




# Ignorance is not bliss: managing uncertainty in acute stroke treatment in the COVID-19 era

Aravind Ganesh<sup>1</sup> · Johanna M. Ospel<sup>1,2</sup> · Julie Kromm<sup>1,3</sup> · Mayank Goyal<sup>1,4</sup> 

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Decision-making in medical emergencies like acute stroke is fraught with potential pitfalls at the best of times. Whereas patients often prefer utilizing shared decision-making with detailed information [1], emergent decisions are based on a limited pool of immediately available information that may not reflect physicians', patients', and caregivers' preferences. The COVID-19 era has introduced additional challenges in this information flow. We use the example of acute ischemic stroke—a prototypical high-stakes, time-pressured emergency—to examine how information flow and availability have changed during the pandemic and their implications for emergent decisions.

In conventional settings, physicians decide about thrombolysis and endovascular therapy (EVT) for acute ischemic stroke based on available “known” clinical and imaging information like the patient’s deficits or presence of a large vessel occlusion. This information is often provided by caregivers/proxies, as the patients’ deficits render them unable to cooperate or communicate [2]. Proxies base their decisions on how the physicians frame the patient’s prognosis and the risks versus benefits of treatment. This interaction also builds a therapeutic alliance when facing uncertain treatment outcomes. Such discussions occur very rapidly (mean time of 2.7 min in one study) [2]. Several data points are variably available, depending on access to previous medical records and imaging

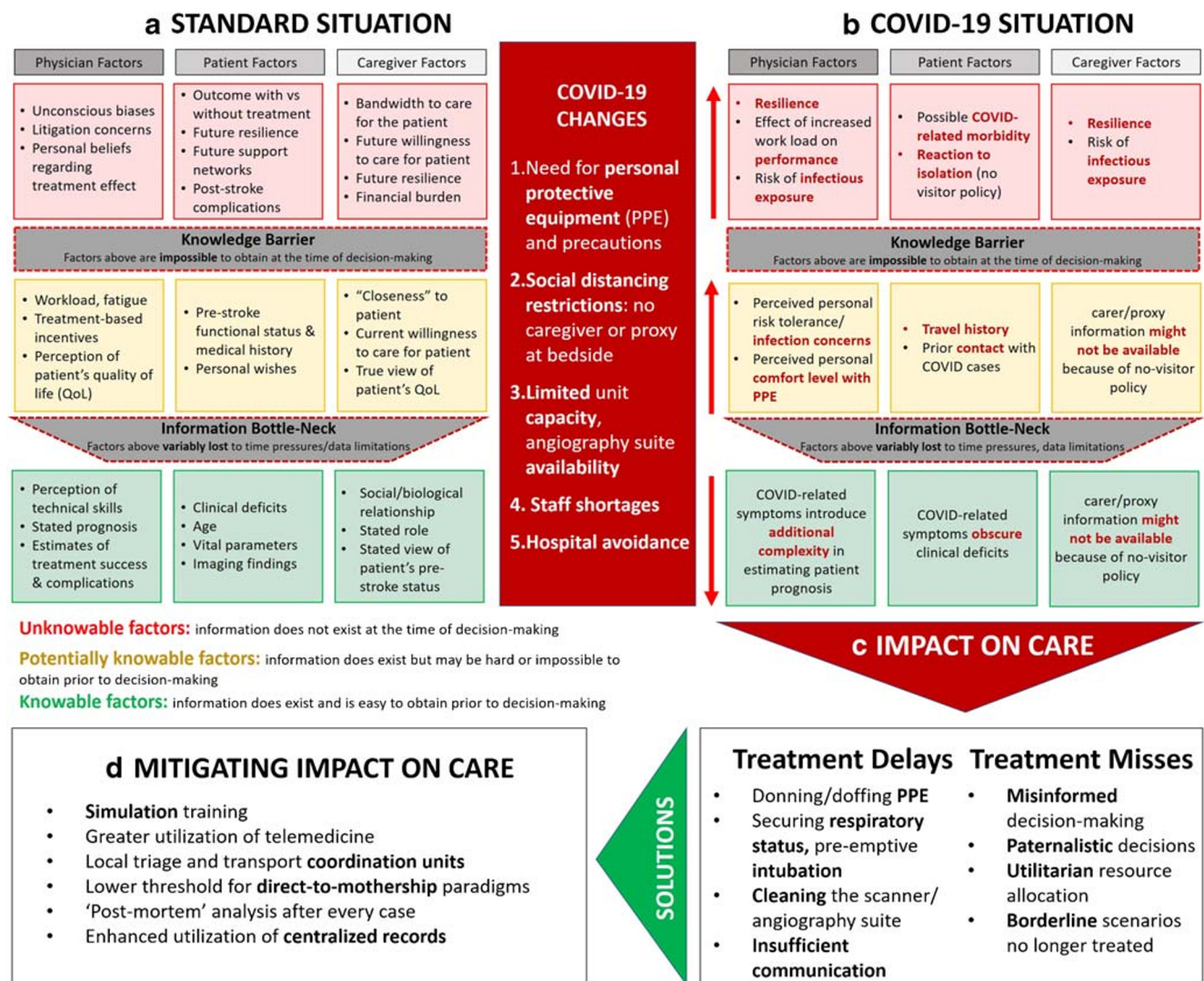
technology, like identifying a mismatch between the ischemic core and penumbra, differentiating old and new strokes, and knowledge about the patient having tortuous vessels or other potential technical challenges for EVT.

Numerous relevant factors that are potentially “knowable” are often lost to an “information bottleneck” (Fig. 1a) caused by time pressures or inter-personal factors, including how the patient, caregiver, and physician interpret the patient’s quality of life; the proxy’s true degree of “closeness” or investment in the patient’s daily life (affecting their interpretation of the patient’s functional status and wishes); the physician’s experience with treating someone like the patient and their practice-specific incentives/disincentives for treatment; and the patient’s current support system, their ability to pay for different options, and the patient’s/proxy’s understanding of the limits of therapy. In addition, there are other unknowable factors operating subconsciously behind a “knowledge barrier,” including the physician’s concerns about litigation, the physician’s or proxy’s personal philosophies (e.g., utilitarianism versus egalitarianism) or potential unconscious biases (e.g., ableism, ageism, sexism, racism), and the caregiver’s willingness and bandwidth to care for the patient with their potential post-stroke disability [3]. Other factors behind the “knowledge barrier” can only be known in the future; information about them does not exist at the time of decision-making, including how the patient will actually fare with versus without treatment, the occurrence of unexpected treatment complications, the patient’s response to rehabilitation, or their future resilience and support networks [4].

The COVID-19 pandemic has resulted in several systemic and workflow changes in emergency medicine—the added hassles of personal protective equipment (PPE) and COVID-19 precautions, limited unit capacity and angiography suite availability due to healthcare system demands, and staff shortages and redeployments resulting in unfamiliar team compositions [5]. The risk of contracting COVID-19 has led to hospital avoidance behaviors among many patients with emergencies like stroke, whereas social-distancing restrictions

✉ Mayank Goyal  
mgoyal@ucalgary.ca

<sup>1</sup> Calgary Stroke Program, Department of Clinical Neurosciences, Foothills Medical Centre, University of Calgary, 1403 29th St. NW, Calgary, AB T2N 2T9, Canada  
<sup>2</sup> Department of Radiology, University Hospital Basel, University of Basel, Basel, Switzerland  
<sup>3</sup> Department of Critical Care Medicine, University of Calgary, Calgary, Canada  
<sup>4</sup> Department of Radiology, Foothills Medical Centre, University of Calgary, 1403 29th St. NW, Calgary, AB T2N 2T9, Canada



**Fig. 1** During typical emergency medical scenarios like ischemic stroke, there are various factors that are immediately available ("known") at the time of decision-making for physicians, patients, and their caregivers/proxies, whereas other factors are potentially knowable but lost to an "information bottleneck" and still others lie hidden behind a "knowledge barrier" (a). The COVID-19 pandemic has resulted in a constellation of systemic and workflow changes that have resulted in additional unique

challenges in information flow for emergency medical decision-making (b). These challenges have a very tangible impact on patient care, largely in the form of treatment delays and missed opportunities for treatment (c). By recognizing the challenges to information flow and proactively responding to them, we may potentially mitigate this adverse impact on patient care (d)

have resulted in no-visitor policies at many institutions, meaning there is often no caregiver/proxy at the bedside [6]. These changes further compromise and complicate information flow for acute treatment decisions, generally resulting in a greater information bottleneck and more factors trapped behind the knowledge barrier (Fig. 1b). Without readily available proxies, critical information like when the patient was last-seen-well, his/her pre-stroke functioning, comorbidities, advanced care directives, and COVID-specific information like travel/contact exposures are easily lost to the information bottleneck. The physical examination may be limited by "protected" codes or clouded by the patient's need for respiratory support

with/without sedation for suspected COVID-19 [7]. Beyond the knowledge barrier lie numerous additional factors like the patient's unknown COVID-19 status and associated risk of complications, the physician's/team's risk tolerance about contracting COVID-19, and added uncertainty about treatment success posed by the unpredictable efficiency of new team members.

These added challenges in information availability can have a profound impact on patient care (Fig. 1c). Treatment delays may seem inevitable with competing priorities like donning/doffing PPE, greater attention to the patient's respiratory status with more frequent pre-emptive intubation, and a

more obsessive need to clean the scanner and angiography suite after each case [8], with the team's speed often determined by its most risk-averse members. Communication with team members, the patient, and their proxy easily takes a back seat, particularly when it entails added efforts like finding and calling different phone numbers. There can be many missed opportunities for treatment, as reported by colleagues in China [6], with treatment decisions being easily misinformed by the added knowledge barriers and information bottlenecks. It becomes convenient to fall back on paternalistic and utilitarian models of decision-making, especially if treatments like EVT are viewed as being in competition with other uses of scarce resources during the pandemic [9].

Nevertheless, by appreciating the underlying pitfalls in information flow, we can adopt a more proactive and nuanced approach to emergency decision-making and potentially mitigate the impact of COVID-19 on patient care (Fig. 1d). First, we should vigorously train new and existing team members and practice COVID-19 workflows in simulations to streamline donning/doffing and cleaning procedures, thereby minimizing impediments to timely treatment [10]. Second, we should prioritize the use of telemedicine resources for efficient communication with caregivers/proxies to reduce our risk of misinformed decisions. Third, we should adapt our pre-hospital triage protocols for the COVID-19 era through both local triage and transport coordination units [11]. Recognizing the added risks of treatment delays or misses in these times, we may adopt a lower threshold for “direct-to-mothership” paradigms that bring stroke patients directly to comprehensive stroke centers to minimize blind spots. Fourth, the pandemic emphasizes the value of centralized electronic medical records to mitigate critical information loss, especially if a proxy is unreachable.

By responding to the inevitable barriers to information flow during the pandemic, we can ensure that our systems are best prepared to serve patients with acute stroke well beyond the COVID-19 era.

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