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Navigating shifting waters: rapid response to change in the era of COVID-19

The emergence of severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) in Wuhan, China in December 2019 has resulted in a global COVID-19 pandemic and a consequent rapid transformation of medical practice in 2020. Overseas, distressing reports of overwhelmed health systems,[1] healthcare workers losing their lives[2] and shortages of personal protective equipment (PPE)[1,3–5] have created significant anxiety and catalysed rapid action across Australia and New Zealand. Enormous effort has been invested in developing screening clinics; redesigning general practice, hospital inpatient wards and emergency departments (and the models of care used within them) and expanding intensive care capacity. Public and private pathology services have rapidly expanded their capacity to meet the testing demand. As of 6 May, 664 756 tests for SARS-CoV-2 have been performed in Australia, representing 2611 tests per 100 000 people.[6] Fundamental changes to general practice have also occurred rapidly; across five Australian Primary Health Networks, weekly face-to-face consultations dropped from around 300 000 to 200 000 per week from February to April 2020; in the same period, telephone/telehealth consultations in general practice rose from 0 to 120 000 per week, now representing 40% of consultations overall.[7]

Modelling-derived estimates of infection in our populations are constantly changing, as is our understanding of how to best care for patients infected with SARS-CoV-2. In both Australia and New Zealand, mathematical modelling efforts[8,9] have been vital sources of strategic information to inform the public health and social policy decisions – including requirements to stay at home; restrictions on educational, recreational and social gatherings and travel, isolation and quarantine directions – that have made daily life in our countries almost unrecognisable when compared with a few weeks ago. Elements of these pandemic countermeasures are likely to continue for months to come. To date, the heroes of Australia and New Zealand's effective response to COVID-19 are the epidemiologists and public health physicians who have enacted these community interventions (and the politicians who have heeded their advice). We are now well placed to respond to COVID-19, and our public health leaders, politicians and the general community must be commended for slowing the spread of SARS-CoV-2.

The result of sacrifices made is that we have been spared the enormous morbidity and mortality experienced by most countries. As of 17 April 2020, cumulative COVID-19 related deaths reported to the World Health Organisation (WHO) from New Zealand and Australia were around 0.25 per 100 000 population (similar to those reported by Singapore, Japan, South Korea and China – all <1 per 100 000). In contrast, the cumulative reported mortality in Germany (4.6 per 100k), the United States (8.5), the United Kingdom (20.2) and Italy (36.7) ranges from 18 to 145 times that reported from Australasia.[10] However, even these stark figures are almost certainly underestimates of total deaths attributable to COVID-19 based on analysis of excess mortality in the most affected populations.[11]

The other result is that we now have time, time to ensure the health system preparations we have put in place are ready to be activated at an unknown point in our future; time to determine whether locally acquired infection has truly been suppressed below the critical R0 value of 1 – that is, that each infected individual infects (on average) less than one other person, thereby breaking the chain of transmission and time to scale further up access to diagnostic testing and use the rapidly expanded public health workforce available to health departments to design and implement rapid response mechanisms to swing into action whenever and wherever local clusters of infections are detected. This will be essential to prevent our communities from again being set along the trajectory of a substantial epidemic curve – the 'second wave' – or from being forced once more to endure profound restrictions on individual freedoms and to our way of life.

Evidence of high asymptomatic proportions continues to mount when universal testing irrespective of symptoms is implemented – for example, recent accounts from the United States, including a naval vessel (600/4500 sailors infected, 60% asymptomatic),[12] a New York maternity service (33/215 women infected, 88% asymptomatic)[13] and a Boston homeless shelter (146/397 clients infected, 100% asymptomatic).[14] General population testing in Iceland identified 87 positive individuals out of 10 797, with 41% of these reporting no symptoms at the time of testing.[15] While many of these individuals may have been in pre-symptomatic or convalescent phases of infection, it appears clear that asymptomatic infections still represent a profound public health challenge. It also suggests why early adopters of whole-of-population social-distancing measures – such as New Zealand and Australia – may have averted the crisis seen overseas. If adhered to, these measures reduce the potential for transmission of infection from all infected individuals, symptomatic or not. This contrasts with traditional clinically focussed approaches, such as testing those with symptoms and isolating them until cleared; if a substantial proportion of infected people have no symptoms, these measures alone will be doomed to fail. While Australia's COVIDSafe App can speed up contacting of people exposed to a diagnosed case of COVID-19, it cannot replace broader social distancing and other public health measures should we face a second, more substantial wave of infections in coming months. To develop an early warning capacity ahead of a substantial increase in presentations to hospital, other innovative surveillance mechanisms must be considered, including real-time data from presentations to general practice[7] and surveillance for SARS-CoV-2 detection in sewerage.[16]

Pleasingly, with the success of social/physical distancing measures, it seems our countries will be spared the prospect of clinicians being forced to practise outside their knowledge/skillset, as has been required in many other countries.[17] Even so, clinicians whose purview would ordinarily include severe respiratory infective illnesses face the prospect of clinical decision-making in the absence of established evidence supporting specific interventions.

It is difficult to discern signal from noise among the deluge of published studies on COVID-19 (over 5500 studies recorded in PubMed since 1 April 2020).[18] Unsurprisingly, for an illness undocumented less than 4 months ago, no treatments, beyond supportive care, have been established to be effective, highlighting the need for well designed and coordinated clinical trials. Guideline development is tricky when even basic questions are unknown – is hydroxychloroquine effective[19] or toxic;[20] is use of high-flow nasal prongs an aerosol-generating procedure[21] or not;[22] should anti-coagulation be at prophylactic or therapeutic dose;[23] in isolated hypoxic respiratory failure, is there a role for conscious proning of hypoxic patients[24] or is mechanical ventilation the only acceptable management pathway?

As COVID-19 has forced innovation at a health service level, it is also accelerating a transition in scientific publishing. The results of the hundreds of therapeutic studies currently underway are likely to be unavailable for some time.[25] Much of the knowledge regarding clinical presentation of COVID-19 or management strategies are gained from unconventional sources, for example, early findings regarding the efficacy of resdemivir have been published in conventional literature,[26] but presentation of non-peer-reviewed data in a White House media conference gained vastly more publicity.[27] Pre-print publications have gained prominence in their ability to provide data quickly (veracity of these studies will remain an ongoing challenge for the medical community),[28] and the spike in such studies is proportionally significantly greater than seen in traditional peer-reviewed literature.[29,30]

Even more nimble social media tools have proven incredibly effective at dissemination and have the advantage of being obtained from a trusted source (or at least a source where trust can largely be established). Their ability to disseminate rapidly experience from the frontline has proven invaluable in allowing clinicians to compose a picture of what COVID 'looks like' and what impact might be anticipated for their institutions. One tweet, chosen somewhat randomly from those we have received, has garnered a level of engagement (10 300 retweets, 30 400 'likes')[31] that would make a Nobel Laureate blush. This does not even include the innumerable occasions where this tweet was communicated between colleagues through email, text or WhatsApp.

One curious side-phenomenon is that previously esoteric and little-known studies have provided a significant basis for guideline development. Two studies regarding aerosol generation during non-invasive ventilation from

Hui *et al*.[21,32] had garnered a total of 18 citations prior to January 2020 but, in the 3 months since, have been cited 57 times,[33,34] including within WHO guidance[35] and other consensus/position papers.[36]

The constantly changing landscape has provided challenges but highlights the ability of our healthcare systems to adapt and develop new models of care. An opportunity exists to transform many aspects of healthcare for the longer term once the pandemic phase of COVID-19 has passed, acknowledging that the threat of focal outbreaks seeding an epidemic second wave in almost completely susceptible populations means that a time when the pandemic phase is truly past for New Zealand and Australia is an unknown point in the future.

At the patient level, we rely heavily on seeing patients face to face. The response to COVID-19 has demonstrated that telehealth appointments, remote monitoring and visiting patients (in their place of residence) are feasible and often preferable for many patients.[5] There are marked efficiencies for both healthcare workers and patients minimising travel and waiting times at hospital clinics, as well as the ability to remain at work or at home. Evaluating the uptake of telehealth and other ambulatory services will be influential in the design of a post-pandemic health service.

This pandemic response has highlighted critical issues to address, including the ability to expand rapidly inpatient capacity, access to PPE and stockpiles and challenges beyond the health system, including viable and scalable local manufacturing and the ability to be self-sufficient in an era of globalisation. Governments and health officials must also plan for future pandemics and learn from countries that have responded well. In doing so, we have the opportunity to expand our public health support networks, hospital infrastructure and training.

Coronaviruses with pandemic potential have emerged three times in the past 18 years – SARS (2002–2003), Middle East Respiratory Syndrome (MERS) (2012) and now COVID-19.[37] Following the initial SARS outbreak in 2003, both Singapore and Taiwan developed national command frameworks to respond to future pandemics.[38,39]As a result, Singapore's initial response to COVID-19 was rapid, successful and widely praised. However, subsequently, significant outbreaks in the migrant worker population in Singapore provide a cautionary tale for Australia and New Zealand.[40] Despite our initial success in controlling the spread SARS-CoV-2, we must identify, screen and care for vulnerable and marginalised populations that do not traditionally seek medical care. This includes the homeless, people who inject drugs, international students and migrant workers.

Over the coming months, we will have easing of restrictions across Australia and New Zealand, and it is likely we will see the emergence of localised outbreaks of COVID-19, necessitating extensive testing and potential reintroduction of restrictions. We must be vigilant to prevent a 'second wave' of the pandemic in our largely non-immune population.

We have plenty to learn as we navigate these shifting waters. We are also fortunate now to have time to develop constructive and permanent reforms in our health system to improve the health of our populations well after the threat of COVID-19 has ebbed. As we embrace these opportunities for domestic reform, we must also engage with our colleagues around the world to ensure that the next emergent virus with pandemic potential is met by a connected and prepared clinical and public health community. Support of key global networks and agencies, such as the WHO, remains critical as we mobilise against a shared threat. The national responses of New Zealand and Australia have emphasised the importance of decisive coordinated action and working in partnership to face major threats. We should strengthen our resolve, contribute more resources (financial and human) to international partners involved in the fight against COVID-19 and set an example as good global citizens in the face of shared threats. Once the pandemic phase of COVID-19 is passed, lessons learned and opportunities missed should rightly be examined and challenged. Now is not that time.

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References

1 Hunter DJ. Covid-19 and the stiff upper lip – the pandemic response in the United Kingdom. *N Engl J Med* 2020; **382**: e31.

2 Zhan M, Qin Y, Xue X, Zhu S. Death from Covid-19 of 23 health care workers in China. *N Engl J Med* 2020; **382**: 2267–8.

3 Omer SB, Malani P, del Rio C. The COVID-19 pandemic in the US: a clinical update. *JAMA* 2020; **323**: 1767–8.

4 Ranney ML, Griffeth V, Jha AK. Critical supply shortages – the need for ventilators and personal protective equipment during the Covid-19 pandemic. *N Engl J Med* 2020; **382**: e41.
5 Mehrotra A, Ray K, Brockmeyer DM, Barnett ML, Bender JA. Rapidly converting to "virtual practices": outpatient care in the era of Covid-19. *NEJM Catal* 2020. doi:10.1056/CAT.20.0091
6 Coronavirus (COVID-19) in Australia. 2020 [cited 2020 May 14]. Available from URL: https://www.covid19data.com.au/testing
7 COVID-19 and Australian General Practice – Insights Paper No. 3: a preliminary analysis of changes due to telehealth use: *Outcome Health*; 2020. [cited 2020 May 14]. Available from URL: https://www.digitalhealthcrc.com/wp-content/uploads/2020/05/COVID19-Insights-Paper-3-Telehealth.pdf
8 Moss R, Wood J, Brown D, Shearer F, Black AJ, Cheng AC *et al*. Modelling the impact of COVID-19 in Australia to inform transmission reducing measures and health system preparedness. Melbourne: The Peter Doherty Institute for Infection and Immunity; 2020. doi:10.1101/2020.04.07.20056184
9 Wilson N, Barnard LT, Kvalsig A, Baker M. *Potential Health Impacts from the COVID-19 Pandemic for New Zealand if Eradication Fails: Report to the NZ Ministry of Health*. Wellington: University of Otago; 2020.
10 *Coronavirus Disease 2019 (COVID-19) Situation Report – 88*. Geneva: World Health Organization; 2020.
11 Tracking COVID-19 excess deaths across countries. *The Economist* 16 April 2020.
12 Stewart P, Ali I. Coronavirus clue? Most cases aboard U.S. aircraft carrier are symptom-free. 2020 [cited 2020 May 14]. Available from URL: https://www.reuters.com/article/us-health-coronavirus-usa-military-sympt-idUSKCN21Y2GB
13 Sutton D, Fuchs K, D'Alton M, Goffman D. Universal screening for SARS-CoV-2 in women admitted for delivery. *N Engl J Med* 2020; 382: 2163–4.
14 Karedes D. CDC reviewing 'stunning' universal testing results from Boston homeless shelter. 2020 [cited 2020 May 14]. Available from URL: https://www.boston25news.com/news/cdc-reviewing-stunning-universal-testing-results-boston-homeless-shelter/Z253TFBO6RG4HCUAARBO4YWO64/
15 Gudbjartsson DF, Helgason A, Jonsson H, Magnusson OT, Melsted P, Norddahl GL *et al*. Spread of SARS-CoV-2 in the Icelandic population. *N Engl J Med* 2020; **382**: 2302–15.
16 Medema G, Heijnen L, Elsinga G, Italiaander R, Brouwer. A Presence of SARS-Coronavirus-2 in sewage. 2020. doi:10.1101/2020.03.29.20045880
17 Berjano P, Prewitt E. Covid-19 message from Milan: be ahead of the curve. You cannot wait. *NEJM Catal*. 2020 [cited 2020 May 14]. Available from URL: https://catalyst.nejm.org/doi/full/10.1056/CAT.20.0096.
18 PubMed: National Center for Biotechnology Information. COVID-19 OR COVID OR SARS-CoV-2. 2020 [cited 2020 Apr 21]. Available from URL: https://www.ncbi.nlm.nih.gov
19 Gautret P, Lagier JC, Parola P, Hoang VT, Meddeb L, Sevestre J *et al*. Clinical and microbiological effect of a combination of hydroxychloroquine and azithromycin in 80 COVID-19 patients with at least a six-day follow up: a pilot observational study. *Travel Med Infect Dis* 2020; **34**: 101663.
20 Howard J, Cohen E, Kounang N, Nyberg P. Heart risk concerns mount around use of chloroquine and hydroxychloroquine for Covid-19 treatment. 2020 [cited 2020 Jun 3]. Available from URL: https://edition.cnn.com/2020/04/13/health/chloroquine-risks-coronavirus-treatment-trials-study/index.html
21 Hui DS, Chow BK, Lo T, Tsang OTY, Ko FW, Ng SS *et al*. Exhaled air dispersion during high-flow nasal cannula therapy versus CPAP via different masks. *Eur Respir J* 2019; **53**: 1802339.
22 Leung CCH, Joynt GM, Gomersall CD, Wong WT, Lee A, Ling L *et al*. Comparison of high-flow nasal cannula versus oxygen face mask for environmental bacterial contamination in critically ill pneumonia patients: a randomized controlled crossover trial. *J Hosp Infect* 2019; **101**: 84–7.
23 Bikdeli B, Madhavan MV, Jimenez D, Chuich T, Dreyfus I, Driggin E *et al.* COVID-19 and thrombotic or thromboembolic disease: implications for prevention, antithrombotic therapy, and follow-up. *JACC* 2020; **75**: 2950–73.
24 Bamford P, Bentley A, Dean J, Whitmore D, Wilson-Baig N. ICS Guidance for Prone Positioning of the Conscious COVID Patient 2020. 2020 [cited 2020 Jun 3]. Available from URL: https://emcrit.org/wp-content/uploads/2020/04/2020-04-12-Guidance-for-conscious-proning.pdf
25 ClinicalTrials.gov. 2020 [cited 2020 May 14]. Available from URL: https://clinicaltrials.gov/ct2/results?cond=Sars-CoV2&term=treatment&cntry=&state=&city=&dist=
26 Wang Y, Zhang D, Du G, Du R, Zhao J, Jin Y *et al*. Remdesivir in adults with severe COVID-19: a randomised, double-blind, placebo-controlled, multicentre trial. *Lancet* 2020; **395**: 1569–78.
27 Voytko L. Fauci says remdesivir reduces recovery time for coronavirus patients. 2020 [cited 2020 May 14]. Available from URL: https://www.forbes.com/sites/lisettevoytko/2020/04/29/fauci-says-remsdesivir-reduces-recovery-time-for-coronavirus-patients/#22cceb963755
28 Yan W. Coronavirus tests science's need for speed limits. 2020 [cited 2020 Jun 3]. Available from URL: https://www.nytimes.com/2020/04/14/science/coronavirus-disinformation.html
29 OSFPreprints. Preprint archive search: covid. 2020 [cited 2020 May 14]. Available from URL: https://osf.io/preprints/discover?q=covid
30 MedRxiv preprint server. 2020 [cited 2020 May 14]. Available from URL: https://connect.medrxiv.org/relate/content/181
31 Horowitz L. Twitter. 2020 [cited 2020 May 14]. Available from URL: https://twitter.com/leorahorwitzmd/status/1244795551595614210
32 Hui DS, Chow BK, Lo T, Ng SS, Ko FW, Gin T *et al*. Exhaled air dispersion during noninvasive ventilation via helmets and a total facemask. *Chest* 2015; **147**: 1336–43.
33 Google Scholar. [cited 2020 May 14]. Available from URL: https://scholar.google.com/scholar?cites=15382516320604297149&as_sdt=2005&sciodt=0,5&hl=en
34 Google Scholar. [cited 2020 May 14]. Available from URL: https://scholar.google.com/scholar?cites=14431322815443661123&as_sdt=2005&sciodt=0,5&hl=en

35 *Clinical Management of Severe Acute Respiratory Infection (SARI) When COVID-19 Disease is Suspected: Interim Guidance*. Geneva: World Health Organization; 2020.
36 Alhazzani W, Moller MH, Arabi YM, Loeb M, Gong MN, Fan E *et al*. Surviving sepsis campaign: guidelines on the management of critically ill adults with coronavirus disease 2019 (COVID-19). *Intensive Care Med* 2020; **46**: 854–87.
37 Fauci AS, Lane HC, Redfield RR. Covid-19 – navigating the uncharted. *N Engl J Med* 2020; **382**: 1268–9.
38 Ray Junhao Lin, Lee TH, Lye DCB. From SARS to COVID-19: the Singapore journey. 2020 [cited 2020 Apr 4]. Available from URL: https://www.mja.com.au/journal/2020/sars-covid-19-singapore-journey
39 Wang CJ, Ng CY, Brook RH. Response to COVID-19 in Taiwan: big data analytics, new technology, and proactive testing. *JAMA* 2020; **323**: 1341.
40 Leung H. Singapore was a Coronavirus success story – until an outbreak showed how vulnerable workers can fall through the cracks. *TIME* 18 April 2020 [cited 2020 May 14] Available from URL: https://time.com/5825261/singapore-coronavirus-migrant-workers-inequality/