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ORIGINAL RESEARCH

Navigating Acute Stroke: Perspectives from Survivors, Caregivers, and Healthcare Professionals in Ireland During COVID-19: A Qualitative Study

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Purpose: Evaluating time-sensitive conditions like acute stroke and transient ischemic attack (TIA) provides insight into the impact of the COVID-19 pandemic on healthcare access and delivery. Our aim was to investigate the perspectives of stroke/TIA survivors, caregivers, and healthcare professionals, on the emergency/pre-treatment phase of acute stroke care in Ireland during the COVID-19 pandemic.

Patients and Methods: During April-August 2023, we conducted semi-structured interviews with stroke/TIA survivors, caregivers and healthcare professionals involved in prehospital and hospital-based stroke care during the COVID-19 pandemic in Ireland (March 2020-February 2022). Participants were purposively sampled from four hospitals and one ambulance service region in the South of Ireland. Data analysis involved reflexive thematic analysis and patient journey mapping.

Results: Thirty participants were interviewed: eight stroke/TIA survivors, seven caregivers and fifteen healthcare professionals (seven prehospital practitioners, four nurses, four doctors). Data analysis revealed five main themes: (i) Triage of stroke onset and transport to hospital; (ii) Treatment: navigating the hospital-based stroke pathway; (iii) Importance of time in stroke care; (iv) Navigating communication and connectivity in an era of COVID-19 risk and stroke care; (v) COVID-19 public health measures. These themes remained consistent across all three groups, although the depth of coverage varied. Patient journeys exhibited wide variation, with all groups noting the impact of COVID-19 on acute stroke/TIA care.

Conclusion: This multi-stakeholder study revealed that the integrity of the acute stroke pathway remained intact during the COVID-19 pandemic. However, overall patient experience and willingness to seek care for suspected stroke or TIA were negatively impacted. Delays were observed across all stages of the stroke chain of survival during COVID-19, highlighting the importance of healthcare system resilience in this context. Additionally, it is important to consider how healthcare professionals can address the needs of individuals during times of increased demand on the healthcare system.

Plain Language Summary: This study examines how the COVID-19 pandemic affected the treatment of acute stroke and transient ischemic attack (TIA) in Ireland. By exploring the experiences of stroke/TIA survivors, caregivers, and healthcare professionals, the study aimed to understand the impact on emergency and pre-treatment phases of stroke care.

Between April and August 2023, we interviewed 30 participants: 8 stroke/TIA survivors, 7 caregivers, and 15 healthcare workers (including ambulance staff, nurses, and doctors) who were involved in stroke care during the pandemic. Participants were selected from four hospitals and one ambulance service in Southern Ireland. Data were analyzed to identify common themes and map out patient journeys. Stroke/TIA survivors and their families actively shaped the research throughout the study.

Five main themes weredeveloped:

(1) Recognition of stroke onset and patient transport to the hospital.

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(2) Navigation of the hospital-based stroke treatment pathway.
(3) The critical role of time in stroke care.
(4) Communication challenges and connectivity during COVID-19.
(5) Impact of public health measures related to COVID-19.

All groups identified these themes, though their perspectives and depth of discussion varied. Patient experiences varied widely, with all participants noting COVID-19's impact on stroke care.

In conclusion, although the core stroke care process remained unchanged during the pandemic, patients were less likely to seek care promptly. Delays occurred at all stages of stroke treatment, highlighting the need for a healthcare system that can adapt and recover from challenges. Healthcare professionals should consider ways to address individual's patient needs within the constraints of public health measures.

Keywords: cerebrovascular disease, healthcare systems, health services research, patient journey, patient and public involvement, multi-stakeholder perspectives

Introduction

Stroke remains a significant global health concern, ranking second in global mortality.[1,2] The most recently published Global Burden of Disease (GBD) study in 2019 estimated the global incidence of stroke was 12·2 million (95% uncertainty interval (UI) 11·0-13·6), with a prevalence of 101 million (93·2-111) cases.[1] Furthermore, at that time there were 143 million (133–153) disability adjusted life years (DALYS) attributed to stroke and 6·55 million (6·00-7·02) stroke-related deaths.[1]

In recent years, rapid recognition of stroke symptoms and timely acute interventions (eg, thrombolysis, endovascular thrombectomy, blood pressure regulation), particularly in specialized stroke units have significantly improved outcomes.[3–6] The stroke chain of survival outlines key steps in emergency stroke care, from symptom recognition to hospital arrival, identifying critical points where delays could occur and emphasizing the roles of key stakeholders in the acute management of stroke (Figure 1).[6,7]

The chain of survival also informs and maps the "stroke patient journey" according to the internationally recognized Ulstein Recommendations for Emergency Stroke Care (Figure 2).[6]

Patient journey maps are visualization techniques that diagrammatically represent stakeholder groups and depict the patient experience throughout the continuum of care.[8–10] Therefore, in a healthcare context, journey maps can reveal complex service delivery bottlenecks.[10] This process has the potential to inform and enhance service delivery by visualizing patient interactions with healthcare services.[8–10]

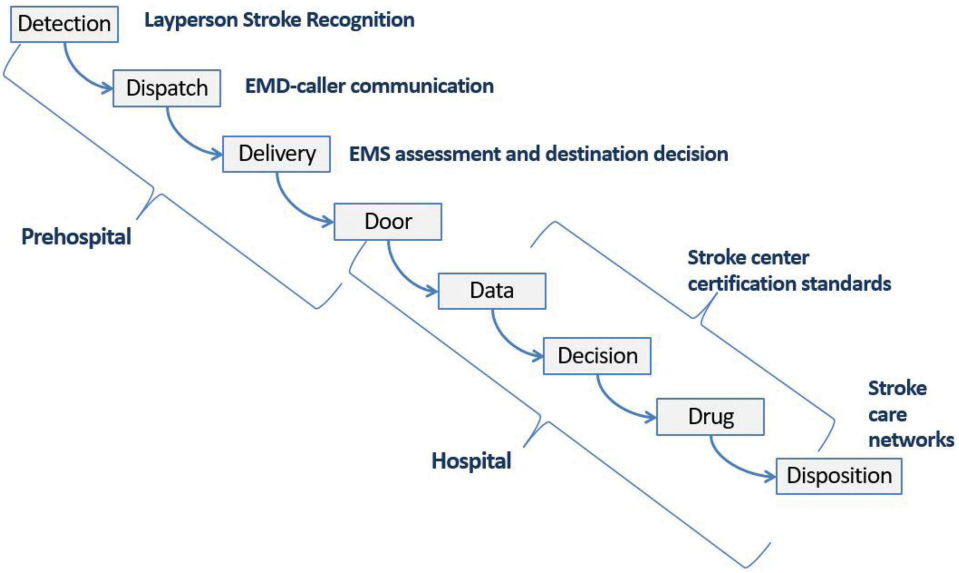

Figure 1 The Stroke Chain of Survival. Reprinted from Zachrison KS, Nielsen VM, de la Ossa NP, et al. Prehospital stroke care part 1: emergency medical services and the stroke systems of care. *Stroke*. 2023;54(4):1138–1147. Available from: https://www.ahajournals.org/doi/10.1161/STROKEAHA.122.039586?url_ver=Z39.88-2003&rfr_id=ori:rid:crossref.org&rfr_dat=cr_pub%20%200pubmed.[7]

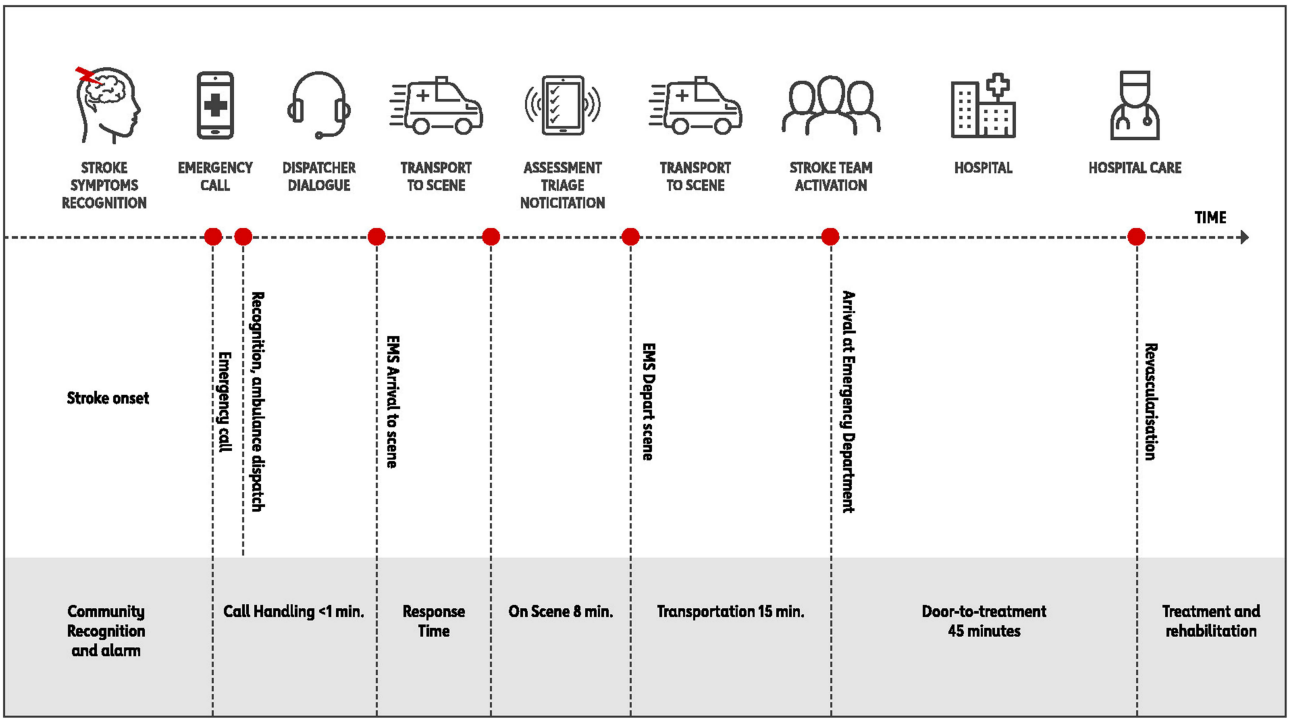

Figure 2 The Stroke Patient Journey. Reprinted from Rudd AG, Bladin C, Carli P, et al. Utstein recommendation for emergency stroke care. *Int J Stroke*. 2020;15(5):555–564. Creative Commons. © 2020 World Stroke Organization.[6]

In Ireland, ongoing efforts to improve stroke care along the stroke chain of survival have been evident in recent years. The Irish National Stroke Strategy 2022–2027 highlights the crucial role of organized pathways of acute stroke care throughout the stroke patient journey, emphasizing their significant impact on stroke outcomes and recovery.[11] Furthermore, The National Clinical Guideline for Stroke for the United Kingdom and Ireland, published in 2023, marked the country's first set of stroke clinical guidelines.[5] With the implementation of these policies and national clinical guidelines there have been improvements in the proportion of stroke survivors reaching the hospital within 3 hours of symptom onset and notable increases in timely brain imaging.[5] Despite this, thrombolysis rates have significantly declined from 2013 to 2022.[12,13]

Furthermore, the COVID-19 pandemic served as a "shock" to healthcare systems worldwide, prompting a heightened emphasis on healthcare system resilience.[14] Reports indicate that the pandemic potentially led to delays in the management of stroke and transient ischemic attack.[15–19] However, there is a lack of exploration into potential reasons or explanations for these observed changes. By exploring stakeholders' perspectives, a comprehensive understanding of the stroke journey over the two-year pandemic period can be facilitated, which can inform future stroke care provision. Thus, the aim of this study was to investigate stroke/TIA survivors, caregivers, and healthcare professionals' perspectives on the emergency/pre-treatment phase of acute stroke and TIA care in Ireland during the COVID-19 pandemic.

Materials and Methods

We reported this study in line with the Consolidated Criteria for Reporting Qualitative Research (COREQ) checklist.[20] A completed COREQ checklist is available in supplementary file 1.

Study Design

We used a qualitative narrative inquiry approach in this study.[21,22] We also illustrated the experiences of stroke/TIA survivors using the concept of patient journey mapping.[23,24] Data were collected using individual and dyadic semi-

structured interviews. The multi-stakeholder perspective captures interactions with healthcare professionals, resources utilized, and any barriers encountered.

Qualitative Narrative Inquiry

Narrative inquirers stress that research should commence with a focus on participants' lives rather than policies and practices.[22] Beginning with policies can silence participant experiences.[25] The narrative inquiry process starts by examining the conditions and systems shaping individuals' daily lives.[22] Individual experiences can inform and give meaning to shared experiences.[26–29] Narrative inquiry considers the position of time, context and external or internal social factors.[26–28,30] This approach showcases in-depth lived experiences and unique perspectives during a global pandemic, from service users and healthcare professionals.[29] It is a commonly used approach to describe in-depth experiences of stroke survivors of aspects of the stroke journey.[26–28,30]

Patient Journey Mapping

Patient journey mapping can be used to assess how individuals navigate intricate and dynamic health services and systems and offers detailed insights into individuals' experiences going beyond capturing isolated episodes of care.[24]

Study Participants

Setting

Irish public hospitals are classified into model 1–4, according to the range and complexity of services offered.[31] For stroke, whether a hospital is model 1–4 is dependent on whether certain services are available. e.g thrombolysis or rehabilitation units[31] (Table 1). Of the 86 public hospitals in Ireland, 21 are acute stroke receiving hospitals.[11] All 21 of

Table 1 Definition of Hospital Models in Ireland, in the Context of Stroke and Ambulance Service provision[31]

Hospital Model	Ambulance Services	Stroke Services
Model 1	General practitioners, hospital staff, and ambulance services will establish protocols for the transfer of patients by ambulance to and between hospitals.	The hospital might feature an onsite stroke rehabilitation unit.
Model 2 Model 2R: Remote rural hospital	General practitioners, hospital staff, and ambulance services will collaborate to establish protocols for the transfer of patients by ambulance to and between hospitals.	Stroke rehabilitation services will be offered.
Model 3	General practitioners, hospital staff, and ambulance services will collaborate to establish protocols for ambulance transfers to and between hospitals.	• An acute stroke unit may be available onsite, offering thrombolysis, rehabilitation, and maintaining a stroke register. • Additionally, a rapid access service for TIAs and stroke prevention clinics will be offered.
Model 4	General practitioners, hospital staff, and ambulance services will collaborate to establish protocols for ambulance transfers to and between hospitals.	• Onsite, there will be both acute and rehabilitation stroke units. These will provide: a. Thrombolysis services b. A rapid access service for TIAs c. Stroke prevention clinics d. An early supported discharge service e. A stroke register f. Vascular surgery facilities g. Triage protocols for neurosurgical services h. Advanced stroke imaging, including MRI

these stroke receiving hospitals have stroke units.[11–13] Two of the 21 acute receiving hospitals are endovascular thrombectomy stroke centres providing 24/7 treatment.[11–13]

Sampling

For this study, our objective was to recruit participants from a diverse range of stroke receiving hospitals, aiming to capture the spectrum of acute stroke services available across Ireland. The region contains six hospitals, of which four are acute stroke receiving hospitals. All four of these stroke-receiving hospitals have stroke units. Each of the four hospitals offers thrombolysis services, with one also providing thrombectomy services. Of the included hospitals, one was model two, three were model three and one was one model four hospital.[11] Following the selection of this region, we proceeded to recruit prehospital professionals from the corresponding National Ambulance Service region.

A purposeful sampling strategy was used for stroke/TIA survivors and caregivers to ensure a variety in ages, gender, and the specific COVID-19 wave during which they experienced their stroke/TIA. Whereas for the healthcare professionals purposive and snowball sampling was used. The research team identified potential participants from their hospital or prehospital networks, aiming to include a variety of practitioner types and ensure representation from both urban and rural practice areas. From there these initial participants recommended other colleagues within or external to their service to participate in the study.

Sample Size

Maximum variation sampling ensured demographic diversity, inclusion of various healthcare disciplines, and representation of stroke/TIA survivors from different pandemic waves[32,33.] Instead of recruiting to saturation, the study prioritized data richness, aligning with the qualitative narrative inquiry approach.[34–37] Emphasis was placed on detailed descriptions, constructed themes reflecting shared meaning, and rare but valuable insights.[34–36]

Recruitment

Patients/Carers

Eligible participants included individuals admitted for stroke/TIA treatment within the designated region between March 2020 and February 2022, as well as their caregivers. Participants were required to be 18 years or older and capable of providing informed consent. Those with communication impairments that could hinder interview participation were excluded. Recruitment occurred via social media, advocacy organizations, stroke support groups, hospital posters, leaflets, and public venues like community centers and parish halls.

Healthcare Professionals

Healthcare professionals were eligible if they had provided acute stroke care in the emergency or pre-treatment phase during the COVID-19 pandemic (March 2020-February 2022) in the selected region. Hospital-based healthcare professionals were recruited with the assistance of a clinical gatekeeper (ÁM), who contacted the lead stroke consultant at each of the four stroke-receiving hospitals in the region. National Ambulance Service staff were recruited through a gatekeeper (SM), who contacted station managers within the selected geographical region.

Patient and Public Involvement (PPI)

Throughout this research, we collaborated closely with a panel of 13 stroke and TIA survivors and their families (6 stroke survivors, 2 TIA survivors, 5 family members). These contributors played an integral role in co-developing the research question, the topic guide, and the lay summary for this study. The panel was also involved in recruiting stroke/TIA survivors and family members to the study, piloting the topic guide and advising on recruitment strategies. Five panel members were involved in coding and interpretation of the transcripts. We describe PPI in this study in detail using the GRIPP 2 checklist[38] (supplementary file 2).

Data Collection

Semi-structured interviews were conducted between April and August 2023. We developed an interview topic guide based on the study objectives, existing literature, and discussion with PPI contributors and other expert stakeholders (Table 2 and supplementary file 3). The topic guide was tailored to each of the three groups: stroke/TIA survivors,

Table 2 Summary of Topic Guide Themes for Stroke/TIA Survivors, Caregivers, and Healthcare Professionals

Stroke/TIA Survivors and Caregivers	Healthcare Professionals
1. Overview of stroke/TIA journey during COVID-19	1. The importance of time in acute stroke care
2. Priorities for acute stroke care	2. Healthcare seeking behaviour of stroke/TIA survivors during COVID-19
3. Public awareness of stroke during COVID-19	3. Stroke healthcare workforce during COVID-19
4. Access to acute stroke services during COVID-19	4. Operation of acute stroke services during the COVID-19 pandemic
5. Delivery of acute stroke services during COVID-19	5. Stroke pathway resilience during COVID-19
6. Learnings about acute stroke care from COVID-19	

caregivers, and healthcare professionals. EB piloted the topic guides with one representative from each of the above groups. The pilot interviews were not included in the final analysis.

Stroke/TIA survivors and caregivers had the option to complete interviews individually or in dyads. Participants self-selected their preference for individual interview or interview as part of a dyad, in advance of the interview. Interviews were conducted online (Microsoft Teams), on the phone or face-to-face. EB audio-recorded all interviews, with the consent of the participants. EB took field notes during all interviews. Interviews were transcribed verbatim, anonymized, and imported into QSR NVivo Version R1® to aid in the analysis process.

Data Analysis

We followed the principles of Braun and Clarke's reflexive thematic analysis when analyzing the interviews,[39,40] which is a commonly adopted approach in narrative inquiry.[41] The narrative inquiry approach focuses on the participant stories/experience, whilst thematic analysis allows for the identification of common themes between experiences.[42]

Firstly, EB inductively analyzed stroke/TIA survivor/caregiver and healthcare professional interviews separately. Based on this initial familiarization, we decided against analyzing the interviews in separate groups. This decision was made because the topic guide was similar across the groups, and similar issues were emerging from the different groups in all the interviews. EB then generated initial codes, identified initial themes, and reviewed and developed themes related to acute stroke care during the COVID-19 pandemic.[39] IH and AF each independently analyzed 50% of the transcripts. A multiple coding approach with collaborative and reflexive discussions between the research team was used to validate ideas and examine various assumptions and interpretations of the data. Reflexivity statements for the three coders can be found in supplementary file 4.

Secondly, patient journey mapping[8–10,23,24] was conducted to outline a structured chronology and illustrate the patient journey through the stroke pathway for participants. These maps were developed based on the stroke/TIA survivor stories and experiences as a method to present and enhance the understanding of the depth of those experiences. EB mapped out each stroke survivor journey individually, before combining experiences for each wave, and then throughout the pandemic. These maps were created using Inkscape Version 1.3.2.

Results

Description of Participants

We included thirty participants in this study: eight stroke/TIA survivors, seven caregivers and fifteen healthcare professionals. Three stroke survivors experienced TIAs preceding their strokes.

Three of the stroke/TIA survivor and caregiver interviews were dyads (all consisting of husband and wife). Supplementary file 5 includes key details about the stroke/TIA journeys of (a) stroke/TIA survivors and (b) caregivers. Prehospital professionals include three paramedics, three advanced paramedics and one doctor. Hospital-based professionals included four nurses and four doctors. Supplementary file 6 includes key details about the (a) prehospital care practitioners and (b) hospital-based HCPs.

The remaining 24 interviews were individual interviews. Mean interview duration was 40 minutes (range 19–63 minutes).

Themes and Subthemes

We identified five themes and eighteen subthemes from the data. All themes were present for the stroke/TIA survivors, caregivers, and healthcare professionals. However, the coverage of themes varied between groups. Table 3 summarizes the identified themes and subthemes. Themes and subthemes will be presented below with illustrated quotes.

Theme 1: Triage of Stroke Onset and Transport to Hospital

Untangling the Understanding of Stroke Onset

Stroke/TIA survivors, caregivers, and healthcare professionals (HCPs) emphasised the importance of enhancing education and public awareness about stroke. All participants agreed that increased knowledge and awareness would empower stroke/TIA survivors, bystanders, and the public to recognize and respond effectively to stroke/TIA symptoms. This is exemplified by a quote from a health professional

> I think from a stroke point of view we can educate better. (PH1)

The experiences of stroke/TIA survivors raising the alarm varied. For some this involved symptom recognition and alerting family members who then rang the ambulance service. Stroke/TIA survivors and caregivers discussed the Irish Heart Foundation F.A.S.T. (Face, arms, speech, time) signs of stroke awareness raising campaign. This campaign helped jog their memory of stroke symptoms and when to raise the alarm.

> that F.A.S.T. thing is there, and I'd be very conscious of that. (Dyad 1, SS)

However despite the principles and purpose of this campaign,

> the practice and theory were different. (Dyad 2, CG).

Although this survivor presented to hospital swiftly after symptom recognition they experienced long delays in receiving medical attention. Furthermore, others spoke of the limitations of this campaign if someone experiences a "wake-up" stroke. In this instance as the time of onset could not be identified, time-sensitive treatments were no longer an option.

All HCPs discussed the F.A.S.T. campaign's impact on public awareness of stroke and immediate actions to take. However, hospital-based HCPs observed that the impact of this intervention is temporary, with awareness quickly fading once the campaign ends.

> When the F.A.S.T. campaign, which is a public kind of health campaign, starts, public awareness probably tends to rise and then falls away quickly. (DR4)

Healthcare professionals from prehospital and hospital settings discussed the benefits of educating the public on stroke, emphasising the significant impact a bystander can have on stroke survivor outcomes. They explained that education helps bystanders recognize stroke symptoms and initiate the prehospital stroke pathway.

> ring 999, you know, certainly in a stroke context. (PH7)

Prehospital Delays During COVID-19

Stroke/TIA survivors and caregivers reported no delays in the ambulance reaching the location of the stroke. Typically, this would be there home. One caregiver shared that because a community first responder lived nearby, her husband received emergency care within minutes during COVID-19.

> there was no delay, there was… nothing, absolutely nothing. (CG4)

HCPs re-emphasised that in the context of stroke

> ambulance response times is critical. (D1).

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Table 3 Themes and Subthemes Identified From the Data With a Sample of Illustrative Quotes

Theme	Subthemes	Stroke/TIA Survivors and Caregivers	Healthcare Professionals
Triage of stroke onset and t**ransport** to hospital	• Untangling the understanding of stroke onset	*"rang 999 and asked for ambulance service. And she called out the stroke unit. She rang the stroke unit and was on for a while. " (SS4)* "the HSE insisted on putting it out there, Act FAST, like I suppose you still have to act fast, we still have to do it, but…that wasn't our experience". *(Dyad 2, CG)* "They didn't know when the stroke started - was it the middle of the night, or was it the six o'clock in the morning, or ten o'clock. They couldn't put a definite time and it would do more damage than good". *(Dyad 3, CG)*	"I think from a stroke point of view we can educate better. " *(PH1)* "the stroke community would like to see the FAST campaign rolled out more frequently, and be more visible". *(DR4)* "I think it's [public awareness of stroke]probably poorer now than what it was, so then I think another public campaign could be done". *(N3)*
	• Prehospital delays during COVID-19	"*outstanding because we had the first responder. " (CG4)* "I don't think I was waiting out long. They put me in handy enough". *(Dyad 1, SS)* "There was like no delays, you know, we were kind of communicated with everything that was kind of important and all that".*(CG3)*	"Lack of resources more than anything else. I mean the ambulance service is massively understaffed…under-resourcing was out biggest obstacle like. " *(PH3)* "Ambulance response times is critical. We've noticed a very significant deterioration in ambulance response times during Covid and since Covid and the situation continues today that the ambulance response times are not what they should be". *(DR1)* *"but there was probably an increase I would say in your ambulance times, for ambulance cleaning, you know, the decontamination of ambulances, PPE gear, everything, you know, getting into a house, doing your, kind of, little, I suppose safety checks within your Covid checks and things too as well, you know. " (N4)*
	• Mode of transport preferences during COVID-19	*"So I said you ring up the [urban hospital] and we will take him in. So we took him in the car the second time because we would have been faster, you know? " (CG4)* "There was no conscious decision, we went. There was no call for an ambulance. Well no he, the doctor, said just take him out you know". *(Dyad 1, CG)* "So I suppose you really have to go in the ambulance, to bypass A&E, I think, that's the only way we can get in there fairly fast. But anyway, that was…that was our experience". *(Dyad 2, CG)*	"I think, you know, I am not aware of any trend on that. I mean, I think, generally speaking people found accessing their GP harder and we were certainly saw more demand from that, but specific to stroke, how that might've played out, I do not know. There's so many confounders there, I could not really make any comment on it. " (PH7) "I didn't spot a problem or a difference, a change in how people would come in. I didn't". *(DR1)* "The ambulance would be our main, yes, link to me. No, it was about the same, I think. I didn't see any big change, no, no. No. It would have hit me maybe if I noticed any big change, but it didn't". (N1)

Treatment: navigating the hospital-based stroke pathway	• Patterns of stroke/ TIA presentations during COVID-19	"Yes, and I think we were kind of lucky enough in the sense that it didn't happen at the peak of one of the waves, it was in the trough, so it was like, probably easier that way, because obviously there was less people in the hospitals and all that". *(CG3)* "And then, I also, I don't know, but I heard people say that when Covid hit, strokes went through the roof". *(CG7)* "You got in quite quick but there was very few people up waiting in the emergency room because there was no one going to the hospitals at that stage". *(Dyad 1, CG)*	"I think I've probably seen more strokes in the past three years than I have previously". *(PH3)* "Yes, I think then, you know, in that sense, you know, I did feel that people did present later with both kind of TIAs and with strokes as well. Particularly with TIAs, I think. When people felt that it had got better and they had resolved, they were much less likely to present during Covid and we did hear from anecdotal stories of people who they had come in now with something subsequent and they'd comment on something that would suggest a TIA or a minor clinical stroke". *(DR2)* "But then we relaunched education and saying that we were open, that we were treating for stroke and you have to come in. It was a medical emergency and that you cannot be waiting. And kind of the numbers started coming up then again, but it was slow. It was slow in the second wave, but it was better than the first wave". *(N1)*
	• Experience in the emergency department	"They went to the emergency department and as far as I can remember, they were seen very quickly". (CG2) "I went through the Emergency Department, now there was big crowd there that evening and night but I eventually I just had to sit down and wait, and that was it". *(SS8)* "Oh yeah it was like - see the doctor was after ringing ahead, so they were waiting with the wheelchair, ready, once we got there. And my son of course had known…he had worked in A&E, and we were taken in straight now". *(CG4)*	"Emergency Department capacity issues then can be a barrier, that can delay triage, and identification of it at ED and then, you know, I am probably not as well qualified to talk about internal hospital processes - but I think there are…there can be some delays in terms of getting thrombolysis done in a timely manner, and that would benefit from thrombectomy". *(PH7)* "trying to keep people with Covid sort of out of ED". *(DR3)* "I suppose with discussion with the emergency department, we tried to pre-empt particular delays, because obviously, you know, with a stroke being a time-critical emergency, we want to reduce the number of delays as possible, as possible, you know, so I suppose the pre-alert from the ambulance service to the emergency department to say that they have a FAST-positive coming in, and even at that stage, they would be able to tell us whether the person is a Covid contact, or has Covid positive, or any Covid symptoms". *(N3)*

(*Continued*)

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Table 3 (Continued).

Theme	Subthemes	Stroke/TIA Survivors and Caregivers	Healthcare Professionals
	• Early phase of hospital care	"They were slow to do the brain scan, to be honest". *(SS1)* "He did. He got all the tests. He got a blood test and he got, I think he got an X-ray as well and he had some sort of a scan and it was diagnosed fairly quickly now". *(CG2)* "The scans were done relatively quickly both times. The scan was done pretty fast. Within an hour of arriving a scan was done". *(Dyad 2, CG)*	"I suppose my own personal view is that I did not see that happening and I suppose again, similar to thrombolysis and thrombectomy, you know, they are critical emergencies and they are recognised as such, in the same way that an acute myocardial infarction, ventricular dysfunction, respiratory distress, these are issues that have to be dealt with absolutely urgently, both at a department level and at specialist level as well and they are recognised as such as well. They are always prioritised over other more routine care, you know". *(DR2)* "And there would have been, I suppose then, radiology would have slowed their process because they had to gown up and they had to clean and they had to whatever". *(N2)* "Our system that we already had is based on time and it probably adapted very very quickly to Covid in regard to you know, that week where we had few calls, it gave us a little bit of time. "*(N3)*
	• Stroke unit care during COVID-19	"Covid had any bearing whatsoever, like there was no difference". (CG4) "Well no, the A&E was the worst part, the waiting, for a doctor to come and say right she's had a stroke, we need her upstairs, in [stroke unit], which is the stroke ward. That took a long time". *(Dyad 2, CG)* "He was in the stroke unit and he spoke extremely high of it". *(CG2)*	"the stroke unit, like most of the units, had COVID on it the most times, the single rooms are occupied by COVID patients". *(DR4)* "with nursing staff who maybe weren't like, who weren't trained or skilled in nurse, in stroke care" (DR3). "the stroke unit was converted actually into, at one stage into a Covid bay". *(N1)*

Importance of **time** in stroke care	• Time is brain	"Again, I guess, with like the stroke, the faster the response, the better. So, that's definitely one of the biggest things, I guess, because the longer you leave it, the more damage the person's brain may suffer, and the more disabled they might end up at the back end of what's happening, so that's definitely a big thing". *(CG3)* "he had the same strokes [as husband] but he was acted straight away and he got his sight back". *(CG7)* "Getting the patient straight to the ward where she's supposed to be. Straight to [stroke unit], to the stroke unit. FAST, it's supposed to be – time is of the essence". *(Dyad 2, CG)*	"I suppose time is critical, as I'm sure you're aware, you know. Time equals brain cells when it comes to reduced ischemic injury and trying to I suppose preserve the best neurological and functional outcomes for patients". *(DR2)* "So as soon as people come in, it's about time is brain. So you're losing brain cells immediately when you experience a stroke". *(N2)* "that's been deprived of the blood is losing volume, number one and it's losing oxygen to that part of the blood, and every time you lose oxygen and supply of blood to an area of the brain, it means that that muscle and that tissue is dying, ideally. So ideally what's more important there is that that the flow of blood gets back to that area. So that's why is very important to get in there in that timeframe, which ideally is the four to four and a half hours". *(PH2)*
	• Factors influencing timely hospital arrival	"He didn't have any typical stroke symptoms, so he couldn't". *(Dyad 3, CG)* "To a certain extent, but it's when he comes home and you're living with him you can see things. I can see things now that say the person that met him now yesterday wouldn't see". *(Dyad 1, CG)* "I don't think it mattered at the time [COVID-19], to be honest because I just had such a pain in my head that I think anything I would have gone to the moon and back for you like if you told me this was going to be cured, do you know". *(SS1)*	*So there's no doubt, people were terrified to come to hospital during that time (COVID-19) and it definitely impacted on stroke outcomes. (DR1)* *The patients that do come in are usually people maybe that would have a family member that knows about stroke and then knows the stroke unit in [rural area] and they know to call the ambulance or else they will just drive in. (N1)* *"because of health system capacity issues the ambulance service may not be able to respond in a timely manner" (*PH7).
	• Interconnectedness of the stroke chain of survival	"But we were on the…that was the first time, she was whisked away up to [stroke unit] before that, was on treatment up there". *(Dyad 2, CG)* "In the stroke unit, 20 minutes, half an hour, three-quarters of an hour". *(SS4)* "I think when they saw…my personal opinion is they were very fast once they got him off the ambulance, but once they got him off the ambulance and they did the CT scan". (Dyad 3, CG)	*"We've a fabulous ambulance service who generally work exceptionally well, and they've been particularly good in recent years at recognising the importance of stroke and the importance of getting people to hospital quickly". (DR4)* "*every minute is counting. So from, I suppose, your alert, prehospital, to your ambulance getting in, to your notification from ED, or whichever process it is".* (N4). "So, proper…correct assessment, from our perspective transport to the appropriate hospital and then that hospital providing treatment in a timely manner has…all of those have a direct outcome, a direct impact on outcome". *(PH7)*

(*Continued*)

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Table 3 (Continued).

Theme	Subthemes	Stroke/TIA Survivors and Caregivers	Healthcare Professionals
Navigating **Communication** and **Connectivity** in an Era of COVID-19 Risk & Stroke Care	• Technology to assist communication	*"Again, my dad is probably – just does not like technology, so I'd say that would've been a challenge for him anyway. " (CG3)* *"trying to get hold of people when you are in the hospital and there was nowhere to do your phone and you were terrified you'd be cut off, you know, and you could not get through to people. "(SS2)* "After two or three weeks, they brought me in a tablet, but up to that, I wouldn't have been able to use it anyway, do you know". *(SS1)*	*There was and we did that, so we were again one of the first kind of services to do that so we linked closely with Apple who kind of gave us a number of iPads and that allowed kind of communication with families, that otherwise would not have been possible. It allowed communication with team members, particularly with CNSs who played a pivotal role in continuing to communicate with families through phones and through iPads. So, yes, that's something that we, I think adapted reasonably quickly to open the lines of communication". (DR4)* "WhatsApp" *of them[family] milking the cows in the evening". (N1)* "So, it just made it, I suppose it kind of worked, but it did not and then I think it's, families very much want to physically see people, which you can understand, and you can tell a person over the phone, you know, if someone did not have the capacity for video calls and things, you can tell them as much over the phone, but it's, I think until you see a person sometimes, you kind of, you know, you do not understand how good or bad they are and things, you know, and people can decide, you know, I think at times you pick the good components, do not want to hear the bad components". *(N4)*
	• Communication with stroke survivor and caregiver	"explain all these things in medical terms and they tend to forget that we're plain common people". *(CG2)* *And then again, you know, in the times of Covid as well, it's just communication as well, because obviously, you cannot go in there yourself, you cannot speak to anyone, so just, as I said, even getting that phone number from the stroke nurse was very reassuring, because I knew I had someone in there that I could call, you know, if I had any questions. (CG3)* *Communication, I think, is the word that I would use with them, to me…it was good, it was great, but like I think it was because you can, you could improve it another small bit I think. (SS8)*	" Just I suppose, I suppose the initial concern and maybe nervousness PPE made, like so we'd a lot of people with language and communication issues and PPE was hugely problematic". (DR3) "don't know how much they're (stroke survivor) going to remember" *(N2)*. *So I suppose it was, you know, Zoom was not the easiest to use and then family members, if they were elderly, did not know how to do it so someone else was trying to do it for them. (N4)*
	• Communication between healthcare professionals	"I suppose for me the information you get leaving the hospital or while you you were in hospital is very very poor. And then they are trying to give it to somebody that mightn't be able to pick it up. there's no joined-up services is what I think is the problem". *(SS1)*	*And that, you know, there was a diversion to a lot of our patients away from [urban hospital] through I suppose better communication with primary care and through the ambulance services as well. (DR2)* " they'd [stroke team] always listen to the pre-hospital handover, like you know, which is nice". *(PH3)* "better communication lines between the national ambulance service and the acute service that every patient who is a suspected stroke should be pre-alerted as same". *(N3)*

	• Public messaging during COVID-19	"It must have. It must have because people probably didn't go to the hospital maybe when they got a stroke first and by the time they got there, the damage was done". *(CG2)* "Oh I'd say there was that, definitely, but at the same time you have to, like if you need to go to hospital you have to go to hospital, but people were afraid to go in I would imagine. Particularly elderly people". *(Dyad 1, CG)* "And turn on television, people in Italy then, they bring in army trucks with bodies into community centres to stack them up, they couldn't bury them fast enough or cremate them, that frightened people". *(Dyad 2, SS)*	"a problem with the amount of fear that was stoked up by the government and about various different healthcare agencies at the time. I think it was completely and utterly overdone and it was responsible for people being reluctant to go to hospital". (DR1) "only go to hospital if, if deemed necessary you know for a medical, but I suppose everyone classes, what I say is a medical emergency, compared to another person" *(N4)*. *That's it. They have been watching the media and the news and all the news was bad, so hospitals are full of people. Covid is rampant and they are going right, I am in my house here where I am safe. Why am I going into that? (PH6)*
COVID-19 public health measures	• COVID-19 superseded everything	"COVID took over the whole world like and that was it". (SS1) "This shouldn't be like this. So, I rang the doctor and obviously, Covid, I'd to wait for the doctor to ring back". *(CG7)* "I think things got lost in Covid because they're down staff, people working from home you know". *(Dyad 1, CG)*	*"COVID superseded it [stroke awareness]. "* (DR3) "Everything that presented and everything that was delayed or not managed well, it was Covid that was blamed for that, you know". (DR2) "public perception with regards to the severity of stroke, I think the Covid probably took over"(N3).
	• Personal protective equipment	"Everything was gowned up and gloves by every professional above, so there was no kind of I suppose one-to-one. Do you know that you'd get to know somebody or a bit of craic". *(SS1)* *"The first responder came, but of course we were looking out the window seeing a man putting on his apron and his mask and we said would you ever come in please, come in this man is going, going, going. "(CG4)* "You know, I was in a private room, but…plenty of nurses and doctors, but they had all this gear outside the door, my door, and nobody could come into the room, only …. they had to be togged out like, you know". *(Dyad 2, SS)*	"when our crews get on scene, you know, having to put on full PPE before going in to a house or getting involved with a patient. That definitely would've slowed down" *(PH7)*. "So usually we have got time to do that. You have got time to don your PPE. So often you are in your PPE waiting for them to come in the door. So I would not have said it would not have delayed our door to CT. It would not have delayed our door to needle time very much. It would not have delayed door in, door out for thrombectomy very much". *(DR1)* *And then when you are in the pod, you have to gown up, go in and then come out and gown down again. So all that took time, so you were not in as much contact with people, you know". (N1)*

(*Continued*)

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Table 3 (Continued).

Theme	Subthemes	Stroke/TIA Survivors and Caregivers	Healthcare Professionals
	• Visitor restrictions	"I suppose you would feel alone inside you know. I had to phone my wife to say to her I got sick and she phoned the hospital then from outside to say I was in the waiting room, that I was sick". *(SS1)* "I didn't see [husband]. I didn't see [husband] for nearly three weeks because Covid was on". *(CCG2)* "And my wife didn't, she wasn't allowed in, you see, at that time they were very strict with the Coronavirus. And she helped me in and that was alright anyway. So I phoned her about 10 o'clock to go away home". *(SS8)*	"We took people out of their houses from their family and they never saw them again until they were burying them, you know?" *(PH1)* *"God that [visitor restrictions] was desperate, yes, yes. And in fact, still even on sites in the city that could manage strokes there's still really tight visitor restrictions. So, for example in [urban hospital] where there is still only two hours visiting in the evening, with this false sort of sense of somehow that protects Covid. " (DR3)* "So anyone in times where it was end of life care you know that you're having to reduce the visitation of people who you know are, you know, sadly saying goodbye, that's a huge impact". *(N3)*
	• Acute stroke workforce	*"No, just I suppose that's it really during the early stages, the staffing and the communication would be a big…. "(SS1)* *"But the system broke them [healthcare staff] down like, they were just… they were pushing a snowball up hill all the time like. "(Dyad 2, CG)* "No, they said, look, we had a staff there, we were working with, they weren't actually, I think, they were understaffed, I could be wrong in that but there was something, I think it was that". *(SS8)*	"We all had the same fears about bringing it home, bringing it to our families, you know, getting it ourselves". *(PH1)* "So I would have said we were particularly badly affected. Now, at the start, I think there was an issue with people being redesignated to work elsewhere during Covid. Now, that was a big problem. For example, our clinical nurse specialist in stroke was, you know, being put off swabbing and things like this. And so that would not have been good". *(DR1)* "We were generally quite well protected, to be fair to the hospital, like, we did not lose any of our acute, our specialists, there were staffing implications, obviously, as staff got affected, some staff were out awaiting swabs, staff who were sick themselves, but we did not notice a huge redeployment of existing staff". *(N4)*

Notes: *Participant groups are represented by the following: SS (stroke/TIA survivor); CG (caregiver); PH (prehospital practitioner); N (nurse); DR (doctor).

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However during COVID-19 some hospital and prehospital professionals noted a deterioration in response times. Other prehospital practitioners believed that, since stroke was categorized as a high-priority condition, its response times did not increase during the pandemic.

Most participants believed that COVID-19 related measures increased ambulance times. Prehospital practitioners discussed ambulances needing to wait for substantial time periods outside emergency departments (EDs) before handing over to hospital staff.

Furthermore in the triaging software used by the ambulance service

> the highest acuity level you can get for a stroke on AMPDS (Advanced Medical Priority Dispatching system)[43] is a Charlie call. (PH7)

A Charlie call is categorized as serious not life threatening, but warranting an immediate response.[44] Participants believed this was a prehospital care issue, as calls that were triaged higher than stroke would be responded to preferentially. For time-dependent conditions such as stroke/TIA this could impact on patient outcomes.

> straight away that pushes it (stroke calls) down, I think that's about 38% of our call volume are echo or delta (life-threatening category). (PH7)

Mode of Transport Preferences During COVID-19

In this study an equal number of stroke survivors arrived at the hospital by car and ambulance during COVID-19. Those who came by car had typically seen their General Practitioner (GP) beforehand. Stroke/TIA survivors and their families had various personal reasons for their transportation choices. Some participants preferred ambulances transport as it allowed faster access to in-hospital stroke teams.

> we lived very close to the hospital, and my mum doesn't drive, so that [ambulance] kind of felt like the quickest way of getting him [stroke survivor] to get looked at. (CG3)

All HCPs discussed the primary access routes to the hospital for stroke/TIA survivors: 1) driving directly to the emergency department; 2) visiting the GP first, then being referred to the ED; 3) being transported by ambulance to the ED.

Hospital-based HCPs observed no change in preference of stroke/TIA survivors for presenting by ambulance during the COVID-19 pandemic. However, they observed that generally rural dwellers opt for ambulance transport, whilst those from urban locations typically arrive by car.

> those from urban locations usually arriving to the front door [of the hospital], where they would have been brought in by car by a family member. (N3)

Theme 2: Treatment: Navigating the Hospital-Based Stroke Pathway

Patterns of Stroke/TIA Presentations During COVID-19

This theme was mainly discussed by HCPs. However, one caregiver perceived a decrease in hospital presentations during high COVID-19 levels, noting the reduced number of patients in the hospital

> during the peak of one of the waves". (CG3)

HCPs discussed four main changes in stroke/TIA presentation during the COVID-19 pandemic: 1) Reduction in stroke/TIA presentations; 2) Variation in stroke/TIA presentations during different COVID-19 waves; 3) Delayed stroke/TIA presentations; 4) Severity of presenting stroke/TIA. HCPs discussed a notable reduction in stroke/TIA presentations during COVID-19. This was particularly apparent during the early stages of wave 1 (1st March 2020-August 2020) and subsequently during surges in COVID-19 cases. This was observed in both the hospital and prehospital settings.

> a measurable, significant drop in numbers of patients dialling 999 with symptoms that were consistent with stroke or TIA. (PH7)

> There was a dip in people coming in at all, even for thrombolysis. They weren't coming in even when they had a stroke. I suppose the second wave, they were getting a bit better [at presenting to hospital]. (N1)

Furthermore hospital-based HCPs described witnessing

> later strokes and … bigger strokes.

(N1) presenting during the COVID-19 pandemic. Some believed that COVID-19-related fear motivated changes in healthcare-seeking behavior. They also observed that TIA survivors were less likely to present to the hospital during the pandemic. These practitioners discussed that these patients might have presented later with a full stroke, whereas prompt investigation and management of the TIA could have prevented such an event.

> delayed presentation or a reduction in presentations across the hospital group and particularly in the [urban hospital] as well. People tended to stay away. (DR2) particularly the minor stroke presentations, and the TIAs would probably have fallen off a little. (DR4)

Experience in the Emergency Department (ED)

Stroke/TIA survivor and caregiver experiences of the ED during COVID-19 varied greatly. Some described fast clinical review due to less people presenting to hospital during wave 1 and 4 of COVID-19.

> Very few people up waiting in the emergency room because there was no one going to the hospitals at that stage. (Dyad 1, CG)

Others who presented during wave 2 and 3 described the opposite situation. Some stroke/TIA survivors and caregivers described long waiting times in the ED. For these survivors, the ED seemed to be the bottleneck for entry to the acute stroke pathway.

> five or six hours waiting in A&E, which was scandalous, with 60 or 70 people sitting in chairs in A&E at night, and all the cubicles were full. (Dyad 2, CG)

From the HCP perspective, EDs were "structured into a COVID pathway and a non-COVID pathway" (N1) despite presenting with a non-COVID-19 condition. This could result in delays for the stroke/TIA survivor due to factors such as waiting for the results of COVID-19 tests. However all HCPs reported that otherwise the usual acute stroke pathway transitioning from prehospital to hospital care remained intact. For example the hospital-based stroke team still received "the normal, you know, pre-alerts from ED". (N4)

Early Phase of Hospital Care

After triage and a period in the ED stroke/TIA survivors and caregivers discussed their initial hospital-based stroke treatment. Most survivors found once they "got into the system, the care was excellent". (SS1)

After the ED, the procedure which appeared to be the most delayed across all survivors was brain imaging. Conflicting views were expressed by hospital-based HCPs, with some believing t"here wouldn't be many significant delays in terms of, imaging". (DR2) However others discussed how COVID-19 cleaning protocols and PPE may have caused delays in brain imaging.

> radiology would have slowed their process because they had to gown up and they had to clean…. (N2)

Stroke Unit Care During COVID-19

Stroke/TIA survivors and caregivers had varied experiences of stroke unit care during COVID-19. The majority of stroke survivors "couldn't fault the hospital". (Dyad 1, SS) These participants believed COVID-19 had no impact on their stroke unit care. However whilst some stroke survivors were,

> diagnosed with the stroke and brought up into the stroke unit (CG2) others experienced substantial delays. two days before I got up to the stroke unit. (Dyad 3, SS)

The sanctity of the stroke unit, as the cornerstone of stroke care was discussed by all HCPs. Hospital-based stroke teams discussed lack of or delayed access to stroke units during COVID-19. One reason offered for this was that the single rooms in the stroke units of study hospitals could be occupied by COVID-19 patients for isolation purposes.

> It [COVID-19] certainly would have impacted on getting people to the stroke unit, which is a key proponent of acute stroke care. (D4)

Furthermore, during outbreaks of COVID-19 stroke survivors could be transferred to other wards. HCPs relayed that this resulted in non-stroke specialist HCPs caring for stroke survivors.

> Big issues with the stroke ward where I primarily work is that when we've had COVID outbreaks we've often moved people off the unit. (DR3)

Theme 3: Importance of Time in Stroke Care

Time Is Brain

This subtheme focuses on the multi-stakeholder discussion of why time is so important in the context of stroke/TIA. This was discussed in much greater detail by HCPs than stroke/TIA survivors and caregivers.

Some caregivers discussed the cumulative brain damage a stroke can have without prompt review and intervention. Others discussed the time-sensitive treatments, such as thrombolysis.

> The longer you leave it, the more damage the person's brain may suffer, and the more disabled they might end up. (CG3)

Some caregivers understood that thrombolysis can only be administered within 4.5 hours of symptom onset. Furthermore, all affected caregivers and stroke/TIA survivors expressed disappointment about missing the treatment window and discussed its potential impact on their recovery.

> The effect that that would have on it at that stage. I know if you get it [thrombolysis] fairly fast, it works wonders. (CG2)

However, despite being aware of this, many stroke/TIA survivors interviewed chose to delay while traveling from the GP surgery to the hospital. One caregiver described: "Stopped for the glasses, and there was something else she wanted to do as well". (Dyad 2, CG).

Reflecting on this decision later, they expressed regret, recognising its potential consequences in terms of the time-critical nature of stroke/TIA management.

> Hospital-based HCPs discussed the urgency of making decisions about hyperacute [stroke] care. (DR2).

They explained the reasonings for this in great detail. In the context of an ischaemic stroke they discuss lack of perfusion to the brain and the deleterious effect his has on patient outcomes was critical to the urgency of treatment/management. Despite the challenges of COVID-19 HCPs believe that this concept remained at the core of acute stroke care.

> Regardless of Covid. I think we're very fixed in regard to time is brain, and there's brain cells dying. (N3)

Unfortunately, hospital and prehospital professionals have observed multiple survivors presenting outside of the thrombolysis treatment window. Prehospital practitioners are typically the first healthcare professionals to record the time from stroke symptom onset. They noted encountering more survivors who presented outside this window during COVID-19.

> Many people do not make that treatment window, a lot of those three, four-hour windows were missed [during COVID-19]. (PH5)

Factors Influencing Timely Hospital Arrival

Similar factors influencing timely hospital arrival were discussed among all three groups. Factors related to the stroke symptom recognition phase were identified: "symptom severity;" "presentation of atypical symptoms" and "family as a motivator". Factors related to the prehospital phase of care were also mentioned.

Stroke/TIA survivors and caregivers recounted their diverse presentations and experiences related to raising the alarm. Generally, those that experienced more "obvious" and typical stroke symptoms recognised they needed to act fast. Some stroke survivors presented with the typical F.A.S.T. symptoms, "*looking* in a mirror and it was classic, you know". (CG2)

Whereas others presented with symptoms that were debilitating but sometimes outside the F.A.S.T. acronym. HCPs gave the impression "that it's always the severity". (N2) of symptoms that motivates a stroke survivor or bystander to raise the alarm.

Additionally, a survivor's living arrangements was seen to influence their time to hospital presentation. A factor that was potentially aggravated by "stay at home" orders during the COVID-19 pandemic.

> People living alone and an inability to be able to, you know, contact anyone. (N4)

All groups identified family members as a motivator for timely hospital presentation, as families "can be a source of persuasion I think from family relatives saying, you know, this is a serious event".(DR1)

Amongst the participants, all bystanders were family members, which could have been influenced by COVID-19 restrictions. They believed they were best placed to identify symptoms in their loved ones. Whereas one stroke survivor spoke of how she"lived on my own, you know". (SS2), thus did not have a family member to recognise her symptoms and raise the alarm.

In the next link of the chain of survival, prehospital factors can influence timely hospital arrival. At times health system capacity issues result in untimely prehospital responses. During COVID-19 as increased pressure was placed on the healthcare system, HCPs noticed longer ambulance response times.

> Very significant deterioration in ambulance response times during Covid and since Covid and the situation continues today that the ambulance response times are not what they should be. (DR1)

Another barrier to timely presentation was survivors contacting their GP rather than the ambulance service upon recognition of stroke/TIA symptoms. Activating the prehospital pathway allows for activation of the stroke code protocol, with rapid transport to hospital and rapid handover to the stroke team on arrival.

> We still have patients. not a huge amount tend to contact their GP when have stroke symptoms which obviously isn't the most efficient pathway from them. (PH7) Due to their GP surgery being closed one stroke survivor lost 24 hours at least. 36 hours maybe. (SS8).

Interconnectedness of the Stroke Chain of Survival

Participants, especially HCPs, discussed how the acute stroke pathway from start to finish, "is obviously time-critical". (N4).

HCPs highlighted that the co-operation between each phase of the stroke chain of survival facilitates timely provision of care.

Caregivers recognised the efforts of the multi-disciplinary team operating in these different phases of care. Some discussed how the swift arrival of the ambulance and handover to the acute stroke team resulted in optimal care and outcomes for the survivor.

> The emergency services, the ambulance was there, and like, they were kind of getting ready to take him to the hospital. (CG3)

HCPs felt that interdependence and co-operation facilitated the seamless transition between phases of acute stroke/TIA care. In the context of stroke/TIA prehospital practitioners can pre-alert the stroke team of the receiving hospital. This typically results in swifter review by the stroke team once the patient arrives at hospital.

Pre-alert to the hospital and they will determine the care plan from that point on. (PH1)

All HCPs discussed how this process remained intact during the COVID-19 pandemic. However, one HCP thought that little attention was given to the overall patient journey, which was further impacted by COVID-19.

What we don't look at well, is the patient journey, and I think Covid didn't help it. (N3)

Theme 4: Navigating Communication and Connectivity in an Era of COVID-19 Risk & Stroke Care

Technology to Assist Communication

In this subtheme, participants discussed technology in the context of communication with family and also the provision of remote stroke services.

Most stroke survivors and caregivers contacted each other using a traditional phone call, whilst others video call platforms. Due to COVID-19 restrictions these were the only means of connection and communication. This was challenging for those who were not familiar with technology pre-COVID.

The only contact we had was video calls. (CG7)

Hospital-based HCPs discussed facilitators to communication between stroke/TIA survivors and family members, such as collaborations with industry –

linked closely with [technology company] that provided tablet devices and that allowed kind of communication with families. (DR4)

Others discussed families using applications such as "WhatsApp" to stroke/TIA survivor to observe routine family activities, such as milking the cows. However these methods did not suit all cohorts, such as some older stroke/TIA survivors.

Communication with Stroke Survivors and Caregivers

Stroke survivors and caregivers discussed the challenges and opportunities of communication with the HCP team during COVID-19.

Some caregivers discussed the willingness of stroke nurses to regularly update the family by phone. However, others had "to ring them [stroke team] all the time like to get in contact with them". (SS1)

Furthermore, due to the nature of stroke, cognitive impairment may reduce a stroke survivors' ability to comprehend and assimilate information. Thus caregivers emphasised the importance of the team relaying the information to both the stroke/TIA survivor and caregiver in an accessible manner.

Firstly HCPs believed that "communication issues and PPE was hugely problematic". (DR3)

Stroke/TIA survivors at times struggled to hear or understand the prehospital or hospital-based HCPs due to PPE. Like stroke/TIA survivors and caregivers, HCPs discussed the challenges of communication for stroke/TIA survivors due to stroke-induced cognitive impairment. Furthermore, due to visitor restrictions HCPs were required to call distressed family members, at times needing to get their phone numbers from prehospital care practitioners.

On a phone call to a distressed family member at home, and then trying to explain to them…(N3)

Communication Between HCPs

Overall HCPs believed they "adapted reasonably quickly to open the lines of communication" (DR4) during COVID-19.

Despite COVID-19, HCPs maintained effective communication throughout the stroke chain of survival, including transitions of care handovers. Prehospital professionals appreciated hospital-based stroke teams' respect during handovers. However, one nurse in a rural hospital lost contact with ambulance crews due to COVID-19 redeployment, affecting her ability to receive alerts about suspected stroke/TIA patients while on duty. Others believed, "regardless of

COVID-19 communication in hospital is always going to have to improve, you know, and adjust to what we're faced with". (N3)

> The handovers I get from our ambulance crew locally are really good and they're really spot on and I think that's because they are interested, and they're involved in the stroke care. (N1)

Public Messaging During COVID-19

"The importance of nuanced public health messaging" (DR4) during COVID-19 was discussed by multiple HCP participants, from both settings.

Some expressed their disregard for the COVID-19 related fear evident in the media at the time. With others believing that this public messaging deterred some stroke/TIA survivors from presenting to hospital. HCPs discussed that they believed the public were almost too adherent to public health messaging. They highlighted "their efforts to encourage the public to present to hospitals during COVID-19 with medical emergencies such as heart attacks, strokes, suspected strokes, TIAs". (DR4)

> Contact your GP and you know if you become really, really unwell, dial 999 - but people weren't, they just didn't want to do that. (PH1)

> The public took on board the message, you know, to stay away from hospitals, it definitely did have an impact on their presentation to hospital. (N3)

Theme 5: COVID-19 Public Health Measures

COVID-19 Superseded Everything

All participant groups discussed how COVID-19 seemed to be prioritised over other conditions.

Some stroke survivors and caregivers believed COVID-19 affected their acute stroke care and reported the lack of access to primary care physicians to manage potential stroke risk factors.

> If Covid wasn't there [stroke survivor] would have his blood pressure check then. (Dyad 3, CG)

HCPs from prehospital and hospital care shared similar views, believing that COVID-19 clouded out stroke awareness. Furthermore, in terms of stroke severity HCPs thought that the public viewed COVID-19 as more serious and life-threatening than stroke. This was particularly true for prehospital practitioners whilst transporting stroke survivors to hospital.

> I think COVID superseded every, pretty much every aspect of it [stroke awareness]. (DR3) COVID was going to kill you, whereas do you know, they'd survive a TIA. (PH5)

Others emphasized the need for critical reflection on care provision during the COVID-19 period, suggesting that the crisis could influence perspectives of those impacted.

> Temporal distortions and the disruption to the service during a traumatic event tend to skew everything. (DR2)

Personal Protective Equipment (PPE)

PPE became part of the stroke pathway, from prehospital to hospital-based care. Although this theme was more extensively covered by HCP participants, stroke survivors and caregivers also relayed how PPE affected their journeys. For many stroke survivors "PPE, yes, yes. That's what stands out"(SS3). Some described the anxiety experienced when they witnessed the community first responder donning PPE before entering the stroke survivor's home.

> First responder came, ….we were looking out the window seeing a man putting on his apron and his mask and we said would you ever come in please, come in this man[stroke survivor] is going, going, going. (CG4)

Some stroke/TIA survivors were required to wear a mask themselves in certain areas of the hospital. Survivors accepted this custom. However believed "it was incredibly difficult for the nurses"(SS3) to be wearing PPE. Some HCPs believed

> PPE protocols undoubtedly delayed and slowed up. (DR4)

stroke-related care processes". This was echoed in prehospital care due to the donning of PPE when reaching the location of the stroke/TIA. Prehospital practitioners relayed how initially there was a delay in the provision of adequate PPE. Furthermore, they discussed challenges with PPE, such as the process of "donning" and 'doffing" along with potential supply shortages.

> closest we came we had about 24 hours of PPE left - but we never actually had a PPE shortage, and it's a credit to our own people and to the procurement people. (PH7)

Visitor Restrictions

All participants felt very strongly about visitor restrictions, across all groups. All discussed the potential impact of this policy on the morale, mental and physical outcomes of stroke survivors.

Stroke survivors "felt abandoned" (SS4) whilst in hospital.

Different levels of visitor restrictions appeared to be present in different hospitals.

Most discussed total visitation bans. Whilst caregivers thought it was "disheartening, because like you know, we just couldn't do anything, you could just like drop it off. Couldn't say hi, couldn't say hello" (CG3). Finally, caregivers were seen as providing information for both medical and emotional purposes;

> Do you know, I'm with my wife for 23 years, so she knows basically everything about me like, so like what they see as normal, she'd see as strange. (SS1)

Amongst HCPs it was clear that "visitor restrictions was the worst part of the whole thing". (PH3) Some stated that "the evidence or the logic behind some of the visitor restrictions(DR3) was never discussed". With others believing it "was never justified actually, the exclusion of family from hospitals in patients with stroke. It was never ok" (DR1). Others discuss "the importance of family in the context of stroke as a debilitating kind of thing that happens, and a hugely emotive time for patients and their families". (DR4)

Prehospital care practitioners discussed at "the height of Covid, nobody [family members] was travelling with us" (PH6). They were also limited in the early stages, family members didn't travel or were discouraged, "not because we didn't want them in the ambulance, but because when they got to the hospital, they wouldn't be allowed in". (PH7)
The role of family members in the recovery of stroke survivors was also emphasized as "they're so important to finding out what their baseline is". (N2). Furthermore", if a family member comes with somebody say on a F.A.S.T. positive call, that's really valuable. Certainly if they witnessed it and that, it's really valuable". (DR1)

Acute Stroke Workforce

Overall, HCPs felt they were "all shoulders to the wheel with everybody and everybody has the same goal, everyone from a shopkeeper to the cleaners in the hospitals, everybody was doing their bit like"(PH1). However, staffing levels, redeployment and absenteeism affected prehospital and hospital services during COVID-19.

Ambulance services faced staff shortages due to COVID-19 cases and close contact scenarios, impacting their ability to respond effectively. They discussed a phase where "staff were getting COVID, and then there was close contact scenarios where staff were definitely down, you know, so it was tough, it was a really stressful scenario". (PH2)
Hospitals also experienced staff shortages across various roles, affecting service quality and experience levels. In the context of stroke, "this did not only affect staffing levels but also the experience mix remaining on the floor, with our experienced staff, taking them out of the unit was a bit of… Left us lacking in the experience, you know". (N1)
Redeployment of prehospital practitioners to COVID-19-related tasks like swabbing and vaccination disrupted normal operations. Some practitioners felt privileged to remain in their roles, while others were redeployed, leading to staffing challenges and a sense of uncertainty among staff.

> Now, at the start, I think there was an issue with people being redesignated to work elsewhere during Covid. Now, that was a big problem. (DR1)

In the ambulance service efforts were made to adapt, such as employing role specific emergency medical technicians and establishing swabbing teams, which became a permanent fixture: "They're now called emerging threat teams". (PH7) This also meant new fleets of ambulance vehicles being procured. Furthermore just "the sheer uncertainty of it all. …. affected staf"f. (PH7). The toll on staff morale and mental health was evident, with fears of infection and increased social isolation. Most HCPs "could not work through another one. It was so bad, you know". (N1)

Others felt they all "had the same fears about bringing it home, bringing it to our families, you know, getting it ourselves". (PH1) However others thought "if we can't treat them, who the hell is going to treat them, do you know?" (PH2) Stroke survivors and caregivers appreciated the efforts of healthcare staff but noted understaffing issues and delays in accessing care, which could have been due to overwhelmed GP services.

For stroke survivors and *caregivers* "the nurses and all were brilliant, and the doctors to be fair. (Dyad 2, CG)". Despite COVID-19 pressures "that particular stroke nurse was just being very empathetic about us and all that, or was it like, a systemic thing". (CG3)

However they also realised they were understaffed, "I could be wrong in that but there was something, I think it was that". (SS8)

They suspected this may be caused by staff being out sick, due to COVID-19 rules at the time.

Patient Journey Maps

The patient journey maps illustrate the five identified themes. The stroke journeys of 12 stroke survivors (8 of whom were interviewed (individually) and 4 as a dyad with their caregivers) are represented in Figure 3 and supplementary files 7–10. Two stroke survivors had two strokes; thus 14 strokes are represented here. All stroke survivors had their strokes between March 2020 and December 2021. Thus their journeys span four waves of COVID-19 in Ireland. Figure 4 represents the recommended time intervals for stages along the stroke survivor journey laid out by the INAS.[13]

Figure 3. portrays the stroke journeys of all twelve survivors during the first to the fourth wave of the COVID-19 pandemic in Ireland. The longest "symptom onset to hospital arrival" interval and "medical assessment to hospital arrival interval" were experienced in wave 1, compared to all other waves. All other intervals were the longest during wave 4.

Supplementary file 7 represents the journeys' of two stroke survivors who had their strokes during the initial wave of the COVID-19 pandemic in Ireland. Supplementary file 8 illustrates the experiences of two individuals who had their strokes during the second wave of the COVID-19 pandemic in Ireland. Supplementary file 9 represents the experiences of five stroke survivors during wave 3 of the COVID-19 pandemic in Ireland. Supplementary file 10 depicts the journeys of three survivors during the fourth wave of the COVID-19 pandemic in Ireland.

Figure 4. contains recommended time intervals for stages along the stroke survivor journey, from the INAS.[12,13]

Recommendations

Participants from all three stakeholder groups offered recommendations for future routine and crises provision of acute stroke/TIA care. These are summarized using the steps in the stroke survivor journey, in Table 4.

Discussion

This qualitative narrative study provided a detailed exploration to understand the differences in stroke/TIA presentation and management during COVID-19, from survivor, caregiver, and healthcare provider perspectives. Similar factors were reported by participants as barriers and facilitators to timely hospital presentation throughout the "stroke chain of survival", including COVID-19 specific factors. All groups believed that overall the acute stroke/TIA pathway remained intact during COVID-19. However, although the stroke pathway itself was the main focus of healthcare profesisonals, survivors and caregivers discussed that care experiences were at times negatively affected by the pandemic.

This study had five main findings, which are the reported themes. Firstly all participant groups highlighted that public awareness of stroke is a key impetus for activating the stroke chain of survival. It is evidenced that campaigns such as the Act F.A.S.T. initiative are effective at increasing public awareness of stroke symptoms.[45–47] However ongoing

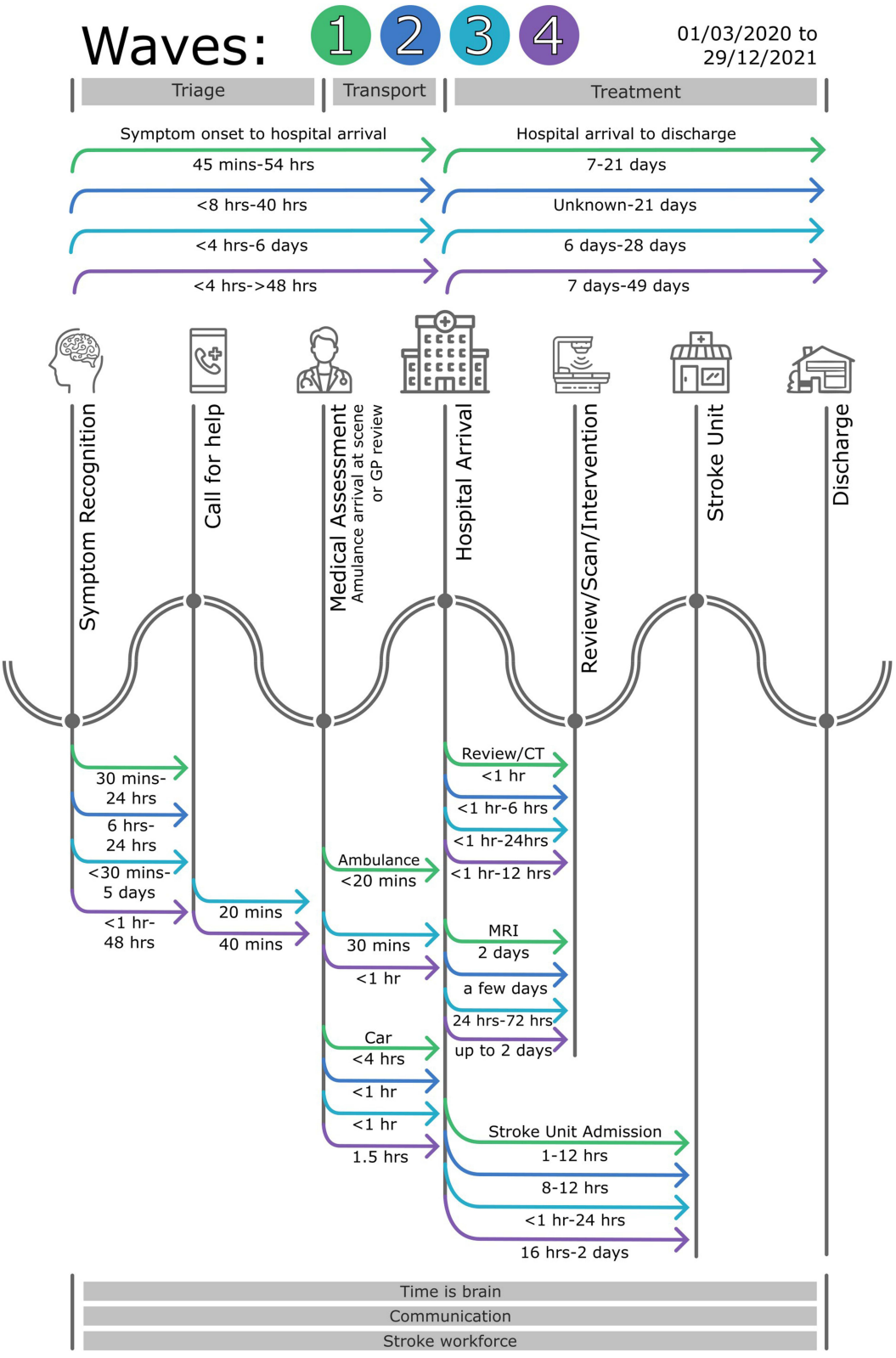

Figure 3 Stroke survivors journey maps across wave 1–4 of the COVID-19 pandemic in Ireland.

https://doi.org/10.2147/JMDH.S486369

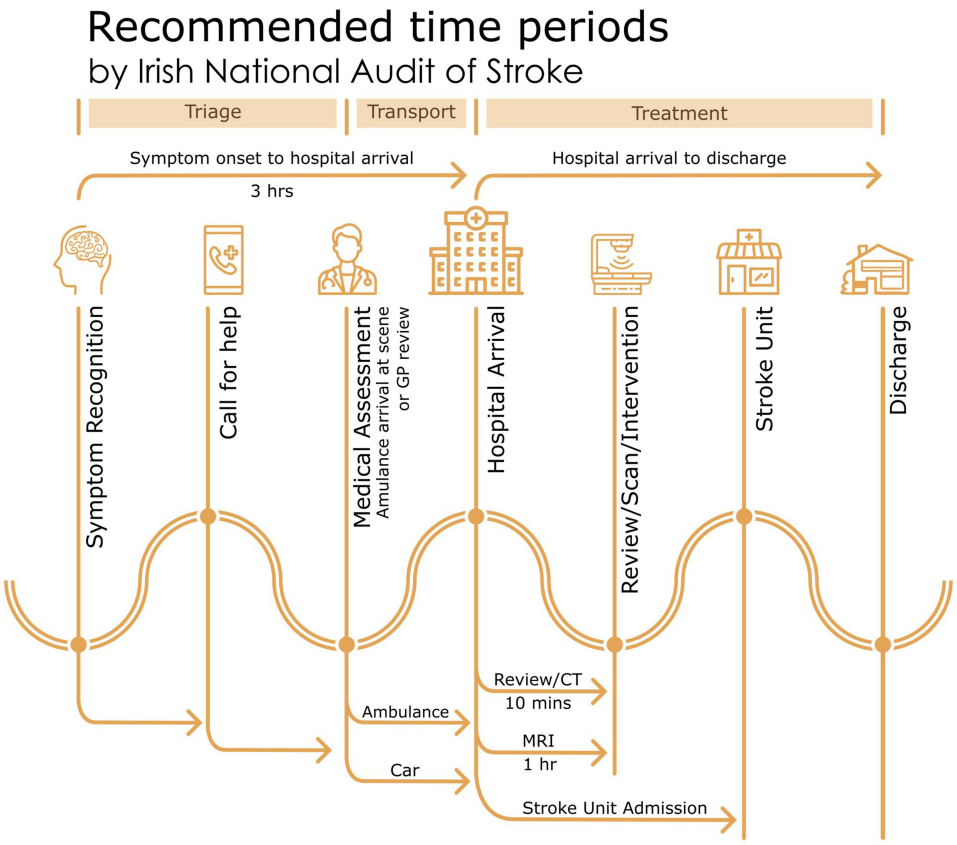

Figure 4 Recommended stroke journey using time points from the Irish National Audit on Stroke. Data from these studies.[12,13]

educational initiatives are required for sustained levels of public education.[45,46,48] Participants observed a decline in such campaigns during the COVID-19 pandemic. Furthermore, with physical distancing in place, stroke self-awareness was more critical during the pandemic, making educational programs an even higher priority.[47] A Japanese study describes a school-based online stroke education program during COVID-19 to address this issue.[49] It included on-demand e-learning sessions and distributed online and paper-based cartoons about stroke risk factors and symptoms to students and their parents/guardians.[49]

In terms of the next step of the pathway; raising the alarm, almost half of the included stroke survivors travelled to the hospital by car. This is consistent with an Irish study conducted pre and post introduction of the F.A.S.T. campaign.[46]

Table 4 Recommendations Made by Interview Participants for Future Acute Stroke/TIA Care Delivery

Stage in Stroke/ TIA Survivor Journey	General Recommendation	Crisis specific Recommendation
1. Symptom recognition	• Continuous educational campaigns to raise aware of stroke/TIA symptoms and appropriate actions	• Nuanced messaging needed in terms of seeking healthcare during pandemics especially for time-critical and life-threating conditions
1. Prehospital phase of care	• Encourage bystanders to call an ambulance rather than attending GP • More sensitive prehospital stroke screening tools and triage system	• Protocols surrounding staffing levels

(*Continued*)

Table 4 (Continued).

Stage in Stroke/ TIA Survivor Journey	General Recommendation	Crisis specific Recommendation
1. Hospital phase of care	• Providing timely and continuous information to stroke/TIA survivors throughout their hospital stay • Crisis telehealth options if suitable for the indication and the individual	• Make efforts to ensure stroke team members are kept within the stroke service • Consider models for retaining stroke survivors within stroke unit and not prioritising "COVID-19 care" and pathways if clinically appropriate • Consider methods of facilitating safe visiting rather than prohibiting the practice • Protecting sanctity of the stroke unit and identifying an alternative area for a COVID-19 ward • Protocols surrounding staffing levels

Prior to the campaign 47.1% of respondents stated they would call an ambulance, whereas post campaign 57.2% would have dialled 999.[46] However in England approximately two-thirds of acute stroke survivors are transported to hospital via emergency ambulance.[50] The perceived lack of ongoing education on time-dependent stroke treatments and the role of prehospital care may contribute to this.[51] Utilizing EMS expedites hospital arrival and increases the chances of receiving intravenous thrombolysis, partly because ambulance crews can perform initial F.A.S.T. screening and pre-alert the hospital's stroke team.[51] During COVID-19, single-site studies in China and the USA noted an increased proportion of stroke/TIA survivors arriving via EMS.[52,53] Additionally, in these studies acute stroke patients arriving by private car tended to have less severe stroke presentations.[52,53]

Secondly, healthcare professionals in this study observed a decline and delay in stroke/TIA presentations during COVID-19, particularly during surges. This trend is reflected in an Irish[54] study and supported by evidence from Germany and the USA.[55,56] International evidence supports the Irish observation that sharpest declines and delays were reported during the first lockdown or wave.[19,57] Fear of contracting the virus prevented many from seeking treatment.[19,54–57] In Ireland the media featured articles from concerned doctors urging individuals with suspected strokes to seek hospital care while in the USA, the American Stroke Association also issued a statement with similar messaging.[58,59]

Thirdly, key barriers and facilitators to access and delivery were identified throughout the patient journey. All participants groups discussed how family can act as a motivator for timely hospital presentation. The presence or absence of family affecting timely stroke presentation is well studied in the literature.[60–63] Furthermore, stroke/TIA survivors spoke of atypical presentation delaying their recognition of stroke/TIA symptoms and thus hospital presentation. HCPs echoed this observation, discussing how unusual stroke symptoms can lead to delayed presentation at the hospital. Atypical presentation or "stroke mimics" are known factors that can result in stroke/TIA survivor delayed access to appropriate acute stroke care for survivors.[63,64]

Fourthly, stroke/TIA survivors and caregivers discussed strengths and limitations of communication with the stroke team. Although some healthcare professionals acknowledged the importance of consistent communication throughout the patient journey, most concentrated on the acute stroke pathway itself. This is consistent with other studies conducted in Peru and Ireland, where improved information provision was a key priority for stroke survivors.[65,66]

Finally, visitor restrictions during the COVID-19 pandemic was an emotive issue, raised by all three groups, with varied perspectives. HCPs discussed the purpose, evidence, and implications of these policies. Further international studies support this, reporting the distress clinicians felt when denying family visits, especially during end-of-life situations.[67–69] Stroke/TIA survivors and caregivers described the personal impact of these restrictions. They suggested adopting a patient-centered, nuanced approach to visitor policies, based on clinical judgment.[67,70,71] Other studies suggest considering factors such as clinical setting, patient demographics, visitor adherence to protective measures, screening protocols, community transmission rates, and vaccination status.[67,71] However it is acknowledged that achieving the

balance between public health safety and patient-centred care was challenging during the first pandemic in one hundred years, but lessons learned should inform future policies.

Strengths and Limitations

This study's strength lies in its generation of rich qualitative data from stakeholders across the chain of survival, from symptom presentation to emergency hospital care. Furthermore, unlike preceding studies, this study included experiences from the five waves of COVID-19 in Ireland (March 2020 – February 2022). The patient journey mapping approach, at surface level may appears descriptive. However it is offering a comparison or interpretation of what happened in stroke care in comparison to the recommended time periods for presentation in the stroke chain of survival. These maps visualize these comparisons, highlighting patient interactions with the system and differences between waves. However, certain limitations should be noted. Firstly, participants were recruited from one healthcare region in Ireland. However this region encompasses all types of stroke-receiving hospitals nationwide, suggesting representativeness. Secondly, the "Hawthorne effect" poses a documented limitation, wherein individuals may enhance performance or behaviour due to being observed during research.[72] Furthermore recall bias may be present due to participants recounting strokes/TIAs or experiences of providing acute stroke care up to two years prior to the interview. However, participants expressed confidence in accurately recalling details due to the gravity of the event, aided by dyad interviews and time for reflection. Finally, the inclusion/exclusion criteria may have introduced selection bias, excluding stroke survivors unable to consent or with communication impairments, as well as those with severe disabilities or who died. Consequently, their caregivers were also excluded. A strength of the study was maximum variation sampling to capture diverse stroke survivor experiences with rich contextual detail of the setting and participants reported. Including this detail enables the reader to assess the transferability of the analysis to their own context or setting.[73]

Future Research

Further research is necessary to understand the enduring effects of various aspects of the COVID-19 pandemic, such as visitor restrictions. The delay in delivering appropriate treatment for stroke is a significant concern, as it can adversely affect stroke outcomes in the long term. Individuals who survived a stroke during this period may be grappling with additional challenges stemming from the pandemic, potentially leading to unmet long-term needs. Finally, research investigating experiences, patterns, and trends for acute stroke care during later stages of COVID-19 and post-COVID-19 are required, as current literature is mainly limited to pre-COVID-19, and early COVID-19 waves.

Conclusion

This study offers detailed insights into the variety of challenges and adaptations made in the provision and reception of care during such a critical time. Although some differences emerged between different stakeholder groups overall it was clear that acute stroke care was still provided during the COVID-19 pandemic, albeit in an adapted manner. Moreover, our findings illuminate the multifaceted nature of factors influencing hospital presentation, encompassing personal, healthcare system, and COVID-specific factors. Although certain experiences and processes were directly related to COVID-19, others were also relevant to routine acute stroke care. Understanding these dynamics is vital for optimising stroke care delivery and ensuring timely access to treatment, even amidst unprecedented challenges posed by pandemics.

Ethics Approval and Informed Consent

Ethical approval for this study was granted by the Clinical Research Ethics Committee of the Cork Teaching Hospitals on 9th March 2023 (reference:ECM 4 (o) 14/02/2023 and ECM 5 (7) 21/02/2023 and ECM 3 (hh) 28/03/2023) for stroke/TIA survivor, caregiver, and hospital-based healthcare professional participants. Ethical approval for the prehospital-practitioner participants was granted by the Health Service Executive Reference Research Ethics Committee for Midlands Area and Corporate (reference RRECB0323CB 31/03/2023).

This study complies with the Declaration of Helsinki. Participants' informed consent included publication of anonymised direct quotes.

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Author Contributions

All authors made a significant contribution to the work reported, whether that is in the conception, study design, execution, acquisition of data, analysis and interpretation, or in all these areas; took part in drafting, revising or critically reviewing the article; gave final approval of the version to be published; have agreed on the journal to which the article has been submitted; and agree to be accountable for all aspects of the work.

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