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Hypothetical model of disease course of COVID-19 patients and their exit plan

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Abstract

In view of preparing ourselves for the possible rise of Corona Virus Disease (COVID-19) cases, we have proposed a hypothetical model of disease course in COVID-19 patients admitted in Patan Hospital and the exit plan based on available evidences. This will give us a scientific basis of planning discharge of our future cases. According to it, patients are subjected to repeat Polymerase chain reaction (PCR) on day 20 of illness onset and then every 4 days till negative result. Patients with two negative PCR test repeated 24 hours apart are discharged and advised for 14 days' home quarantine.

Keyword: COVID-19, disease course, exit plan, Patan Hospital

The corona virus disease (COVID-19) has progressed to a global pandemic with significant morbidity and mortality. Nepal has also reported COVID-19 cases. Patan Hospital (PH), a teaching hospital of Patan Hospital, Patan Academy of Health Sciences (PAHS), located in Lalitpur district, Kathmandu. It has been allocated for management of COVID-19 patients by ministry of health and population of government of Nepal. Looking at the trend of cases throughout the world, we believe Nepal wouldn't be an exception and cases are likely to rise. So, in view of preparing ourselves for the possible rise, we propose a hypothetical model of disease course in our COVID-19 patients and the exit plan

(discharge) based on this which will help in managing future cases.

Cases at Patan Hospital- As a part of screening, three patients who had together travelled back to Kathmandu were tested positive by rapid diagnostic test (RDT). They had returned to Nepal 28 days back and were asymptomatic at the time of testing. Polymerase Chain Reaction (PCR) was done, two tested positive (case 2 and case 3). They are asymptomatic and are being managed in COVID-19 ward. Patient with negative PCR (case 1) was discharged and advised for 14 days home quarantine. Rest two patients tested negative after six days.

Table 1. Hypothetical model of the disease course of three COVID-19 patients managed at Patan Hospital

Day	Case 1	Case 2	Case 3
1	Incubation period (IP) – D1 – Return to Nepal	Return to Nepal	Return to Nepal
2	IP		
3	IP		
4	IP		
5	IP – D5		
6	Viral shedding (VS) – D1	IP – D1	IP – D1
7	VS – IgM	IP	IP
8	VS - IgM	IP	IP
9	VS - IgM	IP	IP
10	VS – IgM	IP – D5	IP – D5
11	VS – IgM	VS – D1	VS – D1
12	VS– IgM	VS – IgM	VS – IgM
13	VS – IgM	VS - IgM	VS - IgM
14	VS – IgM IgG	VS – IgM	VS – IgM
15	VS – IgM IgG	VS – IgM	VS – IgM
16	VS – IgM IgG	VS – IgM	VS – IgM
17	VS – IgM IgG	VS– IgM	VS– IgM
18	VS– IgM IgG	VS – IgM	VS – IgM
19	VS – IgM IgG	VS – IgM IgG	VS – IgM IgG
20	VS – IgM IgG	VS – IgM IgG	VS – IgM IgG
21	VS - IgG	VS – IgM IgG	VS – IgM IgG
22	VS – IgG	VS – IgM IgG	VS – IgM IgG
23	VS- IgG	VS– IgM IgG	VS– IgM IgG
24	VS – IgG	VS – IgM IgG	VS – IgM IgG
24	VS – D20 IgG	VS – IgM IgG	VS – IgM IgG
26	VS – IgG	VS - IgG	VS - IgG
27	VS – IgG	VS – IgG	VS – IgG
28	VS – IgG	VS- IgG	VS- IgG
29	Negative - D24 IgG	VS – IgG	VS – IgG
30		VS – D20 IgG	VS – D20 IgG
31		VS – IgG	VS – IgG
32		VS – IgG	VS – IgG
33		VS – IgG	VS – IgG
34		VS – D24 IgG	VS – D24 IgG
35		Negative - D25 IgG	Negative - D25 IgG

COVID-19 incubation period and viral load- In order to propose a hypothetical model of the disease course, we need to know about the incubation period and duration of viral shedding of SARS-CoV-2. As per the available evidence on COVID-19, median incubation period is 5.1 days (95% CI, 4.5 to 5.8 days), and 97.5% of those who develops symptoms within 11.5 days (CI, 8.2 to 15.6 days) of infection.¹ However, the incubation period has been reported up to 24 days.² Five percentage of patients are asymptomatic and more than 80% have mild disease.³ Viral loads are relatively less in asymptomatic patients.⁴ Mild cases has been reported to have an early viral clearance, with 90% of these patients testing negative on PCR by day 10 post-onset whereas severe cases tested positive beyond 10 days.⁵ The median duration of viral shedding as reported in a study was 20 days (IQR 17.0–24.0) from illness onset in survivors and longest duration was 37 days. The virus was detected until death in non-survivors.⁶ The IgM antibody appears by day 7 and disappears by day 21 whereas IgG appears by day 14 and persists thereafter.⁷

Hypothetical model- Taking the upper limit of all values i.e. incubation period of 5.8 days, viral shedding of 24 days, appearance of IgM antibody by day 7 clearance by day 21 and appearance of IgG antibody by day 14, a model of the disease course in our three cases is shown in Table 1. On the day when PCR was done, case 1 had undetectable viral load whereas IgG was present which resulted in antibody test positive but PCR negative. Case 2 and case 3 would have detectable viral load and IgG resulting in positive antibody and PCR test. So, if case 1 is PCR negative on day 1, then case 2 and case 3 would be PCR negative after 6 days. For discharge, PCR must be negative twice from samples collected at least 24 hours apart.⁸ There is a possibility of re-infection after discharge but it is not clear whether a positive result is more a detection of the remained virus transferred from the lower respiratory tract to the throat or nose with coughs, rather than an indicator of the re-infection of the upper respiratory tract.⁹

Exit Plan- Based on the model, the following exit plans were proposed for admitted cases:

1. Once case is confirmed with PCR, it can be repeated on day 20 of illness onset and then every 4 days till first negative result whichever comes earlier.
2. Test (PCR) may come positive till 5 to 6 weeks.
3. Once the first PCR is negative, it is repeated after 24 hours.
4. If two PCRs repeated 24 hours apart are negative, patients can be discharged and advised for 14 days' home quarantine and follow up on day 7 of home quarantine.
5. On day 7 PCR is done to rule out re-infection or residual disease if patient is symptomatic.
6. If PCR is positive on day 7, patients are readmitted and if negative patients are advised to follow up on day 14.
7. Patients who are asymptomatic on day 14 are discharged from follow up.
8. However, if patients have persistent or increased symptoms PCR is repeated on day 14. Discharge from follow up to be planned once symptom decreases.

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Conflict of Interest

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Author contribution

All authors contributed equally

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