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# Assessment of patients who tested positive for COVID-19 after recovery

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Since the start of the outbreak in December 2019, COVID-19, caused by severe acute respiratory syndrome coronavirus 2 (SARS-Cov-2), has led to an increasing number of infections worldwide, with an estimated overall mortality of 5·7%.[1] Meanwhile, many patients who were hospitalised have recovered and were discharged to self-quarantine. However, some patients have tested positive for COVID-19 again after recovery. An explanation of why patients tested positive for COVID-19 on a retest remains unclear.

In the Wuhan Pulmonary Hospital (Wuhan, China), 651 patients were classified as recovered between Jan 11, 2020, and April 1, 2020. The standard hospital discharge criteria[2] were applied: patients were haemodynamically stable and afebrile for longer than 3 days, with radiological evidence of substantial resolution of pneumonia with a CT scan, two negative SARS-CoV-2 RT-qPCR tests done at least 1 day apart on nasopharyngeal and oropharyngeal swabs, and no concurrent acute medical issues requiring transfer to another medical facility. All discharged patients were followed up by two medical teams; the median follow-up duration was 48 days (IQR 18–50), and the longest follow-up was 91 days.

See Online for appendix

During this follow-up, 23 (3%) of 651 patients tested positive on a retest for SARS-CoV-2 by RT-qPCR assay in a routine health check (appendix). The median age of this retest-positive group was 56·0 years (range 27·0–89·0, IQR 48·5–74·0), with slightly more women (12 [52%] of 23 patients) than men (11 [48%]). In this retest-positive group, 12 patients (52%) had moderate, nine (39%) severe, and two (9%) critical conditions during their previous hospitalisation. The median duration from hospital discharge to a positive retest was 15·0 days (range 4–38, IQR 11·0–16·5; appendix). The median duration from a positive retest to hospital re-admission was 1·5 days (IQR 1·0–2·0). At the time of the positive retest, a colloidal gold-based immunochromatographic strip assay for anti-SARS-CoV-2 viral immunoglobulins showed that seven patients (30%) were positive for both IgM and IgG, whereas five (22%) were IgG-positive but IgM-negative; the remaining 11 patients (48%) were negative for both antibodies. Among this retest-positive group, 15 patients (65%) were asymptomatic at the time of the retest whereas eight (35%) had at least one symptom associated with active COVID-19. Specifically, six patients (26%) presented with fever, two (9%) had a cough, one (4%) reported fatigue, one (4%) dyspnoea, and one (4%) chest tightness. Although a positive PCR test in asymptomatic patients who were retested might only reflect residual non-pathogenic viral components, the positive retest in symptomatic patients suggests the potential for recurrence of active disease and its transmission.

At the time of the last follow-up, on April 4, 2020, all 23 patients with a positive retest were alive, 18 (78%) had recovered and were again discharged from the hospital, four (17%) remained in hospital for additional medical care, and one (4%) remained at home for self-isolation. In this retest-positive group, one 80-year-old patient had thoughts of suicide. No new viral transmission could be ascribed to these patients with a positive retest. This might be due to the precautionary measure of the hospital to discharge patients into intermediary Fangcang shelter hospitals[3] or other related health centres for 14-day clinical monitoring. Fangcang shelter hospitals are large-scale and temporary hospitals rapidly built by converting existing public facilities (ie, exhibition centres) into a medical setting. In Fangcang shelters, basic medical care, frequent monitoring, and rapid referral are effectively provided and implemented while relieving the burden of local medical capacities.[3] This type of clinical management for patients who recovered from COVID-19 might effectively reduce the possibility of additional virus transmission when SARS-CoV-2 re-emerges. During this follow-up study, three patients who were discharged were not able to take part in retesting because two patients died, one from comorbid coronary heart disease and another from acute respiratory distress syndrome, and the third patient had a cardiac arrest. Among patients with a negative retest, one patient had leg thrombosis that necessitated amputation.

Our finding that among patients with a positive retest 52% had IgG anti-viral antibodies and 30% had IgM antibodies suggests partial immune system recognition of SARS-CoV-2. Because 35% of patients with a positive retest had one or more COVID-19-related symptoms, the usefulness of viral antibodies in COVID-19 clearance remains in question, and the potential for continued virus transmission after hospital discharge warrants additional investigation. To prevent a second wave of COVID-19 infections, we recommend a minimum period of 14-day clinical observation in a Fangcang-like medical setting after recovery from COVID-19.

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# Elimination of COVID-19: what would it look like and is it possible?

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In countries that have achieved a low incidence of COVID-19 infection, such as Australia and New Zealand, disease elimination has been proposed.[1,2] Yet we do not have a definition of elimination for COVID-19. Both these countries implemented early, widespread, and strict disease mitigation strategies. With low cumulative incidence, most of the population in these countries remain susceptible to severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2). Before the availability of a vaccine, implementing exit strategies that ease social distancing restrictions will probably result in epidemics if a low level of community transmission remains or is imported through travel, as seen with the resurgence in the state of Victoria, Australia in July 2020. For other respiratory transmitted infections, such as measles, mumps, and smallpox, the prevaccine era saw recurrent epidemic cycles,[3] and a similar pattern is projected for unmitigated SARS-CoV-2 transmission, depending on the duration of immunity.[4] Reduced case counts, flattened epidemic curves, and longer interepidemic periods are also dependent on achieving immunisation coverage and reduced transmission through implementation of non-pharmaceutical interventions (NPIs).[5]

The concepts of disease elimination and eradication mostly relate to immunisation programme outcomes. Disease eradication is the global reduction of infection to zero cases, whereas disease elimination is the absence of sustained endemic community transmission in a country or other geographical region.[6] With ongoing global SARS-CoV-2 transmission, reduction to zero cases in a defined region is only possible with stringent travel restrictions. For COVID-19, modelling estimates suggested that sustained restrictions that reduced travel by 90% to and from Wuhan, China, early in the spread of SARS-CoV-2, only modestly affected the epidemic trajectory to other regions of China.[7] However, in Australia, travel bans were highly effective in controlling