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## Original Article

# Practice Variation among Canadian Stroke Prevention Clinics: Pre, During, and Post-COVID-19

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**ABSTRACT:** ***Background:*** Stroke is a common and serious disorder. With optimal care, 90-day recurrent stroke risk can be reduced from 10% to about 1%. Stroke prevention clinics (SPCs) can improve patient outcomes and resource allocation but lack standardization in patient management. The extent of variation in patient management among SPCs is unknown. Our aims were to assess baseline practice variation between Canadian SPCs and the impact of COVID-19 on SPC patient care. ***Methods:*** We conducted an electronic survey of 80 SPCs across Canada from May to November 2021. SPC leads were contacted by email with up to five reminders. ***Results:*** Of 80 SPCs contacted, 76 were eligible from which 38 (50.0%) responded. The majority (65.8%) of SPCs are open 5 or more days a week. Tests are more likely to be completed before the SPC visit if referrals were from clinic's own emergency department compared to other referring sources. COVID-19 had a negative impact on routine patient care including longer wait times (increased for 36.4% clinics) and higher number of patients without completed bloodwork prior to arriving for appointments (increased for 27.3% clinics). During COVID-19 pandemic, 87.9% of SPCs provided virtual care while 72.7% plan to continue with virtual care post-COVID-19 pandemic. ***Conclusion:*** Despite the time-sensitive nature of transient ischemic attack patient management, some SPCs in Canada are not able to see patients quickly. SPCs should endeavor to implement strategies so that they can see high-risk patients within the highest risk timeline and implement strategies to complete some tests while waiting for SPC appointment.

**RÉSUMÉ : Variation des pratiques dans les cliniques canadiennes de prévention des AVC : avant, pendant et après la pandémie de COVID-19.** ***Contexte :*** Les AVC sont des affections courantes et graves. Avec des soins optimaux, le risque de récidive d'un AVC pendant une période de 90 jours peut être réduit de 10 à environ 1 %. Les cliniques de prévention des AVC (CPAVC) peuvent améliorer l'évolution de l'état de santé des patients et l'allocation des ressources, mais elles manquent de pratiques standardisées en matière de prise en charge des patients. L'étendue de la variation de ces pratiques parmi les CPAVC demeure inconnue. Notre objectif a donc consisté ici à évaluer la variation de ces pratiques au sein des CPAVC canadiennes et à mesurer l'impact de la pandémie de COVID-19 sur les soins prodigués aux patients. ***Méthodes :*** Pour ce faire, nous avons mené de mai à novembre 2021 un sondage électronique auprès de 80 CPAVC situées partout au Canada. À noter que les responsables de ces cliniques ont été contactés par courriel avec jusqu'à cinq rappels. ***Résultats :*** Sur 80 CPAVC contactées, 76 étaient admissibles ; 38 d'entre elles (50,0 %) ont répondu. La majorité (65,8 %) des CPAVC sont ouvertes cinq jours ou plus par semaine. Des tests de dépistage d'une infection à la COVID-19 sont apparus plus susceptibles d'être effectués avant de visiter ces établissements si les patients avaient été orientés par le service des urgences de la clinique plutôt que par d'autres sources. La pandémie de COVID-19 a également eu un impact négatif sur les soins de routine prodigués aux patients, notamment des temps d'attente plus longs (36,4 % des CPAVC) et un nombre plus élevé de patients n'ayant pas effectué d'analyses sanguines avant leur rendez-vous (27,3 % des CPAVC). Pendant la pandémie de COVID-19, il est à noter que 87,9 % des CPAVC ont fourni des soins virtuels et que 72,7 % d'entre elles prévoient de continuer à le faire après la pandémie de COVID-19. ***Conclusion :*** Bien qu'une prise en charge rapide de ces patients soit importante, certaines CPAVC au Canada ne sont pas en mesure de les voir rapidement. Elles devraient ainsi s'efforcer de mettre en œuvre des stratégies leur permettant de voir les patients à haut risque dans des délais plus courts et d'adopter des stratégies pour effectuer certains tests de dépistage en attendant un rendez-vous.

**Keywords:** Transient ischemic attack; Rapid access clinics; Neck imaging; Timing of tests; TIA patient management; COVID-19 impact; Virtual care; Telemedicine; Telehealth

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## Introduction

Stroke is a common disorder and a leading cause of death and disability worldwide.[1] Transient ischemic attack (TIA) or minor stroke patients (here onwards just called TIA) are at elevated risk of a subsequent stroke in the days to weeks following their initial event.[2,3] Up to 10% of patients with TIA will have a subsequent stroke within 90 days without urgent care, but with optimized treatment this risk can be reduced to about 1%.[4,5] The urgency and level of care provided for TIA patients often depends on the perceived risk of subsequent major stroke.[6,7] Traditionally, and still in some parts of the world, TIA patients were admitted to hospital for rapid investigation and comprehensive management.[8] In an effort to optimize health resource utilization with improved patient outcomes, outpatient-based models have been introduced.[8–11] A stroke prevention clinic (SPC) is a specialized outpatient clinic that provides rapid access to experts, diagnostic tests, and treatments. Such clinics are meant to provide an integrated, comprehensive, and interdisciplinary approach to stroke prevention in a timely manner.

In Canada, the Canadian Stroke Best Practice Recommendations (CSBPR) provide guidelines for the prevention and management of stroke.[12] However, we suspect that they are not always followed, for varying reasons, leading to variation in how patients with suspected TIA are identified and managed.[13,14] For example, although CSBPR suggests managing high-risk patients within 48 hours of symptom onset, we suspect that not all organizations meet this recommendation. From information-gathering interviews with local neurologists (key informants), we found that some SPCs might (a) be open limited hours a week, (b) triage patients without assessing and considering risk levels, (c) have protocols in place to have patients complete some tests prior to their clinic appointment, (d) have long wait times for some tests which varies depending on referring source, and (e) lack urgent communication protocols between SPCs and radiology departments. The extent of variation in practice is unknown. Understanding the extent of variation in practice can help develop or modify strategies and guidelines to standardize practices across SPCs which may ultimately reduce the incidence of subsequent stroke.

To understand the extent of variation we conducted a survey of all Canadian SPCs. Prior to implementing the survey, the COVID-19 pandemic started and so we modified our questionnaire to include additional items to understand the impact of the COVID-19 pandemic on TIA patient management.

The aims of this study were twofold: (1) to describe variation in management practices for TIA patients and (2) to characterize the impact of the COVID-19 pandemic on the management of TIA patients including the use of virtual care by the SPCs.

## Methods

### Study Design and Participants

We conducted a self-administered electronic survey of SPCs in Canada. To be eligible, the respondents must have been physician leads, managers, or coordinators at any of the SPCs in Canada. A list of SPCs was provided by the Heart and Stroke Foundation of Canada from which we identified 80 unique SPCs as of May 5, 2021. We obtained the contact information of the person running each SPC using web searches and by calling the clinics. The study was conducted from May 2021 through November 2021. We designed the survey following Dillman's techniques.[15] This study has received Ottawa Health Science Network Research Ethics Board approval.

### Questionnaire Development

We developed the questionnaire in three stages. First, we conducted telephone interviews with key informants to gather information to prepare a draft survey questionnaire. Second, we conducted cognitive interviews (assessing participants' understanding of the questionnaire as they complete each question) to evaluate the clarity, comprehensibility, and face validity of each question in the draft survey. Third, we pilot tested the draft survey questionnaire using a smaller subsample of the SPCs to assess the whole questionnaire and the survey process.[15]

The final questionnaire included 36 questions. Questionnaires consisted of an eligibility question, information about clinic hours of operation and scheduling (14 items), medical imaging (13 items), bloodwork and medications (three items), impact of the COVID-19 pandemic (five items), and additional information (one item). To improve response rate, most items (including questions on wait times) were designed as closed-ended questions where respondents' answers were limited to a fixed set of responses. The questionnaire was developed with attention to clarity regarding question applicability to the pre-pandemic period. The questionnaire, landing page, recruitment, and reminder emails were translated into French by a medical translator.

### Survey Administration

The survey invitation was personalized for each SPC so that the lead's name was inserted on all emails along with a unique link for each clinic. Every email and the landing page of the survey included names of the lead principal investigators, contact information, and affiliations, as an indication of a legitimate source.

We pilot tested the survey on 15 SPCs across the provinces and territories. After revising the survey questionnaire for clarity and verifying the feasibility of the process (i.e., our survey questions were answered as intended), invitations were distributed to the remaining 65 SPCs.

The survey was initiated with a recruitment email containing both official languages (English and French) and links to the survey powered by SurveyMonkey (www.surveymonkey.com). A reminder email along with links to the survey questionnaire was emailed every week to non-responders for up to 4 weeks. A final reminder was initiated 2 weeks after the last email reminder by calling the clinic. Several attempts were made to reach clinics by telephone over a period of 3 weeks.

### Data Analysis

We calculated descriptive statistics to characterize the SPC responses. Continuous variables were expressed as mean and standard deviation or median with interquartile ranges (IQR), while categorical data were expressed as frequencies and percentages. We used boxplots to help visualize the distribution of some of the continuous variables. Chi-squared tests were conducted to compare the geographic region (Western Canada, Ontario, and Eastern Canada) of respondents and non-respondents to examine the possibility of non-response bias. We used Fisher's exact test to study the association between seeing high-risk patients within 48 hours and number of days clinics are open. Two-sided significance tests were set at an alpha level of 0.05.

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We grouped data based on referring source and other characteristics to organize the results. To reduce the number of items in the tables, we combined categories with sparse numbers. Data were analyzed using SAS version 9.4 (SAS Institute, Cary, North Carolina, USA) and R version 4.0.5 (R Foundation for Statistical Computing, Vienna, Austria).

## Results

Of 80 SPCs invited, four indicated they were ineligible (by answering "no" to the question: "are you the physician lead or coordinator/manager of the SPC or answering on his/her behalf?"). Of the remaining 76 SPCs, 38 (50.0%) completed the electronic survey (including eight from the pilot survey and four from final phone reminders). Five respondents provided partial responses.

Table 1 describes the structure of the SPCs. The clinics were open from half a day per week (2.6%) up to 7 days per week (2.6%) with about a quarter (26.3%) being open 2 days or fewer per week. Two-thirds (63.2%) of the clinics were open 5 days a week. Clinic hours varied from less than 4 hours to more than 12 hours per day. Table 2 shows that there is a significant difference in being able to see most high-risk TIA patients within 48 hours and how many days the clinics are open during the week. A small portion (10.5%) of the clinics do not accommodate urgent patients. Patient referrals to the clinics are mostly from their own emergency departments (EDs) (median percentage of patients referred (IQR): 50 (40–70)) followed by family physicians (median (IQR): 20 (15–30)). The initial diagnosis of TIA was confirmed less often when the referral was from family physicians (median (IQR): 30 (20–50)) compared to the organization's own ED, other EDs, or other specialists. Except for one clinic (2.6%), all the clinics use an appointment system that considers patient risk level. The clinic that does not consider risk levels normally sees all patients within a week. For clinics that do consider patient risk levels, the wait times for low-risk patients are within 30 days for 64.8% of SPCs. Wait times for high-risk patients are within 24 hours for 8.1% of SPCs and between 1 and 2 days for 29.7% of SPCs. We found that 29.0% of the clinics do not a have a protocol in place to consult neurology while the patient is in the ED while 32.3% consult neurology for high-risk patients only. We found 60.0% of the organizations admit patients for revascularization directly from the ED. Two clinics are not able to bypass normal wait times for vascular imaging for urgent cases.

To test for the possibility of non-response bias, we compared the geographic region (Western Canada, Ontario, and Eastern Canada) of respondents and non-respondents. Chi-squared analysis showed no indication of a significant difference ($p$ value: 0.17) in responses when we compared the regions (Table 3). We did not have other characteristics to test for non-response bias.

Figure 1 provides the proportion of patients with completed tests at the SPC assessment. When referrals were from the organization's own ED, most tests were already completed. There was more variation for family physician and other specialist referrals. MRI, 24-hour heart rate monitoring, and echocardiogram were the least likely to be completed at the time of SPC assessments.

Duration of waiting times for test results is as follows: for CT, 77.8% within 24 hours and 11.1% between 1 and 7 days; for MRI, 43.8% within 24 hours and 31.3% between 1 and 7 days; for Doppler ultrasound 51.6% within 24 hours and 25.8% between 1 and 7 days; for echocardiogram 15.2% within 24 hours while 36.4% between 1 and 7 days; for Holter 30.3% between 1 and 7 days

**Table 1:** Characteristics of stroke prevention clinics

| Information | Number (%) ($N = 38$) |
|---|---|
| Professionals involved in care at clinic | |
| Neurologists | 17 (44.7) |
| Nurse practitioner/specialists | 17 (44.7) |
| Internists | 16 (42.1) |
| Stroke neurologists | 15 (39.5) |
| Registered nurses | 11 (29.0) |
| Vascular surgeons | 4 (10.5) |
| Others | 4 (10.5) |
| Family physicians | 1 (2.6) |
| Geriatricians | 0 (0.0) |
| Days per week clinic is open | |
| ½ | 1 (2.6) |
| 1 | 5 (13.2) |
| 2 | 4 (10.5) |
| 3 | 1 (2.6) |
| 4 | 2 (5.3) |
| 5 | 24 (63.2) |
| 6 | 0 (0.0) |
| 7 | 1 (2.6) |
| Hours per day clinic is open | |
| <4 | 5 (13.2) |
| 4–8 | 30 (79.0) |
| 9–12 | 2 (5.3) |
| >12 | 1 (2.6) |
| Number of patients seen each day clinic is open, median (IQR) | 7 (5–15) |
| Distribution of patient referrals, median (IQR) | |
| Own ED | 50 (40–70) |
| Other ED | 15 (7–20) |
| Family physicians | 20 (15–30) |
| Other specialists | 5 (5–15) |
| Initial diagnosis confirmed as a TIA by referral, median (IQR) | |
| Own ED | 50 (30–70) |
| Other ED | 50 (20–60) |
| Family physicians | 30 (20–50) |
| Other specialists | 50 (20–60) |
| No capacity for add-on urgent patients | 6 (15.8) |
| Triaging system | |
| No appointments, first-come first-served basis | 0 (0.0) |
| Appointment system without considering risk levels | 1 (2.6) |
| Appointment system that considers risk level | 37 (97.4) |
| Wait times for appointment system that considers risk level | |
| Low risk: | |
| <24 hours | 0 (0.0) |
| <7 days | 4 (10.8) |

(*Continued*)

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**Table 1:** (*Continued*)

| Information | Number (%) ($N = 38$) |
|---|---|
| <14 days | 8 (21.6) |
| <30 days | 12 (32.4) |
| <3 months | 10 (27.0) |
| >3 months | 2 (5.4) |
| High risk: | |
| <24 hours | 3 (8.1) |
| <2 days | 11 (29.7) |
| <3 days | 8 (21.6) |
| <4 days | 1 (2.7) |
| <5 days | 3 (8.1) |
| <6 days | 0 (0.0) |
| <7 days | 4 (10.8) |
| <14 days | 6 (16.2) |
| >14 days | 0 (0.0) |
| ED has a protocol to consult neurology | |
| Yes, routinely | 11 (35.5) |
| Yes, only high-risk patients | 10 (32.3) |
| Not routinely | 9 (29.0) |
| Missing | 1 (3.2) |
| Admit patients for revascularization directly from the ED | 18 (60.0) |
| Modalities most often used for vascular imaging | |
| Computed tomography angiography (CTA) | 30 (79.0) |
| Doppler | 14 (36.8) |
| Magnetic resonance angiography (MRA) | 0 (0.0) |
| Clinic is notified immediately by radiology with important results, such as >50% stenosis | 14 (36.8) |
| For urgent cases, clinic cannot bypass normal wait times | 2 (5.3) |
| Holter monitor duration normally requested | |
| 24 hours | 7 (18.4) |
| 48 hours | 8 (21.1) |
| 72 hours | 2 (5.3) |
| 7 days | 3 (7.9) |
| 14 days | 9 (23.7) |
| >14 days | 4 (10.5) |
| Missing | 5 (13.2) |

ED, Emergency Department; IQR, interquartile range; TIA, transient ischemic attack.

and 33.3% between 8 and 14 days; for bloodwork 45.5% within 24 hours and 45.5% between 1 and 7 days (Figure 2).

### *Virtual Care and Impact of COVID-19 Pandemic on TIA Stroke Patient Management*

Prior to the COVID-19 pandemic, 13 (39.4%) of the 33 SPCs were providing virtual care on a limited basis. During the pandemic, all but 4 (12.1%) SPCs were providing virtual care, with 60.6% providing virtual care for more than half of their patients; 15.2% of the clinics operated only virtual clinics. Among the 29 clinics that provided virtual care to patients during the pandemic, 20.7% of the clinics provided virtual care to all patients, 41.4% provided virtual care for low to medium-risk patients, and 31.0% provided virtual care for follow-ups and new consultations (Table 4). A large percentage (72.7%) of the 33 clinics plan to provide virtual care post-COVID-19 pandemic (Figure 3).

**Table 2:** Association between seeing high-risk patients within 48 hours and number of days clinics are open

| | Most high-risk patients seen within 48 hours | Most high-risk patients not seen within 48 hours | *p* value* |
|---|---|---|---|
| Days open/week | | | |
| ≥4 days | 13 (92.9) | 12 (54.6) | 0.025 |
| ≤3 days | 1 (7.1) | 10 (45.5) | |

Data are reported as number (%) of stroke prevention clinics.
**p* value obtained using Fisher's exact test.

Figure 4 shows the impact of the COVID-19 pandemic on SPCs patient management. Compared to pre-COVID period, the most impacted services by the COVID-19 were the number of referrals from family physicians (declined for 36.4% clinics), wait times once a patient was referred to the clinic (increased for 36.4% clinics), number of patients having already completed bloodwork prior to arriving for their appointment (declined for 27.3% clinics), number of referrals from the clinic's own ED (increased for 24.2% clinics), and proportion of true TIA patients versus mimics (increased for 24.2% clinics).

## Discussion

### *Summary of Main Findings*

We found substantial variation among SPCs in management practices such as hours of operation, duration of wait times to see high-risk patients, capacity for add-on urgent patients, tests completed prior to SPC appointment, time for results, and referrals of patients with incorrect diagnosis of TIA. Although time is essential for TIA patient management, most high-risk patients are not seen by the clinics within 2 days, the highest risk period. To compensate for this, most are not seen routinely in the ED by neurology either. Thus, many of the high-risk patients are not being seen quickly enough within 48 hours to meet existing recommendations. SPCs also reported that on average about half of the patients are incorrectly diagnosed and referred to the clinics; thus, impacting wait times for true TIA patients. Wait times for testing are often short except for echocardiogram and Holter. There is a significant variation in the duration of Holter monitoring.

We found a substantial impact of COVID-19 on clinic routines. There was a substantial decline in referrals to SPCs, especially from family physicians, increase in wait times for appointments and test results, and a decline in TIA mimic referrals. While a small portion of SPCs were making use of virtual care prior to COVID-19, a significant portion of the clinics are planning to use virtual care post-COVID-19.

### *Interpretations*

TIA is a medical emergency that requires urgent management to prevent subsequent stroke. The risk of stroke is greatest in the first

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**Table 3:** Chi-squared tests of non-response bias

| Characteristic | Respondents, *n* (%) | Non-respondents, *n* (%) | *p* value |
|---|---|---|---|
| Region | | | |
| Western Canada[a] | 9 (23.7) | 14 (36.8) | 0.172 |
| Ontario | 20 (52.6) | 12 (31.6) | |
| Eastern Canada[b] | 9 (23.7) | 12 (31.6) | |

[a]British Columbia, Alberta, Saskatchewan, Manitoba.
[b]Quebec, New Brunswick, Nova Scotia, Newfoundland, Prince Edward Island.

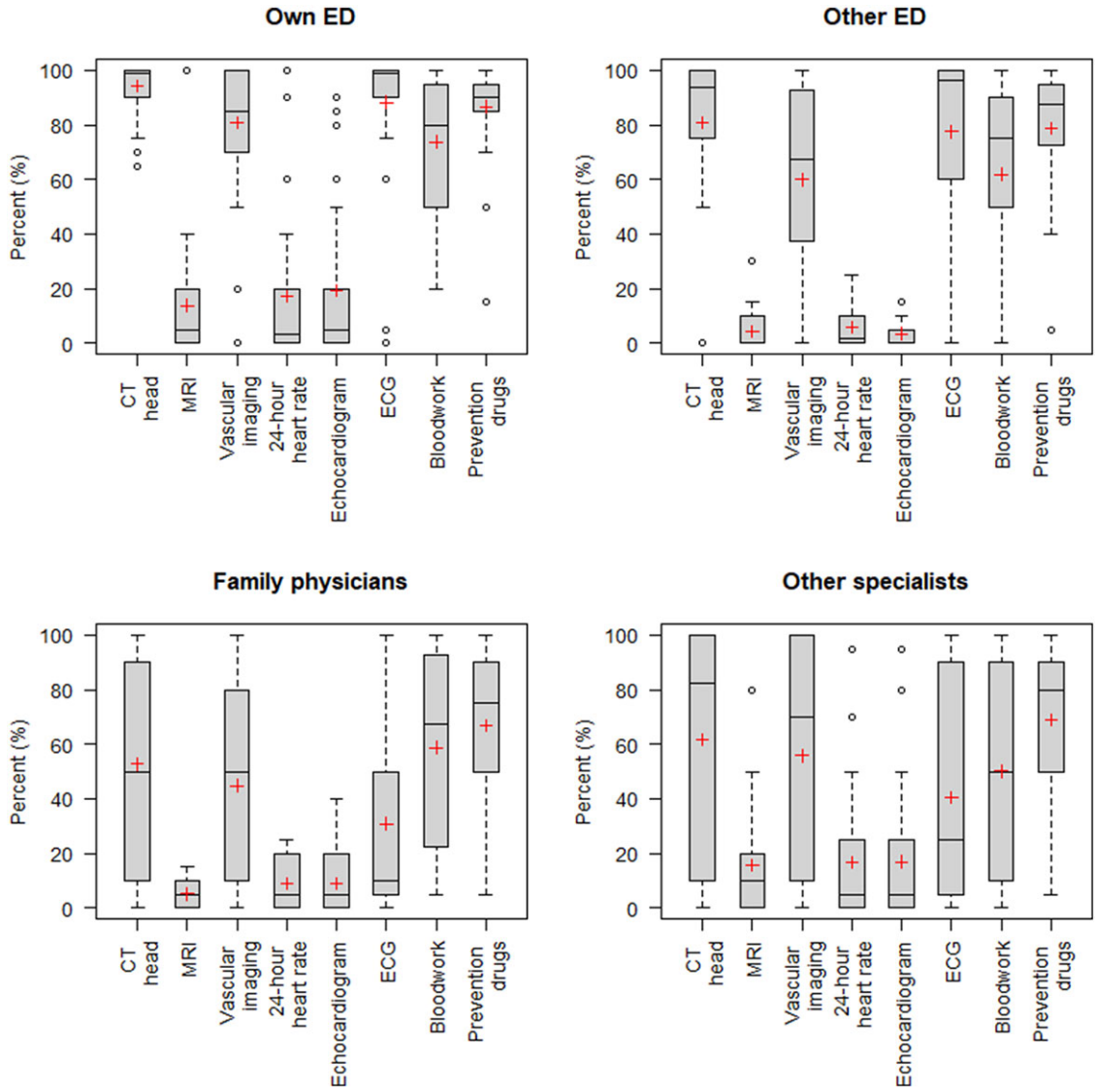


**Figure 1:** Percentage of patients having already completed a test by the time they arrive at the stroke prevention clinic, by referring source.

few days after a TIA with stroke rates as high as 8% within the first 2 days of TIA.[2] Hence, there is need for urgent intervention depending on stroke risk level. Admission of all patients is an inefficient use of health resources.[16] Our data show that a significant percentage of SPCs are open 3 days or fewer per week with a quarter only open 2 days or less per week. We suspect that the clinics opening three or fewer days per week are situated in low-populated areas, such as remote or rural areas. Our results show clinics open 3 or fewer days a week are unable to see most of their high-risk patients within 48 hours. A possible explanation for this is that there might be a high volume of referrals to the clinics but not enough resources to open the clinics more often. About half of the clinics open 4 or more days per week are also unable to see most of their high-risk patients within 48 hours.

Referrals to SPCs are initiated from EDs, family physicians, or specialists. Referrals should be triaged based on patient's risk of

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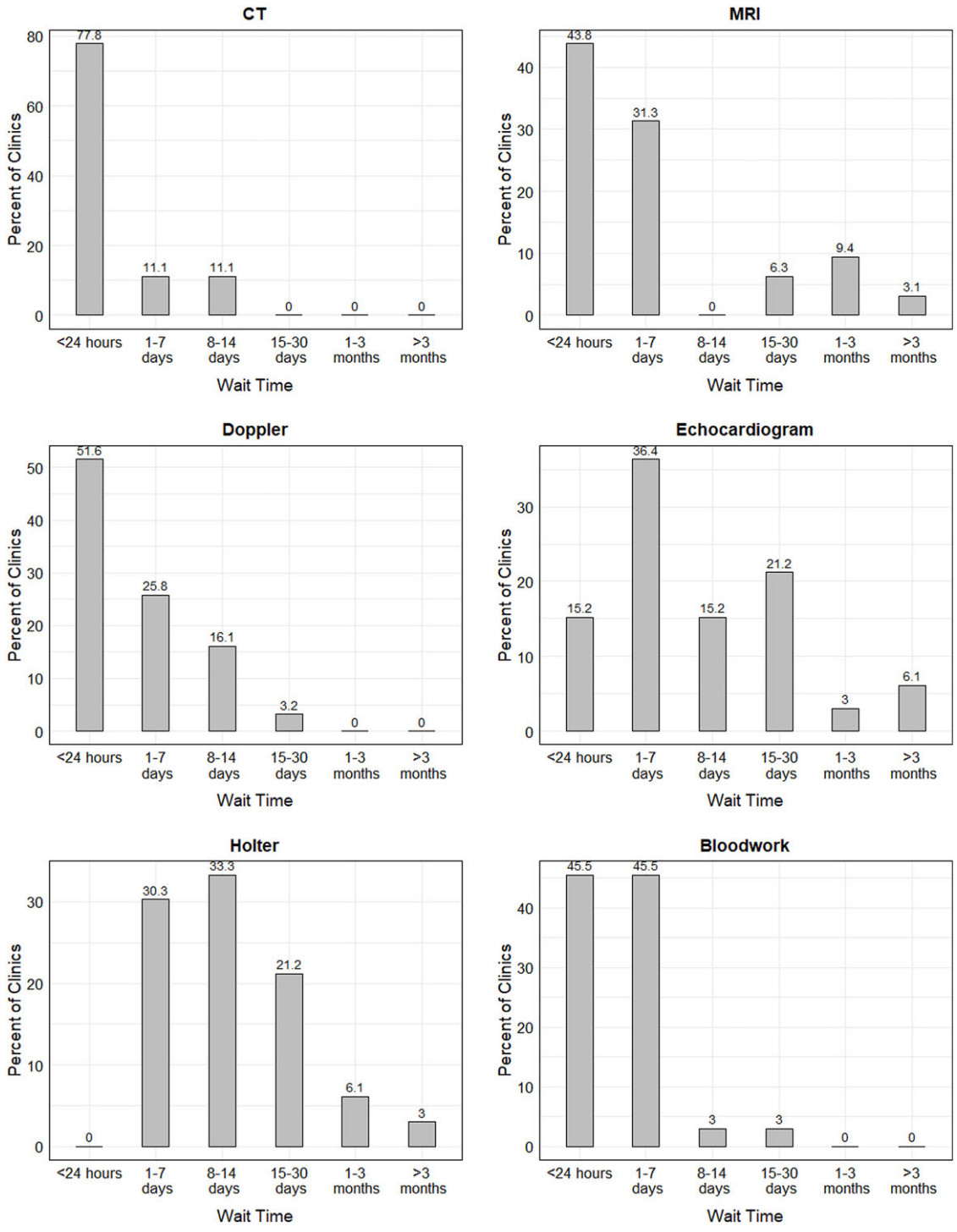


**Figure 2:** Time required for results to become available.

subsequent stroke. Advanced clinical prediction rules, such as the Canadian TIA Score, have been developed and validated for identifying low, medium, and high-risk patients.[17,18] Other clinical prediction rules have been developed and validated for identifying low-risk and high-risk patients including the ABCD$^2$ and ABCD$^2$i Scores.[19–21] However, there are some limitations with clinical prediction rules such as accuracy and non-availability of all the factors during the referral.

In Canada, national guideline recommendations have been developed by Heart and Stroke Foundation of Canada for the management and treatment of TIA patients.[12] All patients suspected with TIA should complete neurologic and cardiac examination including imaging, bloodwork, electrocardiogram, echocardiogram for select patients and, if no etiology found extended cardiac monitoring.[22–24] TIA patients require optimization of antithrombotic agents (anticoagulants or antiplatelets) and prompt carotid revascularization for symptomatic carotid artery stenosis if present.[22] The Canadian Stroke Best Practice Recommendations are not always followed, for varying and possibly valid reasons, leading to variations of practice. Not adhering

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**Table 4:** Extent of virtual care

| | Number (%) ($N = 33$) |
|---|---|
| During COVID-19 Pandemic virtual care provided to (if applicable) | |
| All patients | 6 (20.7) |
| Most low-risk patients only | 5 (17.2) |
| Most low to medium-risk patients only | 7 (24.1) |
| Follow-ups | 7 (24.1) |
| New consults and follow-ups | 2 (6.9) |
| At patient request | 2 (6.9) |
| Plans for virtual care post-COVID-19 pandemic | |
| For most patients | 3 (9.1) |
| For most low-risk patients only | 9 (27.3) |
| Follow-ups | 4 (12.1) |
| New consults and follow-ups | 2 (6.1) |
| At patient request | 5 (15.2) |
| Physician preference | 1 (3.0) |
| No | 9 (27.3) |

Five clinics did not answer questions related to COVID-19 and were excluded from the denominator.

to the guidelines might be out of the control of SPC personnel such as competing priorities.

Having tests completed prior to the SPC appointment could expedite diagnosis and treatment. Our data show investigations were often done prior to SPC assessment for referrals from the organization's own ED. There was less variation among the organization's own EDs while there was a wide variation among family physicians and specialists. This shows that there are likely better protocols in place for the organization's own ED while there is less coordination for inter-organizational referrals. Standardization of community referrals may help decrease variability. However, we acknowledge that it would be challenging to reach and impose standardized referrals in some jurisdictions. In addition, unless a solution is found and implemented to reduce TIA mimics, diagnostic imaging departments could be swamped with test requests if all tests were to be completed for all patients prior to SPC appointments. At the clinics, there is also variation on when tests are ordered based on the structure of the clinic. In some clinics, patients are first seen by a doctor who risk stratifies the patients prior to ordering tests with priority given to high-risk patients while in some clinics tests are ordered first, irrespective of patient risk level, prior to seeing a medical doctor. Hence, the variation in test wait times shown by our results could be due to the structure of the clinics.

Misdiagnosis of TIA is common with an estimated 50% of all TIA patients being stroke mimics.[25–27] With such high misdiagnosis rates, there is potential for delay in care for patients at high risk of stroke. However, TIA is a complex medical emergency with multiple risk factors making it challenging to diagnose, especially in resource- and time-limited settings. In addition, reliability of reporting the events experienced by the patients may vary, leading to subjective diagnosis, even among stroke neurologists.[28–30] Furthermore, TIA patients with mimics still require timely diagnosis and management. Derivation and guidelines on use of clinical prediction rules to identify stroke mimics could potentially allow for faster assessments for higher risk patients. Several prediction rules for the diagnosis of TIA/stroke mimics (e.g., DOT score, Dawson score) have been derived but not adequately validated.[31–33]

A significant percentage of the SPCs turned to virtual care during the COVID-19 pandemic. Although most clinics did not use virtual care prior to the pandemic, most clinics are planning to continue using virtual care post-COVID-19. It is likely that the virtual care has helped reduce a load on the SPCs and opened capacity for high-risk patients.

## Comparison with Previous Literature

Given the urgency and risk of TIA patients, SPCs need to be accessible. Similarly, all clinics should have a triaging system. Two studies, by Wasserman *et al* and Martinez-Martinez *et al*, have shown stroke risk reduction with risk stratification and referrals to SPCs.[10,34] The study by Martinez-Martinez and colleagues reported a median wait time of 1.5 days to SPCs which is shorter in duration than shown by our study. Although the study by Wasserman and colleagues reported that most patients were seen within 48 hours in the ED, they did not report the time it takes from ED to SPC appointment. Wasserman and colleagues showed that neurology was consulted in the ED for only 5% of patients compared to more than 32% reported by our study.

Our results show that the COVID-19 pandemic had a significant impact on TIA patient management. During the pandemic, the proportion of referrals from family physicians declined while the referrals increased from EDs. This was likely due to family physician clinics being closed. It could have also been due to patients not seeking medical help unless they deemed it an emergency. Other studies have found similar findings in reduction of patients during the pandemic period with similar conclusions.[35–41] Also in agreement with our study, a study by Dowlatshahi and colleagues showed a drop in presentation rates to a comprehensive stroke centre in Ottawa, Canada at the beginning of the pandemic.[42] Similarly, a study by D'Anna showed a decline of referrals to North West London, UK SPC clinics during the COVID-19 pandemic.[43] Our study found the proportion of true TIA patients versus mimics increased during the pandemic. Patients with milder stroke symptoms may have intentionally avoided seeking medical care during the COVID-19 pandemic while the patients with more severe cases, such as symptoms due to large vessel occlusion, sought medical help as these more severe symptoms are less likely to be ignored by patients or family members.[38,43] Another study by D'Anna also observed this marked decrease in mimic diagnoses during the pandemic.[40]

## Study Limitations

Despite our efforts to obtain high-quality data, the quality of responses may have been affected by the COVID-19 pandemic. Given that this was a self-reported questionnaire, respondents may have not answered all the questions accurately. Another limitation is that we had a limited set of characteristics to test for non-response bias.

## Clinical Implications

Despite the need for urgent assessment and management, there is delay in seeing some high-risk TIA patients within 48 hours. About a quarter of SPCs are open 2 or fewer days a week, leaving the possibility of some high-risk patients having to wait more than the 48-hour critical time for TIA patients depending on referral volumes.

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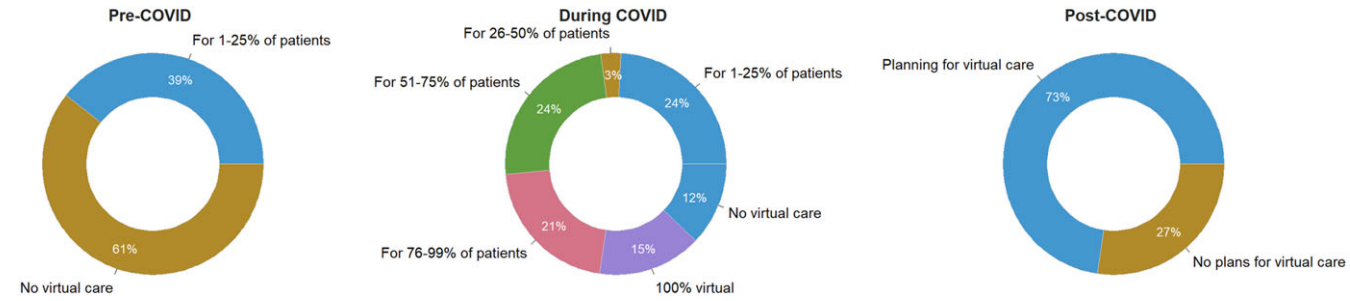


**Figure 3:** Percent of clinics using virtual care.

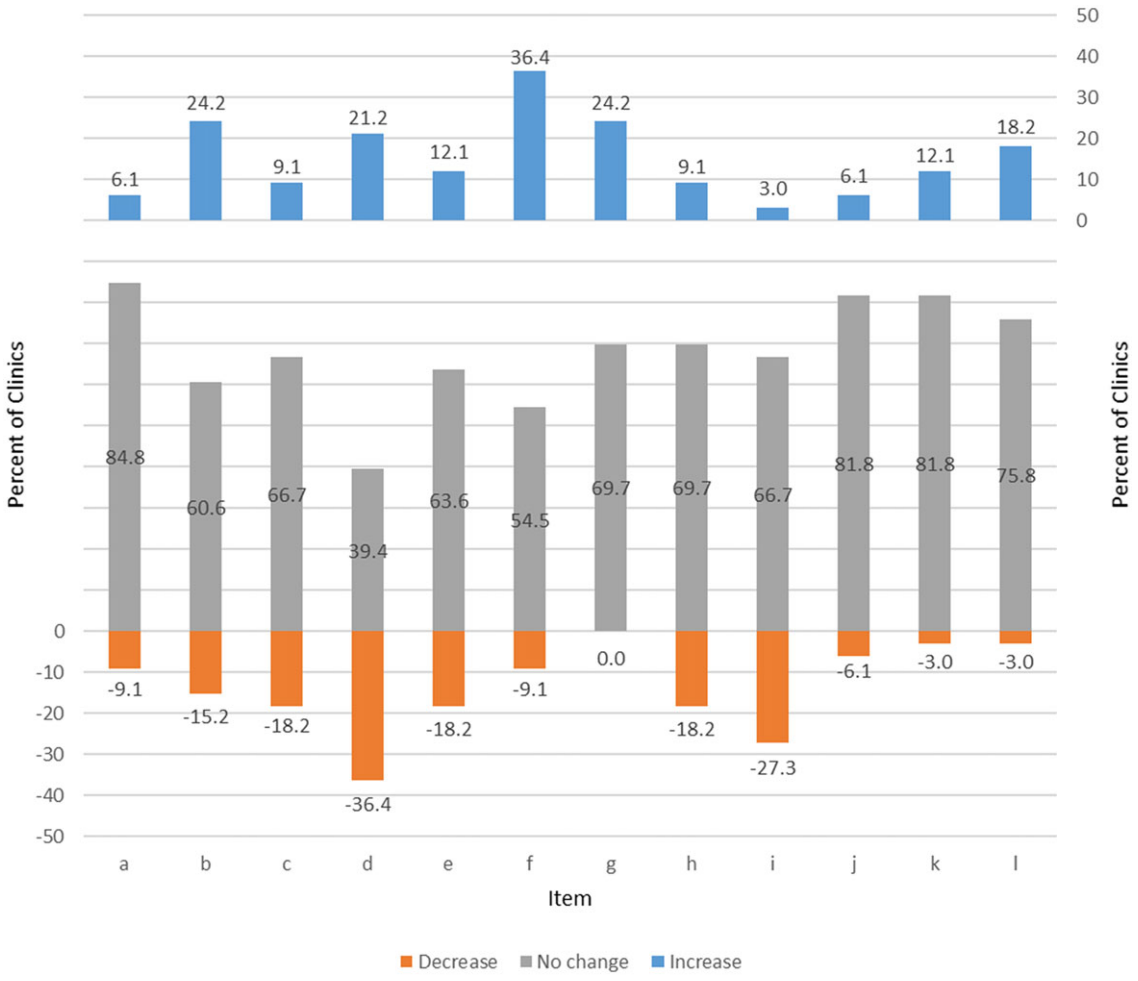


**Figure 4:** Impact of COVID-19 pandemic on clinic services (from pre-COVID to COVID period). a. Hours the clinic is physically open/week. b. Referrals from own emergency department. c. Referrals from other emergency departments. d. Referrals from family physicians. e. Referrals from other specialists. f. Wait times for an appointment once a patient is referred to clinic. g. Proportion of true TIA patients versus mimics. h. Patients having completed imaging prior to appointment. i. Patients having completed bloodwork prior to appointment. j. Patients already taking prevention drugs (e.g. anticoagulants and antiplatelet) prior to appointment. k. If patients need medical imaging done, time it takes to have the results. l. If patients need bloodwork done after arriving, time it takes to have the results. *One clinic did not answer items d, h, i, k, l; two clinics did not answer items c, e, g, j.

A significant percentage of patients referred to SPCs are stroke mimics taking resources from true TIA patients. Using a clinical diagnostic tool, such as the DOT score, after its external validation, could help minimize misdiagnosis of TIA. Stroke prediction tools, such as the Canadian TIA Score, are also important to prioritize high-risk patients.

### *Research Implications*

Our study has shown several gaps in knowledge of SPCs and how they function and interact with other stakeholders. We have also shown the impact of the COVID-19 pandemic on patient management. We have found that referrals from an SPC's own ED are

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better managed than from other EDs, family physicians, or specialists. Understanding the reasons behind these discrepancies could help improve referral systems. We have also shown that several clinics are open 3 or fewer days a week with a quarter being open 2 days or fewer each week and not being able to see most high-risk patients within 48 hours. Half of the clinics that do open 4 or more days are also struggling with seeing most of their high-risk patients. The reasons behind this deficiency and the outcomes of patients seeking medical help at these clinics need to be investigated and compared to other clinics. We suspect there would be more stroke outcomes for high-risk patients at these clinics having to wait longer than 48 hours due to limited clinic days. Clinic structure regarding testing first prior to assessment versus assessment first followed by testing on patient outcomes also needs to be investigated.

## Conclusion

TIA is a serious condition that requires urgent care, depending on the risk level. Outpatient SPCs have been setup to provide more efficient and effective care. Although there are guidelines on the management of TIA patients, they are not fully implemented leading to variations of practice. We suggest that SPCs investigate delays and attempt to see high-risk patients within 48 hours. We also suggest that better systems are put in place between SPCs and referring sources, especially family physicians, so that patients are risk classified and some test are completed prior to their appointments, as appropriate without causing further delays.

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**Statement of Authorship.** KEA, JJP, and MT designed the study. KEA conducted interviews, executed the surveys, conducted analyses, and wrote the draft manuscript. DD, IGS, and GAW provided input into the study design. All authors contributed to the final manuscript review.

## References

1. Latchaw RE, Alberts MJ, Lev MH, et al. Recommendations for imaging of acute ischemic stroke. Stroke. 2009;40:3646–78. DOI 10.1161/STROKEAHA.108.192616.
2. Giles MF, Rothwell PM. Risk of stroke early after transient ischaemic attack: a systematic review and meta-analysis. Lancet Neurol. 2007;6:1063–72. DOI 10.1016/S1474-4422(07)70274-0.
3. Easton JD, Johnston SC. Time to retire the concept of transient ischemic attack. JAMA. 2022;327:813–4. DOI 10.1001/JAMA.2022.0300.
4. Lavallée PC, Meseguer E, Abboud H, et al. A transient ischaemic attack clinic with round-the-clock access (SOS-TIA): feasibility and effects. Lancet Neurol. 2007;6:953–60. DOI 10.1016/S1474-4422(07)70248-X.
5. Rothwell PM, Giles MF, Chandratheva A, et al. Effect of urgent treatment of transient ischaemic attack and minor stroke on early recurrent stroke (EXPRESS study): a prospective population-based sequential comparison. Lancet. 2007;370:1432–42. DOI 10.1016/S0140-6736(07)61448-2.
6. Perry JJ, Losier JH, Stiell IG, Sharma M, Abdulaziz K. National survey of neurologists for transient ischemic attack risk stratification consensus and appropriate treatment for a given level of risks. J Stroke Cerebrovasc Dis. 2015;24:2514–20. DOI 10.1016/j.jstrokecerebrovasdis.2015.06.034.
7. Perry JJ, Losier JH, Stiell IG, Sharma M, Abdulaziz K. National survey of emergency physicians for transient ischemic attack (TIA) risk stratification consensus and appropriate treatment for a given level of risk. CJEM. 2016;18:10–8. DOI 10.1017/cem.2015.57.
8. Ranta A, Barber PA. Transient ischemic attack service provision: a review of available service models. Neurology. 2016;86:947–53. DOI 10.1212/WNL.0000000000002339.
9. Lavallée P, Amarenco P. TIA clinic: a major advance in management of transient ischemic attacks. Front Neurol Neurosci. 2014;33:30–40. DOI 10.1159/000351890.
10. Martínez-Martínez MM, Martínez-Sánchez P, Fuentes B, et al. Transient ischaemic attacks clinics provide equivalent and more efficient care than early in-hospital assessment. Eur J Neurol. 2013;20:338–43. DOI 10.1111/J.1468-1331.2012.03858.X.
11. Sanders LM, Cadilhac DA, Srikanth VK, Chong CP, Phan TG. Is nonadmission-based care for TIA patients cost-effective? A microcosting study. Neurol Clin Pract. 2015;5:58–66. DOI 10.1212/CPJ.0000000000000095/-/DC1.
12. Gladstone DJ, Lindsay MP, Douketis J, et al. Canadian stroke best practice recommendations: secondary prevention of stroke update 2020. Can J Neurol Sci. 2021;49:315–37. DOI 10.1017/CJN.2021.127.
13. Johnston SC, Smith WS. Practice variability in management of transient ischemic attacks. Eur Neurol. 1999;42:105–8. DOI 10.1159/000069419.
14. Goldstein LB, Bian J, Samsa GP, Bonito AJ, Lux LJ, Matchar DB. New transient ischemic attack and stroke: outpatient management by primary care physicians. Arch Intern Med. 2000;160:2941–6.
15. Dillman DA. Mail and internet surveys: the tailored design method, 2nd ed. New York: John Wiley and Sons; 2007.
16. Rizos T, Ringleb PA, Huttner HB, Köhrmann M, Jüttler E. Evolution of stroke diagnosis in the emergency room–a prospective observational study. Cerebrovasc Dis. 2009;28:448–53. DOI 10.1159/000235989.
17. Perry JJ, Sharma M, Sivilotti MLA, et al. A prospective cohort study of patients with transient ischemic attack to identify high-risk clinical characteristics. Stroke. 2014;45:92–100. DOI 10.1161/STROKEAHA.113.003085.
18. Perry JJ, Sivilotti MLA, Émond M, et al. Prospective validation of Canadian TIA Score and comparison with ABCD2 and ABCD2i for subsequent stroke risk after transient ischaemic attack: multicentre prospective cohort study. BMJ. 2021;372:n49. DOI 10.1136/BMJ.N49.
19. Johnston SC, Rothwell PM, Nguyen-Huynh MN, et al. Validation and refinement of scores to predict very early stroke risk after transient ischaemic attack. Lancet. 2007;369:283–92. DOI 10.1016/S0140-6736(07)60150-0.
20. Giles MF, Albers GW, Amarenco P, et al. Addition of brain infarction to the ABCD2 score (ABCD2I): a collaborative analysis of unpublished data on 4574 patients. Stroke. 2010;41:1907–13. DOI 10.1161/STROKEAHA.110.578971.
21. Abdulaziz KE, Perry JJ, Yadav K, et al. Quality and transparency of reporting derivation and validation prognostic studies of recurrent stroke in patients with TIA and minor stroke: a systematic review. Diagnostic Progn Res. 2022;6:9. DOI 10.1186/S41512-022-00123-Z/FIGURES/3.
22. Coutts SB. Diagnosis and management of transient ischemic attack. Continuum Lifelong Learn Neurol. 2017;23:82–92. DOI 10.1212/CON.0000000000000424.
23. Muir KW, Santosh C. Imaging of acute stroke and transient ischaemic attack. J Neurol Neurosurg Psychiatry. 2005;76:iii19–iii28. DOI 10.1136/JNNP.2005.075168.
24. Mair G, Wardlaw JM. Imaging of acute stroke prior to treatment: current practice and evolving techniques. Br J Radiol. 2014;87:20140216. DOI 10.1259/bjr.20140216.
25. Fitzpatrick T, Gocan S, Wang CQ, et al. How do neurologists diagnose transient ischemic attack: a systematicreview. Int J Stroke. 2019;14:115–124. DOI 10.1177/1747493018816430.
26. Cortel-LeBlanc MA, Sharma M, Cortel-LeBlanc A, et al. Predictors of neurologists confirming or overturning emergency physicians' diagnosis of TIA

or stroke. Can J Emerg Med. 2021;23:812–9. DOI 10.1007/s43678-021-00181-0.
27. Prabhakaran S, Silver AJ, Warrior L, McClenathan B, Lee VH. Misdiagnosis of transient ischemic attacks in the emergency room. Cerebrovasc Dis. 2008;26:630–5. DOI 10.1159/000166839.
28. Castle J, Mlynash M, Lee K, et al. Agreement regarding diagnosis of transient ischemic attack fairly low among stroke-trained neurologists. Stroke. 2010;41:1367–70. DOI 10.1161/STROKEAHA.109.577650.
29. Koudstaal PJ, Genitsma JGM, van Gün J. Clinical disagreement on the diagnosis of transient ischemic attack: is the patient or the doctor to blame?. Stroke. 1989;20:300–1. DOI 10.1161/01.STR.20.2.300.
30. Kraaueveld CL, Gun JV, Schouten HJ, Staal A. Interobserver agreement for the diagnosis of transient ischemic attacks. Stroke. 1984;15:723–5. DOI 10.1161/01.STR.15.4.723.
31. Stanciu A, Banciu M, Sadighi A, et al. A predictive analytics model for differentiating between transient ischemic attacks (TIA) and its mimics. BMC Med Inform Decis Mak. 2020;20:1–10. DOI 10.1186/S12911-020-01154-6/TABLES/7.
32. Dutta D. Diagnosis of TIA (DOT) score – design and validation of a new clinical diagnostic tool for transient ischaemic attack. BMC Neurol. 2016;16:723. DOI 10.1186/S12883-016-0535-1.
33. Dawson J, Lamb KE, Quinn TJ, et al. A recognition tool for transient ischaemic attack. QJM. 2009;102:43–9. DOI 10.1093/QJMED/HCN139.
34. Wasserman J, Perry J, Dowlatshahi D, et al. Stratified, urgent care for transient ischemic attack results in low stroke rates. Stroke. 2010;41:2601–5. DOI 10.1161/STROKEAHA.110.586842.
35. Mann E, Swedien D, Hansen J, et al. Reduction in emergency department presentations in a regional health system during the Covid-19 pandemic. West J Emerg Med. 2021;22:842. DOI 10.5811/WESTJEM.2020.10.49759.
36. Rennert-May E, Leal J, Thanh NX, et al. The impact of COVID-19 on hospital admissions and emergency department visits: a population-based study. PLoS One. 2021;16:e0252441. DOI 10.1371/JOURNAL.PONE.0252441.
37. Teo KC, Leung WCY, Wong YK, et al. Delays in stroke onset to hospital arrival time during COVID-19. Stroke. 2020;51:2228–31. DOI 10.1161/STROKEAHA.120.030105.
38. Siegler JE, Heslin ME, Thau L, Smith A, Jovin TG. Falling stroke rates during COVID-19 pandemic at a comprehensive stroke center. J Stroke Cerebrovasc Dis. 2020;29:104953. DOI 10.1016/J.JSTROKECEREBROVASDIS.2020.104953.
39. Hasibul Hasan ATM, Das SC, Islam MS, et al. Impact of COVID-19 on hospital admission of acute stroke patients in Bangladesh. PLoS One. 2021;16:e0240385. DOI 10.1371/JOURNAL.PONE.0240385.
40. D'Anna L, Brown M, Oishi S, et al. Impact of national lockdown on the hyperacute stroke care and rapid transient ischaemic attack outpatient service in a comprehensive tertiary stroke centre during the COVID-19 pandemic. Front Neurol. 2021;12:37. DOI 10.3389/FNEUR.2021.627493/BIBTEX.
41. Rodrigues M, Grunho M, Rachão A, et al. The impact of COVID-19 pandemic in stroke code activation and time from symptom onset to hospital arrival in a Portuguese comprehensive stroke centre. Rev Neurol. 2021;73:89–95. DOI 10.33588/RN.7303.2020445.
42. Dowlatshahi D, Stotts G, Bourgoin A, et al. Decreased stroke presentation rates at a comprehensive stroke center during COVID-19. Can J Neurol Sci. 2021;48:1–121. DOI 10.1017/CJN.2020.193.
43. D'Anna L, Sheikh A, Bathula R, et al. Decreasing referrals to transient ischaemic attack clinics during the COVID-19 outbreak: results from a multicentre cross-sectional survey. BMJ Open. 2020;10:e041514. DOI 10.1136/BMJOPEN-2020-041514.

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