COVID-19: evidence for 2-week versus 3-week quarantine

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To the Editor—A new variant of coronavirus disease 2019 (COVID-19, SARS-CoV-2 VUI 202012/01) was identified in the United Kingdom before Christmas 2020. Preliminary reports suggested that this variant was up to 70% more transmissible compared with previous strains in circulation.[1] In response, large parts of London and South East England introduced the strictest Tier 4 restrictions, where all residents were asked to remain at home, all non-essential shops closed and Christmas celebrations cancelled for many families in the country.[2] This new variant had already been identified in other countries across Europe and beyond (including Australia, Japan and Canada).[1,3] The Hong Kong SAR Government swiftly responded by escalating quarantine requirements for inbound travellers from 14 to 21 days, one of the strictest quarantine policies around the world (Table 1[4-7]). It is important to examine the scientific evidence for the effectiveness of quarantine practices to reassure citizens, government officials, and law enforcing personnel.

To compare the effectiveness of various quarantine protocols, a study focusing on infected individuals and the probability of 'missing' such cases under each protocol based on the evidence available has been conducted (Table 2).[8] Serial testing on days 7 and 14 appeared to be the most effective with 91% of infected individuals identified. On the contrary, the yield was unsatisfactory for serial testing on days 1 and 14 or 21 with a substantial proportion of positive cases missed (43% and 67%, respectively).

Nonetheless the likelihood of COVID-19 transmission is not evenly distributed along the timeline post infection. By applying the known epidemiological characteristics of COVID-19 transmission (ie, transmission follows a gamma distribution with mean=5.3 days, standard deviation=2.1 days, and basic reproduction number=2.5), we can infer the effectiveness of different quarantine durations. For example, an infected individual who has two serially negative reverse transcription polymerase chain reaction (RT-PCR) tests 1 week apart who is released on day 7 post-infection would cause infection in around 0.092 secondary cases (2.5×19%×19.3%). In a second scenario, an infected person with two serially negative RT-PCR tests 2 weeks apart who is released on day 14 post-infection would lead to 0.001 secondary cases (2.5×43%×0.1%). In a third scenario that reflects the latest quarantine changes, an infected individual

TABLE 1. Coronavirus disease 2019 (COVID-19) quarantine duration and COVID-19 testing policies of different places

	Hong Kong[4]	United Kingdom[5]	Canada[6]	Australia[7]
Pre-departure COVID-19 test	Within 72 hours of departure	Not specified	Not specified	Not specified
Quarantine duration	21 days	10 days except from regions on the travel corridor list	14 days	14 days
1st COVID-19 test	On arrival	If test on day 5 is negative, can end self-isolation early	Not specified	First 48 hours
2nd COVID-19 test	Day 12	Not specified	Not specified	Between 10 to 12 days
3rd COVID-19 test	Day 19 or 20	Not specified	Not specified	Not specified

TABLE 2. Theoretical infected cases missed[8]

Day of testing post-infection	Theoretical infected cases missed
Day 1 and Day 7	19% (0.95×0.20) of infected cases are likely to have two serially negative RT-PCR tests 1 week apart
Day 1 and Day 14	43% (0.95×0.45) of infected cases are likely to have two serially negative RT-PCR tests 2 weeks apart
Day 1 and Day 21	67% (0.95×0.70) of infected cases are likely to have two serially negative RT-PCR tests 3 weeks apart
Day 7 and Day 14	9% (0.20×0.45) of the infected individuals will have two serially negative test results 2 weeks apart

Abbreviation: RT-PCR = reverse transcription polymerase chain reaction with two serially negative RT-PCR tests 3 weeks apart and who is released on day 21 post-infection would lead to approximately 0.000 secondary cases (2.5×67%×0.0%). Clearly, the largest reduction in risk of secondary cases due to imported seed cases can be achieved through the 2-week policy rather than a 1-week policy of isolation (99% reduction in risk of secondary cases).

Based on this evidence, it can be concluded that a protocol of 2 weeks quarantine, not 3, will miss one infected person for every 1000 infected persons. Over 8000 reported cases (8425) have been identified in Hong Kong to date and the majority were not quarantined at the time of writing in early 2021. If we apply the policy of quarantine for 2 weeks with two serial tests, we would have missed eight infected individuals who would have been identified over the last 12 months had they been quarantined for 21 days.

Based on scientific evidence, the policy of 3-week quarantine can potentially reduce the risk of introducing this new highly contagious variant. This strict quarantine policy will come with a very high economic cost, but was considered as essential to protect the lives of Hong Kong citizens during the middle of the COVID-19 pandemic in December 2020. In hindsight, our observation provides important information to guide quarantine policy about emerging respiratory viral infections with similar infectivity, basic (and initial) reproduction number R_0 (R-naught), and the current reproduction number R_t (R at time t).

Author contributions

All authors contributed to the concept or design, acquisition of data, analysis or interpretation of data, drafting of the manuscript, and critical revision of the manuscript for important intellectual content. All authors had full access to the data, contributed to the study, approved the final version for publication, and take responsibility for its accuracy and integrity.

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