

18 November 2022



Committee Secretariat  
House of Representatives Standing Committee on Health, Aged Care  
and Sport  
PO Box 6021  
Parliament House  
Canberra ACT 2600

Registered Charity  
ABN 42 006 173 379  
Level 7, 461 Bourke Street  
Melbourne VIC 3000  
Telephone 03 9670 1000  
StrokeLine 1800 STROKE (1800 787 653)  
strokefoundation.org.au

Sent via email: [Health.Reps@aph.gov.au](mailto:Health.Reps@aph.gov.au)

Dear Sir/Madam

**Re: House of Representatives Standing Committee on Health, Aged Care and Sport Inquiry into Long COVID and Repeated COVID Infections**

*Stroke Foundation is a national charity that partners with the community to prevent stroke, save lives and enhance recovery. We do this through raising awareness, facilitating research and supporting survivors of stroke. Stroke Foundation is dedicated to empowering health professionals to deliver high quality best-practice care to stroke patients. We advocate for better systems, processes and resources to help health professionals deliver world class stroke care.*

*As the voice of stroke in Australia, Stroke Foundation welcomes the Inquiry into Long COVID and Repeated COVID Infections.*

In 2020, 27,428 Australians experienced stroke for the first time, and there were more than 445,000 survivors of stroke living in our community - many with an ongoing disability.<sup>1</sup> Unless action is taken, it is estimated by 2050, Australians will experience an additional 23,000 new strokes annually, and there will be an additional 374,000 survivors of stroke living in the community.<sup>1</sup>

There is a growing body of evidence that shows survivors of stroke are at an increased risk of severe symptoms, complications and death from COVID-19, while the risk of stroke is increased both in individuals who contract COVID-19 and in those who experience Long COVID. In addition, many of the neurological problems experienced by survivors of stroke, including fatigue, 'brain fog', and cognitive and memory disturbances, are also symptoms commonly experienced by Long COVID patients.

Our response below, which broadly addresses Terms of Reference 3, 4 and 5, is focused on the relationship between COVID-19, Long COVID and stroke, and the impact of COVID-19 and Long COVID on stroke prevention, dedicated stroke unit care, and stroke rehabilitation services in Australia.

**1. COVID-19, Long COVID and Stroke**

*COVID-19 and Stroke*

Within months of the World Health Organization (WHO) declaring COVID-19 a global pandemic in March 2020, reports of a heightened risk of stroke in those infected with the virus began to emerge. Since then, a significant body of research has established that stroke is one of the most serious complications of COVID-19. In addition, COVID-19 patients with pre-existing chronic neurological

diseases, including stroke, have an increased admission length, risk of hospitalisation, worsening of symptoms, and mortality, compared to patients without pre-existing disease.<sup>2</sup>

Stroke has been reported in between 0.5 percent and 2.5 percent of COVID-19 cases.<sup>3</sup> COVID-19-associated stroke is more severe and has a higher mortality rate than non-infected stroke.<sup>3-6</sup> Studies have shown that the in-hospital mortality rate for COVID-19-associated stroke patients is five times greater than that of non-infected stroke patients.<sup>7</sup> In addition, the incidence of COVID-19-associated stroke is related to the severity of the infection, with one study reporting that 61 percent of stroke cases occurred in severe infection.<sup>7</sup>

Importantly, younger patients (<55 years of age) are at a heightened risk of COVID-19-associated stroke.<sup>8</sup> Many younger patients who suffer a stroke after COVID-19 infection display few, if any of the risk factors typically associated with stroke.

COVID-19-associated ischaemic stroke (caused when a blood vessel supplying the brain becomes blocked by a clot), is more prevalent than COVID-19-associated-haemorrhagic stroke (caused when a blood vessel supplying the brain bursts) (88 percent vs 12 percent).<sup>7</sup>

The exact mechanisms that underlie the association between COVID-19 infection and stroke are yet to be determined; however, infection is thought to trigger a systemic inflammatory response that thickens the blood, making it more likely to clot and cause a stroke.<sup>9</sup> The increased risk of ischaemic stroke in patients with COVID-19 may be explained at least in part, by their prothrombotic state. With regard to haemorrhagic stroke, one of the key underlying mechanisms is thought to be a virus-induced unregulated increase in blood pressure.<sup>10</sup>

### *Long COVID and Stroke*

As the COVID-19 pandemic progressed during 2020, large cohorts of COVID 'long-haulers' emerged in many countries. These patients had survived the acute infection, but had failed to recover as rapidly as others in the population, and many were struggling with debilitating, ongoing post-COVID illness. Long COVID was formally recognised by the WHO in October 2020, and was termed 'Post COVID-19 Condition'.<sup>11</sup> In order to meet the WHO definition of this condition, an individual must have symptoms three months after a confirmed COVID-19 infection, with those symptoms lasting for at least two months and not able to be explained by an alternative diagnosis.<sup>11</sup> According to the Australian Government Department of Health and Aged Care however, an individual has Long COVID if their symptoms remain, or develop, 4 weeks after they were first infected with COVID-19.<sup>12</sup>

Common symptoms of Long COVID include fatigue, shortness of breath, cognitive dysfunction, headaches, a loss of taste and smell, trouble focusing ('brain fog'), problems sleeping, muscle and joint pain and weakness, and mental health problems, including depression and anxiety. These symptoms can persist from an individual's acute infection, or may start after they have made an initial recovery, and can fluctuate or relapse over time. Importantly, many of these problems are also commonly experienced by survivors of stroke.

Fatigue in particular is a debilitating post-stroke complication that has a major impact on the quality of life of a significant proportion of survivors of stroke, and now thousands of Long COVID patients. Unlike other areas of stroke which have benefitted from major therapeutic advances over the past 20 years, there are limited therapeutic options available, and the exact mechanisms underlying post-stroke fatigue are not yet fully understood. As more is invested in research to improve our understanding of Long COVID, this should accelerate the development of therapeutic interventions for a range of conditions, including fatigue.

While significant progress has been made in vaccinating the Australian population, and being vaccinated reduces the chance of Long COVID, it does not eliminate the risk completely. An estimated 5 percent of people infected with COVID-19 will develop Long COVID, even after vaccination.<sup>13</sup> Given the substantial number of people that have been infected in recent waves, there are concerns Long

COVID may become a major cause of longer-term disability in Australia.<sup>14</sup> To date, there have been an estimated 10 million cases of acute COVID-19 infection in Australia. Therefore, it is possible that up to 500,000 Australians may be impacted by Long COVID.

Stroke has been identified as one of the post-acute neurological consequences of COVID-19. A recent study examined the health records of over 153,000 US veterans who had been infected with COVID-19, and compared their rates of stroke to those of two uninfected control groups (5,637,647 contemporary controls and 5,859,411 historical controls).<sup>15</sup> It was found that between 30 days and 1-year post-infection, people with COVID-19 were 52 percent more likely to have a stroke. Therefore, over one year, for every 1,000 people infected with COVID-19, there would be an additional 5 strokes.<sup>15</sup> Importantly, while the highest stroke risk over the following year was observed in those with the most serious acute COVID infections, even individuals with mild infections, who were not hospitalised during the acute phase, were at increased risk of stroke.<sup>15</sup> Given the large numbers of Australians who have been infected in recent waves of the pandemic, this could have a significant impact on the future burden of stroke.

It has been suggested that the increased risk of stroke observed in patients with Long COVID may be due to a prolonged inflammatory and prothrombotic state, with research showing that certain prothrombotic changes may be sustained even months after the initial infection.

*Recommendations:*

- a. Federal Government to develop nationally consistent education, training, support and resources for GPs and other health care professionals in primary care, to optimally diagnose, treat and manage people with Long COVID and associated conditions. This should include access to high quality, up-to-date clinical guidelines (promotion of the 'Clinical Guidelines: Care of People after COVID' by the National COVID-19 Clinical Evidence Taskforce), clear referral pathways for patients who require specialist care, and best-practice models of care.
- b. Australian governments to invest in the expansion and strengthening of specialist Long COVID clinics for patients with more complex problems.
- c. Federal Government to ensure patients with Long COVID have access to affordable, MBS-funded multidisciplinary care (including Allied Health), where the number of sessions they are able to access is determined based on the complexity of care they require.
- d. Australian governments to invest in an awareness campaign, and information and resources (delivered in languages and formats that are accessible to diverse communities), to raise awareness of Long COVID as a potential cause of disability in the Australian community, and support individuals to identify Long COVID symptoms and where to seek help.
- e. Australian governments to strengthen the provision of services and supports for individuals living with Long COVID, including disability supports for those with longer-term problems.
- f. Australian governments to invest in surveillance for Long COVID to track rates, and the impact on health and quality of life outcomes over time.
- g. Australian governments to invest in research undertaken in collaboration with researchers, health care professionals, patients, families, carers and other stakeholders, to advance our understanding of Long COVID, including its characteristics, risk factors and underlying mechanisms, how best to prevent, diagnose and treat it, and how it interacts with other conditions, including stroke.

## 2. Impact of COVID-19 and Long COVID on stroke prevention in Australia

We know that 80 percent of strokes can be prevented<sup>16</sup>, and effective primary stroke prevention remains the best means for reducing the stroke burden in Australia. An assessment of an individual's risk of chronic disease, and early detection of disease, is critical to halting or slowing disease progression, preventing avoidable complications, and providing treatment at an earlier stage, resulting in better health outcomes.

In Australia, a variety of factors, including lockdowns, the diversion of staff and resources to provide COVID-19-specific care, and the temporary suspension or cancellation of screening services and regular check-ups, have compromised key aspects of chronic disease management and preventive care.<sup>17</sup> This has been exacerbated by consumer concerns. A survey undertaken during the initial phase of the pandemic in May 2020 reported that 32 percent of respondents had delayed or avoided a visit to a GP in the last three months, and 21 percent had missed or put off a pathology test.<sup>18</sup> Of those surveyed, 59 percent worried they would be around people with COVID-19 when attending health appointments, and 36 percent worried health services would be too busy.<sup>18</sup>

Australians aged 45 years and above (30 years and above for Aboriginal and Torres Strait Islander Australians), can undergo a Medicare-funded absolute cardiovascular disease risk assessment (Heart Health Check) annually, to determine the probability they will develop cardiovascular disease, including stroke, in the next five years, based on a range of factors.

Modelling by the Heart Foundation has shown that at least 27,000 fewer Heart Health Checks were conducted from March 2020 to July 2021 (40 percent reduction), due to the impact of COVID-19.<sup>19</sup> This represents a significant number of Australians who have missed out on early detection of stroke risk during the pandemic, and have allowed their risk to go unmanaged, which could potentially lead to an increase in preventable strokes in future years. The highest rates of screening were observed in those states least impacted by the pandemic, including Western Australia and Queensland, which averaged 30 Heart Health Checks per 1,000 eligible adults, above the national average of 25 checks per 1,000 adults.<sup>19</sup>

As the number of Australians impacted by Long COVID continues to rise, it will not be possible to rely solely on specialised Long COVID clinics in tertiary centres to manage these patients, and many will need to be managed in general practice. There is a risk that this additional workload will put further pressure on primary care health professionals, and compromise their ability to refocus their attention on chronic disease management and preventive care activities, including those for primary stroke prevention, that have been neglected during the pandemic.

Long COVID imposes a considerable burden on affected individuals, and can significantly limit their ability to undertake activities of daily living. Common symptoms such as fatigue and reduced exercise capacity are barriers to remaining physically active, and maintaining a healthy diet (impacting the ability to shop and prepare meals). In addition, increased body mass index (BMI) and cholesterol (total and LDL) have been observed in some Long COVID patients, persisting beyond 6 months post-infection.<sup>20</sup> Collectively, all of these factors increase an individual's risk of preventable stroke.

### *Recommendations:*

- a. Federal Government to invest in a Heart Health Check public awareness campaign, targeted at Australians aged 45 years and above, and Aboriginal and Torres Strait Islander Australians aged 30 years and above, highlighting the importance of understanding your cardiovascular disease (including stroke) risk.
- b. Australian governments to invest in research to determine the impact of common Long COVID symptoms, including fatigue and reduced exercise capacity, on health behaviours and long-term risk of chronic disease, including stroke.

### **3. Impact of COVID-19 and Long COVID on dedicated stroke unit care in Australia**

Stroke unit care is characterised by provision of care in one location by a multidisciplinary team including medical, nursing and allied health professionals with expertise in stroke. Access to a dedicated stroke unit is proven to make the biggest difference to patient outcomes following stroke, both in hospital and after.<sup>21, 22</sup> Patients treated in a dedicated stroke unit are more likely to be alive, independent, and living at home one year after stroke than if cared for in other settings.<sup>21, 22</sup> Specifically, for every 20 patients treated in a geographically co-located stroke unit, one patient is saved from death or disability.<sup>23</sup>

During the early stages of the COVID-19 pandemic in 2020, health professionals working in stroke treatment and care began reporting about increasing numbers of specialised stroke units being converted into COVID-19 wards, or repurposed to accommodate system-wide changes in bed allocations, and stroke unit staff being redeployed to other areas of the hospital. In response, the Australian Stroke Coalition issued a statement calling on Australian hospitals and health care administrators to maintain best-practice treatment and care for stroke patients during the pandemic.<sup>24</sup>

An examination of data from the Australian Stroke Clinical Registry (AuSCR) has demonstrated that acute stroke care in Australia has been negatively impacted by the COVID-19 pandemic.<sup>25, 26</sup>

When patient-level data for AuSCR hospitals from January to June 2020 were compared to the same period in 2019, fewer patients were provided with treatment in a stroke unit during 2020 compared to 2019 (70 percent vs 76 percent), and treatment in stroke units decreased progressively during the pandemic period.<sup>25</sup> These findings were supported by feedback provided by stroke clinicians working in these hospitals, who reported that during the pandemic period, one in 10 hospitals had their bed numbers reduced in the stroke unit, one in four had their stroke units moved, and one in three had stroke unit staff redeployed to other duties.<sup>25</sup>

The quality of stroke treatment, as measured by the provision of evidence-based processes of care, was found to be superior in stroke units compared to other ward settings both before (January 2019 to February 2020) and during the pandemic (March to June 2020).<sup>26</sup> In addition, during the pandemic period, a widening in care disparities between stroke units and alternate wards was observed.<sup>26</sup> Specifically, during the pandemic period, the proportion of patients receiving a swallow screen or assessment, receiving mobilisation, and being prescribed secondary prevention medications, decreased by 0.58 percent to 1.08 percent per week in patients treated in other ward settings relative to patients treated in stroke units. This represented a nine percent to 17 percent increase in the care gap between these treatment settings.<sup>26</sup>

The repurposing of specialist stroke units, and the redeployment of stroke unit staff to other hospital wards during the COVID-19 pandemic has undoubtedly had a detrimental impact on the quality of acute stroke care in Australia. Although dedicated stroke units have now been restored in the majority of Australian hospitals, some hospitals are still experiencing disruptions to the delivery of stroke unit care. While acknowledging the increased resourcing, and alterations to workflows and processes hospitals require when dealing with the challenges of a pandemic, these changes should not compromise their ability to provide proven treatments for patients presenting with other conditions, including stroke.

As the Australian hospital system comes under increasing pressure in response to new waves of COVID-19 infections, increasing numbers of patients with Long COVID, and health professional workforce shortages, it is critical access to dedicated stroke units is maintained, to provide all stroke patients with the best opportunities for recovery.

### *Recommendations:*

- a. Australian governments to ensure hospitals restore, and maintain, geographically defined stroke units staffed by specialised medical, nursing and allied health professionals to provide evidence-based stroke care.
- b. Australian governments, as part of their plan for strengthening Australia's pandemic preparedness, to identify specific solutions aimed at maintaining evidence-based, best-practice acute stroke care, including stroke unit access, during times of national emergency.

## **4. Impact of COVID-19 and Long COVID on rehabilitation services in Australia**

Rehabilitation is a proactive, person-centred and goal-oriented process that should begin the first day after stroke.<sup>27</sup> Rehabilitation should be timely, equitable and comprehensive and have as the ultimate aim that the person with stroke will maximise their function and achieve the highest possible level of independence — physically, psychologically, socially and financially.<sup>27</sup> Rehabilitation should be provided by a specialised interdisciplinary team of health professionals throughout the care continuum.<sup>27</sup>

We know that since the beginning of the pandemic, Australian survivors of stroke have been discharged early from hospital<sup>25</sup>, and have been missing out on critical rehabilitation therapy in hospital<sup>25</sup>, and in the community, due to COVID-19 restrictions as well as workforce shortages. This in turn has impacted the ability to appropriately assess and treat survivors in line with stroke rehabilitation guidelines, as well as adequately educate and support carers and families.

The Australasian Rehabilitation Outcomes Centre's (AROC) survey of inpatient rehabilitation services<sup>28</sup> examined the impact of COVID-19 on these services, in order to get an accurate picture of changes that have occurred across the sector, as well as inform rehabilitation service planning. The results of the survey showed that the vast majority of participating services (115/139, 83 percent) reported that they had been impacted by COVID-19, with only a relatively small proportion of these services (28/115, 24 percent) reporting that they were starting to return to pre-pandemic levels.<sup>28</sup>

Among the 115 services impacted by COVID-19, a collective loss of 58 rehabilitation wards (26 percent) and 2,140 rehabilitation beds (44 percent) at the most impacted point during the pandemic, was reported.<sup>28</sup> Subsequently, 27 wards and 1020 beds have been returned to rehabilitation; however, collectively this has only returned 86 percent of their prior wards and 77 percent of their prior beds.<sup>28</sup>

For services still being impacted by COVID-19, 54 percent reported more non-rehabilitation patients than usual being admitted to their unit, 38 percent reported their nursing staff had been deployed to work in other services, and 46 percent reported their allied health staff had been deployed.<sup>28</sup>

An increase in early supported discharge was reported by 22 percent of specialist stroke inpatient rehabilitation services.<sup>28</sup> Less capacity to discharge to a nursing home and respite care was reported by 44 percent and 37 percent of services, respectively, with the vast majority of services reporting longer waiting times.<sup>28</sup> Less capacity to access the NDIS was reported by 45 percent of services, and 67 percent reported waiting longer than 60 days for NDIS services.<sup>28</sup>

There are concerns that a range of factors, including high rates of COVID-19 transmission, an increasing number of patients with Long COVID, and health professional workforce shortages, will impact the ability of both inpatient and community rehabilitation services to return to pre-COVID capacity and meet potential increases in demand in the future. Therefore, there is a clear need for the expansion of alternative care pathways, including Rehabilitation in The Home (RITH) and telehealth. In the AROC survey, 19 percent of specialist stroke inpatient rehabilitation services reported an increase in RITH, and 70 percent reported greater use of telehealth to support rehabilitation, due to the impact of COVID-19.<sup>28</sup> In the private sector, ambiguity remains regarding the medical governance

of patients who wish to use their private hospital entitlements to receive RITH. These issues have been carefully examined in a recent decision by the Australian Competition Tribunal, and remain imprecise.

The community benefit of the expansion of MBS telehealth items to include allied and mental health has been demonstrated during the pandemic, and has enabled the delivery of stroke rehabilitation services via telehealth in response to the restrictions imposed by COVID-19. Importantly however, there are several vulnerable groups in Australia who may face challenges accessing telehealth services due to a variety of reasons, including suboptimal internet connectivity, poor digital literacy, and a lack of affordability of computers, mobile devices and internet services. Therefore, government investment in initiatives focused on reducing this digital divide is critical. In addition, many survivors of stroke are affected by cognitive and physical disabilities that make the utilisation of rehabilitation services via telehealth challenging. While stroke rehabilitation delivered via telehealth offers advantages for some, it is not suitable for many others who require face to face services either in their homes or in rehabilitation centres. Therefore, further research is needed to determine how alternative models of care, including telehealth, can be most effectively employed in stroke rehabilitation.

*Recommendations:*

- a. Australian governments to restore inpatient rehabilitation services, including dedicated inpatient rehabilitation beds and specialist rehabilitation staff, to pre-pandemic levels, to ensure all survivors of stroke are appropriately assessed and receive best-practice treatment and care, in line with stroke rehabilitation guidelines.
- b. Australian governments to invest in the development of education and training resources for health professionals to support the delivery of telehealth services, including services for stroke rehabilitation.
- c. Australian governments to invest in telehealth infrastructure development, and the development of patient-end supports for people using telehealth services, to improve digital inclusion for vulnerable groups (people with low levels of income, education and employment, those living in regional, rural or remote areas, people aged over 65, and people with a disability).
- d. National peak bodies representing health professional groups involved in the delivery of stroke rehabilitation to work collectively to better understand:
  - i. where telehealth can make the biggest impact in stroke rehabilitation, and
  - ii. which aspects of rehabilitation will still need to be delivered face to face in order for patients to enjoy the greatest benefit.
- e. Federal government to explore legislative barriers that prevent those with private health insurance from receiving funded stroke rehabilitation in the home, rather than having to be admitted to hospital or utilising hospital substitution where medical governance has not been clarified.

In responding to this Inquiry, Stroke Foundation recognises the COVID-19 pandemic is unprecedented, has impacted the whole community and will continue to require a whole of Government - both federal and state and territory - response.

As the number of Australians with Long COVID continues to rise, it is critical our health, disability and welfare sectors are ready to support them. In addition, it is critical that Australian governments are able to address the health system impacts on stroke prevention and treatment that disruption caused by the pandemic has had, and continues to have.

Thank you for the opportunity to provide input into this Inquiry.

Yours sincerely



Professor Bruce Campbell  
**Chair, Clinical Council**  
Stroke Foundation



## References

1. Deloitte Access Economics. 2020. No postcode untouched, Stroke in Australia 2020.
2. Sakibuzzaman M, Hassan A, Hayee S et al. Exacerbation of Pre-existing Neurological Symptoms With COVID-19 in Patients With Chronic Neurological Diseases: An Updated Systematic Review. *Cureus*. 2022. 14:e29297.
3. Katsanos AH, Palaiodimou L, Zand R et al. The impact of SARS-CoV-2 on stroke epidemiology and care: A meta-analysis. *Ann Neurol*. 2021. 89:380–388.
4. Oxley TJ, Mocco J, Majidi S et al. Large-Vessel Stroke as a Presenting Feature of Covid-19 in the Young. *N Engl J Med*. 2020. 382:e60.
5. Lodigiani C, Iapichino G, Carenzo L et al; Humanitas COVID-19 Task Force. Venous and arterial thromboembolic complications in COVID-19 patients admitted to an academic hospital in Milan, Italy. *Thromb Res*. 2020. 191:9-14.
6. Akhtar N, Abid FB, Kamran S et al. Characteristics and Comparison of 32 COVID-19 and Non-COVID-19 Ischemic Strokes and Historical Stroke Patients. *J Stroke Cerebrovasc Dis*. 2021. 30:105435.
7. Nannoni S, de Groot R, Bell S, Markus HS. Stroke in COVID19: a systematic review and meta-analysis. *International Journal of Stroke*. 2021. 16:137–149.
8. Shahjouei S, Tsvigoulis G, Farahmand G et al. SARS-CoV-2 and Stroke Characteristics: A Report From the Multinational COVID-19 Stroke Study Group. *Stroke*. 2021. 52:e117-e130.
9. Wang Z, Yang Y, Liang X et al. COVID19 Associated Ischemic Stroke and Hemorrhagic Stroke: Incidence, Potential Pathological Mechanism, and Management. *Front Neurol*. 2020. 11:571996.
10. Ahmad SJ, Feigen CM, Vazquez JP et al. Neurological Sequelae of COVID-19. *J Integr Neurosci*. 2022. 21:77.
11. World Health Organization. A clinical case definition of post COVID-19 condition by a Delphi consensus. 6 October 2021. Available at: [https://www.who.int/publications/i/item/WHO-2019-nCoV-Post\\_COVID-19\\_condition-Clinical\\_case\\_definition-2021.1](https://www.who.int/publications/i/item/WHO-2019-nCoV-Post_COVID-19_condition-Clinical_case_definition-2021.1)
12. Australian Government Department of Health and Aged Care. COVID-19 disease and symptoms. 14 October 2022. Available at: <https://www.health.gov.au/health-alerts/covid-19/symptoms#long-covid>
13. Liu B, Jayasundara D, Pye V, Dobbins T et al. Whole of population-based cohort study of recovery time from COVID-19 in New South Wales Australia. *Lancet Reg Health West Pac*. 2021. 12:100193.
14. Angeles MR, Wannan Arachchige Dona S, Nguyen HD et al. Modelling the potential acute and post-acute burden of COVID-19 under the Australian border re-opening plan. *BMC Public Health*. 2022. 22:757.
15. Xie Y, Xu E, Bowe B, Al-Aly Z. Long-term cardiovascular outcomes of COVID-19. *Nat Med*. 2022. 28:583-590.
16. O'Donnell M, Chin SL, Rangarajan S et al; INTERSTROKE investigators. Global and regional effects of potentially modifiable risk factors associated with acute stroke in 32 countries (INTERSTROKE): a case-control study. *Lancet*. 2016. 388:761–775.
17. Parkinson A, Matenge S, Desborough J et al. The impact of COVID-19 on chronic disease management in primary care: lessons for Australia from the international experience. *Med J Aust*. 2022. 216:445-448.
18. Continuity of Care Collaboration. Consumer Survey: Access to healthcare during COVID-19. September 2020. Available at: <https://ahpa.com.au/wp-content/uploads/2020/09/Continuity-of-Care-Collaboration-Consumer-Survey-Results.pdf>
19. National Heart Foundation. Media Release: Fears 27,000 heart checks missed in pandemic could lead to wave of heart disease: new data. 26 September 2021. Available at: <https://www.heartfoundation.org.au/media-releases/heart-checks-missed>
20. Deuel JW, Lauria E, Lovey T et al. Persistence, prevalence, and polymorphism of sequelae after COVID-19 in unvaccinated, young adults of the Swiss Armed Forces: a longitudinal, cohort study (LoCoMo). *Lancet Infect Dis*. 2022. 25:S1473-3099(22)00449-2.
21. Langhorne P, Ramachandra S; Stroke Unit Trialists' Collaboration. Organised inpatient (stroke unit) care for stroke: network meta-analysis. *Cochrane Database Syst Rev*. 2020. 4:CD000197.
22. Stroke Unit Trialists' Collaboration. Organised inpatient (stroke unit) care for stroke. *Cochrane Database Syst Rev*. 2013. 9:CD000197.
23. Yan B. SSA Statement on Stroke Care During COVID-19. Stroke Society of Australasia. 2020. Available from: <https://www.strokesociety.com.au/news-item/4530/ssa-statement-on-stroke-care-during-covid-19>
24. ASC. Australian Stroke Coalition Statement on Stroke Care During the COVID-19 Crisis. 2020. Available from: <https://strokefoundation.org.au/news-and-events/latest-news/2020/04/australian-stroke-coalition-statement-on-stroke-care-during-the-covid-19-crisis>
25. Cadilhac DA, Kim J, Tod EK et al; AuSCR COVID-19 Reporting Consortium Group. COVID-19 Pandemic Impact on Care for Stroke in Australia: Emerging Evidence From the Australian Stroke Clinical Registry. *Front Neurol*. 2021. 12:621495.

26. Cadilhac DA, Kim J, Cloud G et al; AuSCR COVID-19 Reporting Consortium Group. Effect of the Coronavirus Disease 2019 Pandemic on the Quality of Stroke Care in Stroke Units and Alternative Wards: A National Comparative Analysis. *J Stroke*. 2022. 24:79-87.
27. Stroke Foundation. National Rehabilitation Stroke Services Framework 2022. Melbourne, Australia.
28. Alexander T. AROC COVID inpatient services report (February-October 2022). 2022. Australasian Rehabilitation Outcomes Centre, Australian Health Services Research Institute, University of Wollongong.