020; 30(3): 269-71. http://dx.doi.org/10.1038/s41422-020-0282-0 PMID: 32020029

[15] Zhang Q, Wang Y, Qi C, Shen L, Li J. Clinical trial analysis of 2019-nCoV therapy registered in China. J Med Virol 2020; (February): 1-6. http://dx.doi.org/10.1002/jmv.25733 PMID: 32108352

[16] Li G, De Clercq E. Therapeutic options for the 2019 novel coronavirus (2019-nCoV). Nat Rev Drug Discov 2020; 19(3): 149-50. http://dx.doi.org/10.1038/d41573-020-00016-0 PMID: 32127666

[17] Mehta N, Mazier-Amirshahi M, Alkindi N. Pharmacotherapy in COVID-19. Narrative review The American journal of emergency medicine 2020.

[18] Liu F, Xu A, Zhang Y, et al. Patients of COVID-19 may benefit from sustained Lopinavir-combined regimen and the increase of Eosinophil may predict the outcome of COVID-19 progression. Int J Infect Dis 2020; 95: 183-91. http://dx.doi.org/10.1016/j.ijid.2020.03.013 PMID: 32173576

[19] Fan H-H, Wang, Li-Qin., Liu, Wen-Li., An, Xiao-Ping., Liu, Zhen-Dong, He, Xiao-Qi., Song, Li-Hua., Tong, Yi-Gang. 2020. Repurposing of clinically approved drugs for treatment of coronavirus disease 2019 in a 2019-novel coronavirus (2019-nCoV) related coronavirus model. Chinese Medical Journal http://dx.doi.org/10.1097/CMA.0000000000000797 PMID: 32149769

[20] Cai Q, Yang M, Liu D, et al. Experimental Treatment with Favipiravir for COVID-19: An Open-Label Control Study. Engineering (Beijing) 2020. http://dx.doi.org/10.1065/j.eng.2020.03.007 PMID: 32346491

[21] Tang B, Li S, Xiong Y, et al. Coronavirus Disease 2019 (COVID-19) Pneumonia in a Hemodialysis Patient. Kidney Medicine 2020.

[22] De Clercq E. New nucleoside analogues for the treatment of hemorrhagic fever virus infections. Chem Asian J 2019; 14(22): 3962-8. http://dx.doi.org/10.1002/asia.201900841 PMID: 31389664

[23] Yuen KY. Overview of the Current Knowledge on SARS-CoV-2 Infection and Enzyme-Linked Immunosorbent Assay (ELISA) for Detection of Neutralizing Antibody. J Med Virol 2020; 92(7): 2459-69. http://dx.doi.org/10.1002/jmv.25707 PMID: 32108442

[24] Wang M, Cao R, Zhang L, et al. Chloroquine for the 2019 novel coronavirus (2019-nCoV): an in vitro and in vivo study. Cell Res 2020; 30(3): 269-71. http://dx.doi.org/10.1038/s41467-019-13940-6 PMID: 31924756

[25] Colson P, Rolain JM, Lagier JC, Brouqui P, Raoult D. Chloroquine and hydroxychloroquine as available weapons to fight COVID-19. Int J Antimicrob Agents 2020; 55(4):105932. http://dx.doi.org/10.1016/j.ijantimicag.2020.105932 PMID: 32145363

[26] Cao B, Wang Y, Wen D, et al. A trial of Lopinavir-Ritonavir in adults hospitalized with severe Covid-19. N Engl J Med 2020; 382(19): 1787-99. http://dx.doi.org/10.1056/NEJMoa2001282 PMID: 32187464
Coronaviruses, 2020, Vol. 1, No. 1

nonrandomized clinical trial. Int J Antimicrob Agents 2020; 20: 105949.

Speights K. 5 biotech stocks to watch with the coronavirus scare 2020.

Tech P. Coronavirus: Gilead, purdue university explore potential treatments https://www.pharmaceutical-
technology.com/news/coronavirus-drugs-development/

Mak E. Coronavirus outbreak pushes chinese biotech stocks higher despite market downturn https://www.bio-world.com/articles/432890-coronavirus-outbreak-pushes-chinese-biotech-stocks-higher-despite-market-downturn

Zou C. Coronavirus: Chinese researchers claim tcm herbal remedy could ‘inhibit’ 2019-ncov 2020. https://www.bio-world.com/articles/432858-coronavirus-chinese-researchers-claim-tcm-herbal-remedy-could-inhibit-2019-ncov

ClinicalTrials.gov. Efficacy and safety of hydroxychloroquine for treatment of pneumonia caused by 2019-ncov 2020. https://clinicaltrials.gov/ct2/show/NCT04261517

ClinicalTrials.gov. The efficacy of lopinavir plus ritonavir and arbidol against novel coronavirus infection https://clinicaltrials.gov/ct2/show/NCT04252885

ClinicalTrials.gov. 2020.Mesenchymal stem cell treatment for pneumonia patients infected with 2019 novel coronavirus https://clinicaltrials.gov/ct2/show/NCT04252118

ClinicalTrials.gov. Treatment and prevention of traditional chinese medicines (tcms) on 2019-ncov infection 2019. https://clinicaltrials.gov/ct2/show/NCT03301090

ClinicalTrials.gov. Glucocorticoid therapy for novel coronavirus critically ill patients with Severe Acute Respiratory Failure (steroids-sari) 2020. https://clinicaltrials.gov/ct2/show/NCT04244591

Mag S. Can an anti-hiv combination or other existing drugs outwit the new coronavirus? https://www.sciencemag.org/news/2020/01/can-anti-hiv-combination-or-other-existing-drugs-outwit-new-
coronavirus

Today. Brief-asceletsipharma clarifies media reports on coronavirus treatment https://www.todayonline.com/world/brief-asceletsipharma-clarifies-media-reports-
coronavirustreatment?cid=todayInsideTodaypage

Wu D, Yang XO. TH17 responses in cytokine storm of COVID-19: An emerging target of JAK2 inhibitor Fedratinib. J Microbiol Immunol Infect 2020; 53(3): 368-70. http://dx.doi.org/10.1016/j.mij.2020.03.005 PMID: 32205092

Runfeng L, Yunlong H, Jicheng H, et al. Lianhuawingwen exerts anti-viral and anti-inflammatory activity against novel coronavirus (SARS-CoV-2). Pharmacol Res 2020; 156104761 http://dx.doi.org/10.1016/j.phrs.2020.104761 PMID: 32205232

Zhang W, Zhao Y, Zhang F, et al. The use of anti-inflammatory drugs in the treatment of people with severe coronavirus disease 2019 (COVID-19): The Perspectives of clinical immunologists from China. Clin Immunol 2020; 214108393 http://dx.doi.org/10.1016/j.clim.2020.108393 PMID: 32222466

Zhang HL, Zhu YX. One highly suspected case of novel coronavirus pneumonia treated by Integrated Traditional Chinese and Western medicine and nucleic acid analysis http://kns.cnki.net/kcms/detail/12.1349.R.20200227.0909.004.html

Krusse RL. Therapeutic strategies in an outbreak scenario to treat the novel coronavirus originating in Wuhan, China. F1000 Res 2020; 9: 72. http://dx.doi.org/10.12688/f1000research.22211.2 PMID: 32117569

Justin S, Phelan A, Griffin I, Toovey C, OllyOechsle, Dan Smith, Peter Richardson. COVID-19: combining antiviral and antiinflammatory treatments. Lancet Infect Dis 2020; 20: 400-2. http://dx.doi.org/10.1016/S1473-3099(20)30132-8

Zahra Sahraei Pharm. D, BCPS, MinooshShabani MD, ShervinShokouhi MD, MPH, Ali Saffaei Pharm. D. Aminoquinolines against Coronavirus Disease 2019 (COVID-19): Chloroquine or Hydroxychloroquine. Int J Antimicrob Agents 2020; 105945 http://dx.doi.org/10.1016/j.ijantimicag.2020.105945

Ren JL, Zhang AH, Wang XJ. Traditional Chinese medicine for COVID-19 treatment. Pharmacol Res 2020; 155104743 http://dx.doi.org/10.1016/j.phrs.2020.104743 PMID: 32145402

Nguyen TM, Zhang Y, Pandolfi PP. Virus against virus: a potential treatment for 2019-nCoV (SARS-CoV-2) and other RNA viruses. Cell Res 2020; 30(3): 189-90. http://dx.doi.org/10.1038/s41422-020-0290-0 PMID: 32071427

Biot C, Daher W, Chavain N, et al. Design and synthesis of hydroxyferroquine derivatives with antimarial and antiviral activities. J Med Chem 2006; 49(9): 2845-9. http://dx.doi.org/10.1021/jm0601856 PMID: 16640347

de Wilde AH, Jochmans D, Posthuma CC, et al. Screening of an FDA-approved compound library identifies four small-molecule inhibitors of Middle East respiratory syndrome coronavirus replication in cell culture. Antimicrob Agents Chemother 2014; 58(8): 4875-84. http://dx.doi.org/10.1128/AAC.03011-14 PMID: 24841269

Dyall J, Coleman CM, Hart BJ, et al. 2014; Repurposing of clinically developed drugs for Treatment of Middle East respiratory syndrome coronavirus infection Antimicr Agents Chemother 2014; 58(8): 4875-93.

Rabby MI. Md Insiat Islam Rabby. Current Drugs with Potential for Treatment of COVID-19: A Literature Review. J Pharm Pharm Sci 2020; 23(1): 58-64.wws.cspsCanada.org

http://dx.doi.org/10.18433/jpps3102 PMID: 32251618

Thorlund K, Dron L, et al. A real time dashboard of clinical trials for COVID-19. The Lancet. Digit Health 2020; 2(6): 286-7. http://dx.doi.org/10.1016/S2589-7500(20)30086-8

Xu J, Shi PY, Li H, et al. Broad spectrum antviral agent niclosamide and its therapeuticpotential. ACS Infect Dis 2020; ***

http://dx.doi.org/10.1021/acsinfecdis.0c00052

Deng L, Li C, Zeng Q, et al. Arbidol combined with LPV/r versus LPV/r alone against Corona Virus Disease 2019: A retrospective cohort study. J Infect 2020; 81(1): e1-5. http://dx.doi.org/10.1016/j.jinf.2020.03.002 PMID: 32171872