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## Perspective: Patient Apprehensions Prolonged Stroke Presentation During the COVID-19 Pandemic

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In our recent publication titled “The Effects of the COVID-19 Pandemic on Stroke Response Times: A Systematic Review and Meta-Analysis,”<sup>1</sup> we described delays in stroke response time metrics that occurred throughout the COVID-19 pandemic. Door-to-imaging, door-to-needle, and door-to-groin puncture times, which are all intrahospital metrics that are largely dependent on physician response and hospital flow, were all found to experience only minor delays in our study. This demonstrated an effective response to an influx of COVID-19 patients within hospitals and only a minimal sacrifice of time quality for viral precautions. However, one metric was discovered to experience far more significant delays and is largely out of the control of physicians and care teams: last-known-well (LKW)-to-arrival time.

LKW-to-arrival time, defined in our study as the time elapsed from known onset of stroke symptoms to hospital arrival, is primarily dependent on the patient and his or her network. The first and most crucial step of stroke care is getting the patient to the hospital, and this can only be accomplished if the patient and those in the immediate surroundings correctly interpret their symptoms and immediately seek help. Rapid presentation to the hospital is of critical importance for stroke care, given that patients are only eligible for thrombolytic therapies if they arrive within the first few hours of their symptom onset.<sup>2</sup> The perceived reasons for these delays were noteworthy. Twenty-three of the studies included in our analysis cited shelter-in-place advisories and/or patient fear of presentation as potential drivers of delays to hospital presentation. This suggests that patients may have felt the virus posed a greater risk to their health than the neurologic symptoms they were experiencing at the onset of their stroke.

Patients weren't only presenting later in our study; many presumably didn't present at all. During the pre-COVID-19 period, studies included in our analysis reported on 14,637 patients presenting with stroke. In the COVID-19 period, this number decreased almost 60%, to just over 6100 patients. This was an alarming finding and further demonstrated that patients may have been avoiding hospitals out of fear of contracting COVID-19. Multiple studies postulated that patients were attempting to “wait out their symptoms,” especially for more mild strokes. It's possible that a misinterpretation of the “stay-at-home” guidelines during the early months of the pandemic may have led patients to believe that avoiding care for their stroke symptoms was the responsible thing to do. A recent study showed that during the early months of the COVID-19 pandemic, an estimated 41% of U.S. adults either delayed or avoided medical care, including 12% who would have otherwise sought urgent or emergency care.<sup>3</sup> Another showed that during the pandemic, emergency department visits in the United States were 42% lower when compared with the same date range in 2019.<sup>4</sup> Finally, in a report

on the emergency medical services utilization in Massachusetts, 12.3% fewer calls for stroke were noted.<sup>5</sup> These trends held true in our study, as we reported a 20.9% pooled increase in LKW-to-arrival times overall during the pandemic.<sup>1</sup>

These delays to hospital presentation and decreases in stroke presentation overall had noticeable effects on stroke mortality from 2019 to 2020, as the age-adjusted mortality rate from stroke rose 6.4%.<sup>6</sup> Moreover, in an analysis of 40 states and New York City, it was determined that there was excess cerebrovascular mortality during the height of the pandemic (March 28 to May 2, 2020).<sup>7</sup> This study also showed an association between the decrease in stroke-related emergency medical system calls and excess stroke deaths and calculated that a 10% increase in time spent at home was associated with a 4.3% increase in stroke deaths, even after adjusting for COVID-19 deaths.<sup>7</sup> Thus choosing to delay seeking treatment during the pandemic may have meaningfully worsened their chances of recovery.

Due to this increase in mortality caused by delayed treatment noted in the literature, many authors and researchers, including several from our meta-analysis, have called for public health awareness initiatives to help combat the aforementioned misinterpretation of “stay at home” and the overall dangerous belief that avoiding medical attention when it's needed in order to minimize risk of exposure to COVID-19 is worthwhile. On the basis of our findings and the findings of others, it is of critical importance that the public understands the severity of stroke and necessity of seeking care within the context of COVID-19. Yet few pandemic-specific interventions to stress the need to seek care even during public health emergencies have been undertaken. Potential solutions may include the development of targeted messaging through both online and offline modalities to address patient fears by pointing to specific safety measures in place at hospitals meant to combat COVID-19 spread, such as dividing the emergency department into respiratory and nonrespiratory pods, as was demonstrated at a community hospital in California.<sup>8</sup> Initiatives like this may prove imperative in spreading awareness of the need to seek stroke care when it's needed, regardless of COVID-19 burden in the area.

LKW-to-arrival time is one of the most important metrics in stroke care, yet it happens to be the metric over which health care professionals have the least control. It is up to patients and those who surround them to seek care in a timely manner. Thus in hopes of combating delays in the future due to the perceived risk of visiting a hospital, we should seek to implement a human-centered approach by prioritizing outreach and public awareness, as well as proactively evaluating for gaps in care. Likewise, greater utilization of in-situ analysis of patient well-being through health wearables and passive data collection may also play a role in

recognizing symptoms sooner.<sup>9</sup> The COVID-19 pandemic has provided a stark reminder of the dangers of stroke treatment delays, and we must be sure to build on these lessons and improve as a community going forward.

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