

Follow-Up of Coronavirus Infected Patients Using Telemedicine in a Referral Pulmonary Center

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Background: Telemedicine is considered an innovative approach for management and follow up of communicable diseases, when person to person contact has the risk of disease dissemination, such as the situation being experienced with corona virus infection. The aim of this study was to evaluate the role of telemedicine in patient follow-up and patient compliance in different communication methods.

Materials and Methods: All patients discharged from a referral pulmonary hospital dedicated to coronavirus infected patients were given instructions on follow-up of symptoms. One group received messages via short message system regarding the severity of their symptoms. For the other group a mobile application was specially designed for tracking their well-being on a daily basis. Severity of symptoms and course of disease were monitored in each group for a two-month period.

Results: A total 1091 patients with mean age of 53.96 ± 17.95 years were enrolled in the study. In the first group 406 (60.14%) messages were successfully sent, from which 150 (36.94%) patients replied. Also, 243(35%) patients contacted us by making phone calls. Of the total patients in the second group, 153(64%) patients started using the mobile application. Chief complaint of patients was mainly cough, shortness of breath, fatigue, and myalgia. Deep vein thrombosis, hyperglycemia, post kidney transplant patient and bloody diarrhea were among the reported cases.

Conclusion: Patient follow-up during epidemics, especially when the disease course is unknown, is an important step in both successful patient management and disease control. This study showed the role of telemedicine for patient follow-up, mostly in detecting special situations. But, in order to be successful patient education and active follow-up are important factors that must be considered.

Key words: Corona virus, Telemedicine, Patient follow up, Pandemic, Covid-19

INTRODUCTION

Telemedicine improves access to medical services via telecommunication and it is an innovative approach for managing patients with communicable diseases. As its name indicates, medical care can be given to patients from long distance using communication devices especially

when visiting hospitals have the risk of getting infected and also the risk of infecting others, similar to the situation now in corona virus pandemic. This system also reduces the burden on the healthcare system, helps triage patients, direct the symptomatic ones to medical centers for management, and follow the suspected ones on a routine

basis; therefore, save the medical facilities for those seriously ill.

During the previous epidemics, telemedicine has had a leading role in patient management (1). Many patients have been visited, consulted, prescribed, and also followed during SARS, MERS, and Ebola and many other viral outbreaks (2-4,6). Also, China's success in slowing and controlling corona virus transmission in the present outbreak has been partly due to increasing virtual visits (5,7). Most recent recommendations by authorities around the world have also emphasized on using telemedicine as a screening tool and that special arrangements must be made to facilitate its process (8, 9).

Most of the previous experiences considering the use of telemedicine in epidemics has been to help select patients needing hospital care and keeping the suspected ones at home, which is the strategy being implemented in most countries infected with corona virus (10-12). But considering the fact that the disease course is still unknown and many of its features still needs to be clarified, especially reinfection and late complications, patient follow-up after discharge is an important issue that must be taken into consideration.

According to the National Protocol for Corona virus Patient Management in Iran, all patients discharged from hospitals, are to be followed for the first 14 days. This follow-up can be performed through a phone call in its simplest form, but other means of communication, as defined by telemedicine protocols, are also applicable.

Therefore, the aim of this study was to define and evaluate the role of different telemedicine means of communication for follow-up and assessment of patients with corona virus infection after discharge. Also, their participation in utilizing different ways of virtual visit was evaluated.

MATERIALS AND METHODS

This cross-sectional study was performed on all patients discharged from one of the leading and referral hospitals for corona virus infected patients, during a four-

month period. Two different means of telecommunication were used for follow-up. During the first two months a short message service (SMS) panel which was prepared for sending bulk messages to all patients was used along with an application for sending daily recommendations. During the second two months a mobile application specially designed for these patients was used for follow-up and communication.

All patients were given instructions regarding the use of each of these methods on the day of discharge. The patients in the first group were given hard copies of the instructions for SMS contacts and installation of application. For the second group a phone contact was made the day after discharge and oral instructions were given for communication and application installation. Also, the patients were free to make phone calls for any questions they had, any time of the day.

It is worth mentioning that these patients were all positive for corona virus and that their medication had been started but not completed during their admission, and after initial management, they were sent home with drug prescriptions. Therefore, all patients needed to be followed to monitor the course of their illness.

The short message service (SMS), which was sent from the first day after discharge contained the following questions:

Have you experienced aggravation of: 1-fever, 2-cough, 3-dyspnea, 4-chest pain, 5-diarrhea, 6-myalgia, 7-anorexia and fatigue, 8 - none.

The patient would either reply by sending the number relating to one or more of the symptoms or they were free to call and talk about their problem. If the response by SMS was positive to any of the symptoms, the patients were actively contacted and further instructions were given accordingly. Each patient had a separate file and daily reports were registered during the study period. Patients were also asked to install an application for the purpose of receiving recommendations related to their status on a daily basis. The interesting feature of this application was the main reason it was chosen. Each day a

recommendation or an informative message was sent to each patient regarding their illness, which helped them take better care of themselves. The topic of these messages was chosen by the patients and they were renewed regularly. Some of these topics were information about diet and supplements, exercise and physical activities, stress management, information on corona virus infection and its control, personal hygiene, and many other useful topics.

For the second part of follow up a mobile application which could be installed on android smart phones was specially designed for these patients. Some features of this application were: First, a notification was sent every other day on a regular time to ask about their symptoms. Second, a special chat section was designed for the patients to contact their physician and ask questions. Third, the patients were able to send images, such as chest x rays or CT scans, if required. The symptoms include fever, cough, dyspnea, chest pain, diarrhea, myalgia, anorexia, and fatigue which the patients were asked to report on a regular basis. Also the patients were free to make phone calls any time they had problem or question.

Data was analyzed using the statistical package IBM SPSS version 24.0 (Statistical Package for the Social Sciences, Chicago, IL). P values less than 0.05 was considered significant.

RESULTS

During a four-month period, 1091 patients who were discharged from hospital were enrolled in our study. The mean age of patients was 53.96 ± 17.95 years, 631 (57.9%) being male and 460 (42.1%) females.

According to the instructions, during the first two months, communication started by sending SMS from the first day after discharge. A total of 675 patients were discharged and 406 (60.14%) SMS were successfully sent and a total of 150 (36.94%) replies were received. The reasons for unsuccessful sending of message were mainly due to wrong number registration, blocking of commercial messages which is the main issue in sending bulk messages, and no net communication. A total of 243(36%)

patients contacted us by making phone calls. The main question asked by the patients, while speaking to them on the phone, was “what they should do after the drug therapy was finished” “what do they do after their quarantine duration finishes”, “can they have regular contacts with family members thereafter?” (Table 1).

Table 1. Questions mostly asked by the coronavirus infected patients via phone calls

	Question	Frequency (percent)
1	How do I know I am not a carrier after the quarantine period has finished? Can I have close contact with my family?	240 (99%)
2	Should I visit by my physician after the quarantine?	240(99%)
3	Should I refill my medication after I finish the course of treatment?	194.4(80%)
4	Should I perform a coronavirus test after the quarantine?	182.2(75%)
5	Is there a risk of reinfection after recovery?	121.5(50%)

Considering the educational application, especially designed for patients with corona virus, a total of 232(33.4%) patients started using it with a mean age of 40.54 ± 15.42 years, 97(42%) of them being female and 134 (58%) males. The use of this mobile app was additional to the sign and symptom follow-up which was being performed by SMS.

For the purpose of education 1145 health recommendations were prepared regarding general knowledge about corona virus infection, prevention, personal hygiene, medication, stress management, physical exercise, and many other issues which were sent to the patients on a daily basis and as requested by the patients, which means that the patients chose the type and number of recommendation to receive at registration phase. A total of 9200 recommendations were sent to our patients during the study period. The major comments and feedbacks received from the patients are listed in table 2.

For the second part of the study 416 patients who had registered phone numbers were contacted, from which 315 patients replied. Initially the patients were asked whether they had smart phones and 285 (90%) replied positive. Of

these 240(76%) had android phones. Results showed that 240 (100%) patients had installed the application after the oral instructions, but 153 (64%) had used it for communicating with us.

Table 2. Patients' comments and feedbacks on educational application

Positive opinions	
1	Giving information about drugs like drug interactions and adverse effects is useful
2	Nutrition and diet recommendations are very useful
3	Direct and continuous communication with your team and physicians is a positive point
4	Sending physical exercises to do at home is very useful
Negative opinions	
1	It was better if we were taught how to use the application initially
2	I would like to have some space to talk about my problem,
3	I am totally confused and don't know what to do after the drugs finish.

The main symptoms reported by the patients during the two phases of the study were having persistent cough, shortness of breath, fatigue, and myalgia (Figure 1-6).

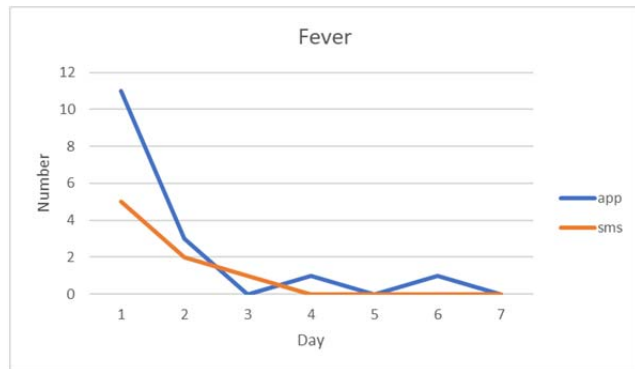


Figure 1. Number of patients reporting fever during 7 sessions of contact by SMS and application.

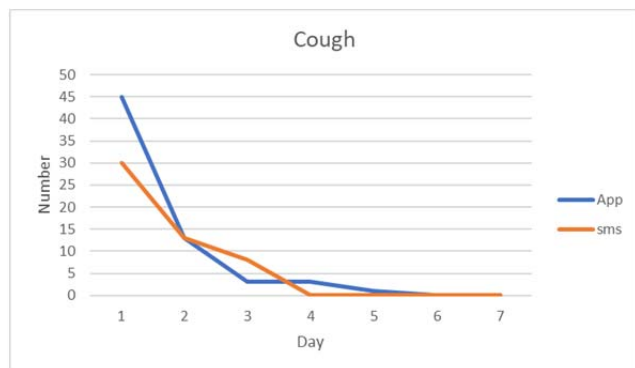


Figure 2. Number of patients reporting cough during 7 sessions of contact by SMS and application.

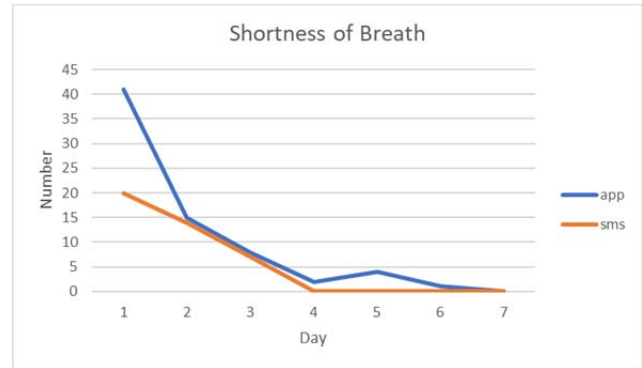


Figure 3. Number of patients reporting shortness of breath during 7 sessions of contact by SMS and application

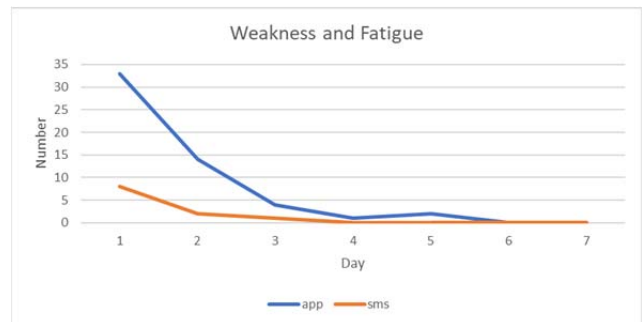


Figure 4. Number of patients reporting weakness and fatigue during 7 sessions of contact by SMS and application

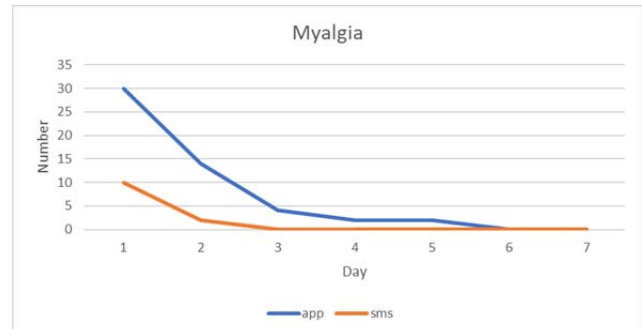


Figure 5. Number of patients reporting myalgia during 7 sessions of contact by SMS and application

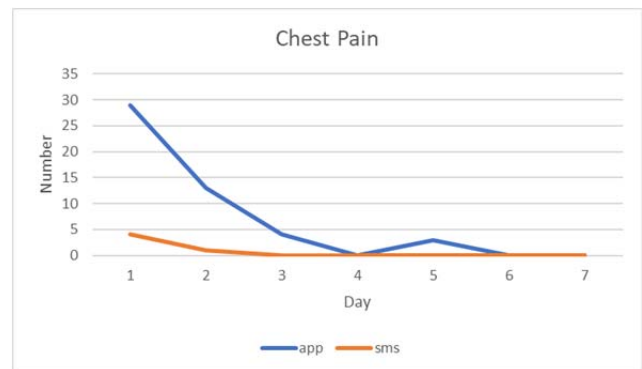


Figure 6. Number of patients reporting chest pain during 7 sessions of contact by SMS and application

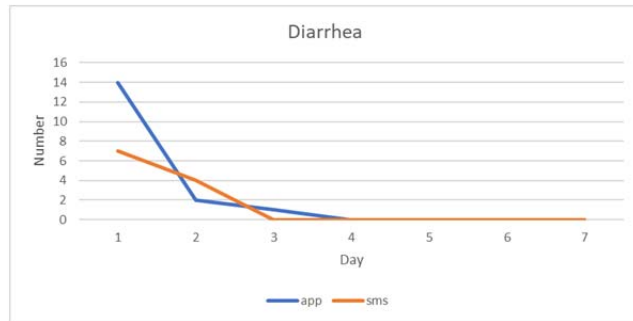


Figure 7. Number of patients reporting diarrhea during 7 sessions of contact by SMS and application

Some special conditions were: 1) a 42-year-old female patient was a case of kidney transplantation and had developed dyspnea after restarting her immunosuppressive drugs after 7 days of anti-corona treatment, who was referred for further evaluation. 2) Two 74 and 68 male cases of persistent hyperglycemias were referred for diabetes control. 3) A 33-year-old male had right leg pain and was referred for Doppler ultrasonography and diagnosed with deep vein thrombosis and received anti-coagulants. 4) A 55-year-old female patient had bloody diarrhea who was referred for management. 5) Twenty-one patients [13, (7.2%) male and 8, (5.3%) female] had died during this period.

DISCUSSION

Telemedicine has many potential capabilities and advantages which can be implemented throughout the entire health-care system during special situations, namely, epidemics, outbreaks, and disasters. Patient follow-up during epidemics, especially when the disease course is a mystery, is an important step in both successful patient management and disease control. This study showed the role of telemedicine as a tool for corona virus patient follow-up and the potentials it has and also highlighted its value for defining the course of this unknown disease.

The use of telecommunication as a method of patient evaluation, diagnosis, and even treatment goes way back in history, but with the advent of novel communication systems and evolve of information technology, medical science has reached a new era (13). Many diverse

applications have been defined for telemedicine such as emergency situations, disasters and outbreaks (2,3,4,6,14), management of chronic diseases (13), acute illness (15-17), intensive care management (18), and rehabilitation (19). As an example, during Ebola disease outbreak specially designed applications were used for patient detection and follow-up, with significant results (1,3).

As a new branch of science which is teamwork between medicine and information technology, telemedicine has introduced many promising options and devices. Each and every device which is developed has in itself specially designed features to meet certain expectations and needs. Therefore, device selection should be based on target patients, needs, and expected results.

Since the first Corona virus pneumonia report to WHO on December 31, 2019 until declaring it a Public Health Emergency of International Concern (PHEIC) on January 30, 2020 (20), and eventually announcing the pandemic situation on March 11th 2020 (21) the world has faced a great challenge. Rapidly increasing number of infected patients and critically ill cases needing intensive care has lead government and authorities to stop the spread of the disease by setting restrictions and regulations for people movement and contacts (22). But still the high number of suspected cases and patients visiting medical centers is a major issue in even highly equipped medical centers around the world (23). Therefore, the most promising solution to this problem is screening and admitting the critically ill patients and monitoring the less severe cases from home using telecommunication devices. One other advantage of using telemedicine is minimizing the length of hospital stay for stable patients and continuing their management at home with the help of telemedicine monitoring and follow-up.

Our study was based on follow-up of patients, to monitor the course of their illness. Considering the fact that many aspects of corona virus infection is still unknown, an interesting output of our study was to describe the disease course during the upcoming weeks and their reactions toward the illness.

As results show, during phase one of our study roughly one third of total patients responded to SMS and/or installed the educational application. This may be due to subsiding of the symptoms or unwillingness to participate. But during phase two when instructions were given orally the day after discharge a considerable positive feedback was received and 100% of the patients installed the application. Although 64% of the patients started using it, which means still one third did not participate. This rate of usage is still twice the feedback we received from phase one and shows the importance of direct contact and active follow up of patients.

One interesting result of this study was that approximately one third of the patients started making phone calls, although they had access to text messaging. This may be due to the fact that the patients feel more confident when speaking to their doctors rather than texting them and speaking gives them the sense of a real visit. While speaking on the phone, the patients talked about more than one issue, but texting gave them limited space. But from our point of view, application gives us the opportunity to be in contact with patients on a regular basis and has the advantage of sending reminders for medicine consumption and online visits and also helps us develop medical records of our patients for future refers. This difference between the point of views of patients and physicians may be an obstacle for successful telemedicine utilization, but further studies are recommended to better clarify the issue.

During the period of our study, the major concern of our patients was "what they should do after the drug therapy was finished" and more importantly "what do they do after their quarantine duration finishes", "can they have regular contacts with family members thereafter?" Although many reports have defined the incubation and infectivity period of the disease, there is still uncertainty regarding the risk of infection these patients have for others (24,25). During our study we came up with interesting information about the duration of symptoms. Most of our patients still had dry coughs during the 3rd

and 4th weeks of their illness, which means they were still symptomatic, and more interesting was the fact that some symptoms appeared during the follow-up period, as an example diarrhea was first detected in some of our patients during this period, and considering the fecal transmission of the disease it seems that the available protocols of quarantine and patient isolation should be revised (26,27).

At the moment the global concern is saving the lives of the newly infected patients, not much information is released regarding the future of the survivors. Can they have normal lives? Since this state of undetermined living puts special psychological pressures on patients and families, having close long- term communication with the patients seems important. Sending health recommendations is one of the options which we tried in our study and received promising feedbacks.

Regarding the potentials of information technology now a days, and also the special situation that covid-19 pandemic has developed for the human beings around the world, it is logical to make more use of telemedicine. But our study showed that to make the use of it more widespread, initially the general population must be familiarized with and informed about the positive aspects of tele-communication and therefore encouraged to further participate in using this new way of clinical management.

CONCLUSION

Telemedicine has much potential in patient follow up during epidemics, especially when the disease course is unknown. This study showed the role of telemedicine as a tool for corona virus patient follow-up, and also for defining the course of this unknown disease. But patient familiarization, initial education, and active follow-up are essential factors for success of this method and better participation of patients.

REFERENCES

1. Ohannessian R. Telemedicine: potential applications in epidemic situations. *European Research in Telemedicine/La Recherche Européenne en Télémédecine* 2015;4(3):95-8.

2. United Nations Population Fund. Mobile app promises to speed Ebola response in Guinea; 2015 [Accessed online April 5th 2020 at <http://www.unfpa.org/news/mobile-app-promisesspeed-ebola-response-guinea>].
3. Tom-Aba D, Olaleye A, Olayinka AT, Nguku P, Waziri N, Adewuyi P, et al. Innovative Technological Approach to Ebola Virus Disease Outbreak Response in Nigeria Using the Open Data Kit and Form Hub Technology. *PLoS One* 2015;10(6):e0131000.
4. Cooper DL, Smith GE, Regan M, Large S, Groenewegen PP. Tracking the spatial diffusion of influenza and norovirus using telehealth data: a spatiotemporal analysis of syndromic data. *BMC Med* 2008;6:16.
5. Zhai Y, Wang Y, Zhang M, Gittel JH, Jiang S, Chen B, et al. From isolation to coordination: how can telemedicine help combat the COVID-19 outbreak?. *MedRxiv* 2020.
6. Swerdlow DL, Finelli L. Preparation for Possible Sustained Transmission of 2019 Novel Coronavirus: Lessons From Previous Epidemics. *JAMA* 2020;323(12):1129-1130.
7. Wu Z, McGoogan JM. Characteristics of and Important Lessons From the Coronavirus Disease 2019 (COVID-19) Outbreak in China: Summary of a Report of 72 314 Cases From the Chinese Center for Disease Control and Prevention. *JAMA* 2020;323(13):1239-1242.
8. Greenhalgh T, Wherton J, Shaw S, Morrison C. Video consultations for covid-19. *BMJ* 2020;368:m998.
9. Hollander JE, Carr BG. Virtually Perfect? Telemedicine for Covid-19. *N Engl J Med* 2020;382(18):1679-1681.
10. Lin M, Beliavsky A, Katz K, Powis JE, Ng W, Williams V, et al. What can early Canadian experience screening for COVID-19 teach us about how to prepare for a pandemic? *CMAJ* 2020;192(12):E314-E318.
11. Adams JG, Walls RM. Supporting the Health Care Workforce During the COVID-19 Global Epidemic. *JAMA* 2020;323(15):1439-1440.
12. Phelan AL, Katz R, Gostin LO. The Novel Coronavirus Originating in Wuhan, China: Challenges for Global Health Governance. *JAMA* 2020;323(8):709-710.
13. Bashshur RL, Shannon GW, Smith BR, Alverson DC, Antoniotti N, Barsan WG, et al. The empirical foundations of telemedicine interventions for chronic disease management. *Telemed J E Health* 2014;20(9):769-800.
14. Tabish SA, Syed N. Disaster preparedness: Current trends and future directions. *International Journal of Research and Science* 2015;4(6).
15. Ronis SD, McConnochie KM, Wang H, Wood NE. Urban Telemedicine Enables Equity in Access to Acute Illness Care. *Telemed J E Health* 2017;23(2):105-112.
16. Johansson T, Wild C. Telemedicine in acute stroke management: systematic review. *Int J Technol Assess Health Care* 2010;26(2):149-55.
17. Rogove HJ, McArthur D, Demaerschalk BM, Vespa PM. Barriers to telemedicine: survey of current users in acute care units. *Telemed J E Health* 2012;18(1):48-53.
18. Rolston DM, Meltzer JS. Telemedicine in the intensive care unit: its role in emergencies and disaster management. *Crit Care Clin* 2015;31(2):239-55.
19. Galea MD. Telemedicine in Rehabilitation. *Phys Med Rehabil Clin N Am* 2019;30(2):473-483.
20. World Health Organization. Coronavirus disease 2019 (COVID-19): situation report, 10. (30 January 2020 <https://www.who.int/docs/default-source/coronaviruse/situation-reports/20200130-sitrep-10-ncov>).
21. World Health Organization. Coronavirus disease 2019 (COVID-19): Situation Report- 51(11 March 2020). <https://www.who.int/docs/default-source/coronaviruse/situation-reports/20200311-sitrep-51-covid-19>
22. Chinazzi M, Davis JT, Ajelli M, Gioannini C, Litvinova M, Merler S, et al. The effect of travel restrictions on the spread of the 2019 novel coronavirus (COVID-19) outbreak. *Science* 2020;368(6489):395-400.
23. Chauhan V, Galwankar S, Arquilla B, Garg M, Somma SD, El-Menyar A, et al. Novel Coronavirus (COVID-19): Leveraging Telemedicine to Optimize Care While Minimizing Exposures and Viral Transmission. *J Emerg Trauma Shock* 2020;13(1):20-24.
24. Lauer SA, Grantz KH, Bi Q, Jones FK, Zheng Q, Meredith HR, et al. The Incubation Period of Coronavirus Disease 2019

- (COVID-19) From Publicly Reported Confirmed Cases: Estimation and Application. *Ann Intern Med* 2020;172(9):577-582.
25. Han Y, Yang H. The transmission and diagnosis of 2019 novel coronavirus infection disease (COVID-19): A Chinese perspective. *J Med Virol* 2020;92(6):639-644.
26. Lei ZY, Cao HJ, Jie YS, Huang ZL, Guo XY, Chen JF, et al. Comparison of epidemiological and clinical features of patients with coronavirus disease (COVID-19) in Wuhan and outside Wuhan, China. (2/24/2020). <http://dx.doi.org/10.2139/ssrn.3546082>.
27. Wu Y, Guo C, Tang L, Hong Z, Zhou J, Dong X, et al. Prolonged presence of SARS-CoV-2 viral RNA in faecal samples. *Lancet Gastroenterol Hepatol* 2020;5(5):434-435.