Canadian Stroke Best Practices

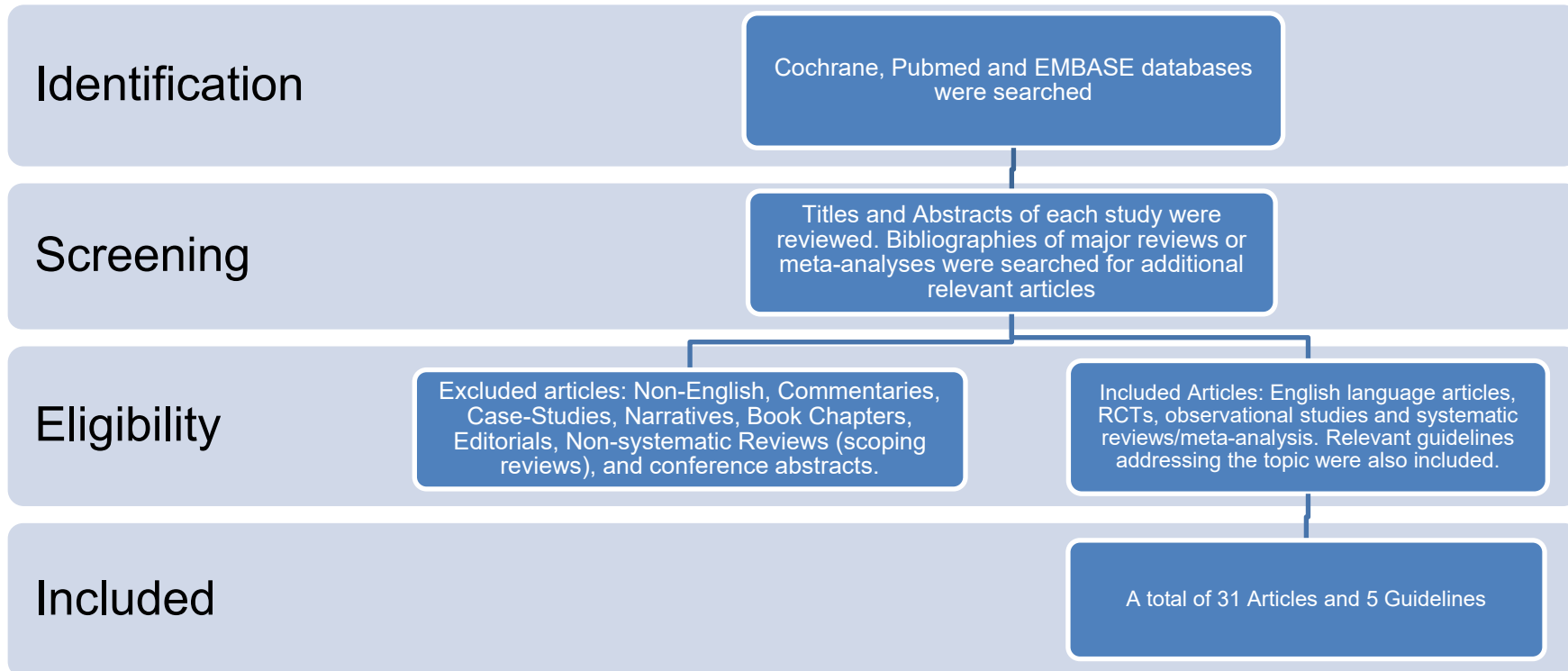# CANADIAN STROKE BEST PRACTICE RECOMMENDATIONS

Acute Stroke Management Evidence Tables

Seventh Edition, Update 2022

Section 1: Stroke Awareness, Recognition and Response

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Acute Stroke Management Writing Group and in collaboration with the
Canadian Stroke Consortium

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Search Strategy

Identification	Cochrane, Pubmed and EMBASE databases were searched
Screening	Titles and Abstracts of each study were reviewed. Bibliographies of major reviews or meta-analyses were searched for additional relevant articles
Eligibility	Excluded articles: Non-English, Commentaries, Case-Studies, Narratives, Book Chapters, Editorials, Non-systematic Reviews (scoping reviews), and conference abstracts. — Included Articles: English language articles, RCTs, observational studies and systematic reviews/meta-analysis. Relevant guidelines addressing the topic were also included.
Included	A total of 31 Articles and 5 Guidelines

Pubmed, EMBASE and the Cochrane Central Register of Controlled Trials databases were search using the terms "stroke risk factors", "stroke symptoms", "stroke awareness", "stroke behaviours", "stroke campaigns", "public education" and "awareness campaigns". Titles and abstract of each article were reviewed for relevance. Bibliographies were reviewed to find additional relevant articles. Articles were excluded if they were: non-English, commentaries, case-studies, narrative, book chapters, editorials, non-systematic review, or conference abstracts. Additional searches for relevant best practice guidelines were completed and included in a separate section of the review. A total of 31 articles and 5 guidelines were included and were separated into separate categories designed to answer specific questions.

Published Guidelines

Guideline	Recommendations
Powers WJ, Rabinstein AA, Ackerson T, Adeoye OM, Bambakidis NC, Becker K, Biller J, Brown M, Demaerschalk BM, Hoh B, Jauch EC, Kidwell CS, Leslie-Mazwi TM, Ovbiagele B, Scott PA, Sheth KN, Southerland AM, Summers DV, Tirschwell DL; on behalf of the American Heart Association Stroke Council. **Guidelines for the early management of patients with acute ischemic stroke: 2019 Update to the 2018 Guidelines for the Early Management of Acute Ischemic Stroke: A Guideline for Healthcare Professionals from the American Heart Association/American Stroke Association** *Stroke* 2019;50:e344–e418.	1. Public health leaders, along with medical professionals and others, should design and implement public education programs focused on stroke systems and the need to seek emergency care (by calling 9-1-1) in a rapid manner. These programs should be sustained over time and designed to reach racially/ethnically, age, and sex diverse populations. (Class 1; LOE B-NR) 2. Such educational programs should be designed to specifically target the public, physicians, hospital personnel, and emergency medical services (EMS) personnel to increase use of the 9-1-1 EMS system, to decrease stroke onset to emergency department (ED) arrival times, and to increase timely use of thrombolysis and thrombectomy. (Class I: LOE C-EO). 3. Activation of the 9-1-1 system by patients or other members of the public is strongly recommended. 9-1-1 dispatchers should make stroke a priority dispatch, and transport times should be minimized. (Class 1; LOE B-NR).
Adeoye O, Nystrom KV, Yavagal DR, et al. **Recommendations for the Establishment of Stroke Systems of Care: A 2019 Update.** *Stroke* 2019; 50: e187-e210.	1. Public health leaders along with medical professionals and others should design and implement public education programs focused on stroke systems and the need to seek emergency care (by calling 9-1-1) in a rapid manner. These programs should be repetitive and designed to reach diverse populations. Further research is needed to establish the most effective programs for diverse populations. (New) 2. EMS leaders, in coordination with local, regional, and state agencies and in consultation with medical authorities and local experts, should develop triage paradigms and protocols that ensure that all patients with a known or suspected stroke are rapidly identified and assessed with a validated and standardized instrument for stroke screening such as FAST (Face, Arm, Speech, Time), Los Angeles Prehospital Stroke Screen, or CPSS. (Revised) 3. When there are several intravenous alteplase–capable hospitals in a well-defined geographic region, extra transportation times to reach a facility capable of endovascular thrombectomy should be limited to no more than 15 minutes in patients with a prehospital stroke severity scale score suggestive of LVO. When several hospital options exist within similar travel times, EMS should seek care at the facility capable of offering the highest level of stroke care. Further research is needed to establish travel time parameters for hospital bypass in cases of prehospital suspicion of LVO. (New)
Kobayashi A, Czlonkowska A, Ford GA, Fonseca AC, Luijckx GJ, Korv J, et al.	We recommend educational campaigns to increase the awareness of immediately calling EMS for people with suspected stroke. (SOR strong; QOE very low quality of evidence)

Guideline	Recommendations
European Academy of Neurology - European Stroke Organisation consensus statement and practical guidance for pre-hospital management of stroke. *Eur J Neurol* **2018 Mar;25(3):425-433.**	
Clinical Guidelines for Stroke Management 2017. Melbourne (Australia): National Stroke Foundation.	Not included in update
Intercollegiate Stroke Working Party. Royal College of Physicians. National Clinical guidelines for stroke. 5th Edition 2016, Edinburgh, Scotland	Public awareness campaigns of the symptoms of stroke should be recurrent, targeted at those most at risk of stroke, and formally evaluated (Consensus).
Scottish Intercollegiate Guidelines Network (SIGN). Management of patients with stroke: rehabilitation, prevention and management of complications, and discharge planning. A national clinical guideline. Edinburgh (Scotland): Scottish Intercollegiate Guidelines Network (SIGN); 2010 June.	**3.1 Referral to Stroke Services** Patients should receive information about the risk of recurrent stroke, the signs and symptoms of onset and the action they should take if stroke is suspected, for example FAST (Face, Arm, Speech, Time (to call 999) [Good practice point].

Evidence Tables

Awareness of Stroke Signs & Symptoms among the General Public

Study/Type	Quality Rating	Sample Description	Method	Outcomes	Key Findings and Recommendations
Naguib et al. 2020 **Saudi Arabia** **Cross sectional study** ***Awareness about Stroke and Proper Actions to Be Taken; A room for Improvement***	NA	600 adults recruited using convenience sampling at public shopping malls from different areas in Riyadh, from September 2018 until March 2019. Mean age was 27.7 years, 39.5% were women. 50.2% had attended university.	Participants were interviewed to determine whether they could recognize ≥ 5 stroke risk factors, 3 warning signs of stroke, and whether they could call an ambulance in the first 3 hours of a suspected incident. Those that fulfilled all criteria were considered knowledgeable.	Knowledge	40% of respondents were considered knowledgeable. Independent factors associated with being knowledgeable were younger age, female, and being employed. The majority of respondents correctly recognized hypertension (64.7%), heart diseases (61%), smoking (58.2%), dyslipidemia (57.7%), increasing age (55.2%), and obesity (50%) as stroke risk factors. 68.3% of participants were able to identify at least 3 warning signs of stroke including slurred speech (61.8%), sudden weakness in arms, legs or face (54.5%), and sudden tingling or loss of sensation in 1 side of the body (53.8%). 9.5% of respondents were not able to identify any warning signs. 70% of respondents indicated they would call an ambulance within 3 hours of observed symptoms, while 86.2% indicated they would call a physician within 24 hours
Krishnamurthi et al. 2020 **New Zealand** **Survey**	NA	400 adults, aged ≥20 years in New Zealand, stratified by the 4 main ethnic groups (Maori, Pacific, Asian/ other, and Europeans), selected through landline telephone directory listings. 42% of participants were between 40 and 59 years of age, had completed at least high school education (97%), were employed (69%), and lived in urban areas (92%)	The survey was conducted between April and June 2015 by telephone interview. Participants were asked to answer a series of questions on stroke knowledge and awareness, using unprompted and prompted methods of questioning	Knowledge, predictors of greater knowledge	Response rate was 57%. Using a prompted method, sudden speech difficulty (94%) and sudden weakness on 1 side (92%) were the most commonly identified stroke symptoms. When asked "Do you think you would be able to tell if someone was having a stroke?" 57% answered yes, while 43% did not believe they could. When prompted with a list of 11 options, 98% of participants identified 1 stroke symptom, 96%

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					identified 2 or more, 86% identified 3 or more, 64% identified 4 or more and 37%) identified all 5 of the correct symptoms in the list. Without prompting, 78% of participants correctly identified ≥ 1 risk factor, 62% identified ≥2, and 35% identified ≥3. Higher education level, higher income, and personal experience of stroke were predictive of greater awareness
Metias et al. 2017 **Canada** **Survey**	NA	Adult patients, accompanying family and friends who were in the waiting room of community- and academic-based vascular clinics in Toronto, at 2 time periods 2009-2010 and 2014-2015	Questionnaires were administered to participants, including questions pertained to knowledge of stroke risk factors and symptoms. Participants were also asked to identify their response to an individual who appeared to be experiencing a stroke, stroke treatments and stroke resources that were available. The responses to these questions were used to develop a stroke literacy score. 'Stroke literacy'' was established by listing ≥1 stroke risk factor and ≥1 signs of stroke.	Stroke literacy	In 2010, 207 surveys were distributed, of which 198 were completed. The mean age of participants was 60.5 years. In 2015, 791 questionnaires were completed. The mean age of participants was 53.4 years. The most frequently identified risk factors for stroke were smoking in 2010 and hypertension in 2015. The most common stroke symptom identified was trouble speaking (56.6%) in 2010 and weakness, numbness or paralysis (67.1%) in 2015. 80.3% vs. 83.1% of participants were able to identify ≥1 stroke risk factor in 2010 and 2015, respectively. The corresponding values for ability to identify a stroke sign/symptom were 90.9% and 88.7%. Television was the most common source of information. The Heart & Stroke Foundation of Canada was a source of information for 6.6% of participants in 2010 compared with 35.8% of those in 2015

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Mochari-Greenberger et al. 2014 **USA** **Cross-sectional survey**	NA	1,205 women aged ≥25 years living in the United States, who had participated in the American Heart Association National Women's Tracking Survey.	Participants were contacted by telephone though random-digit dialing and asked standardized questions, related to stroke warning signs, actions to take in the event of stroke.	Knowledge	The percentage of women who recognized the following signs of stroke: Sudden weakness/numbness of the face or limb of one side: 51%. Loss of/trouble with understanding speech:44% Sudden severe headache: 23% Unexplained dizziness: 20% Loss of vision in one eye: 18% One in 5 women could not identify one stroke warning sign.
Miyamatsu et al. 2013 **Japan** **Cross-sectional survey**	NA	5,540 participants, aged 40-74 years, randomly selected from the Basic Resident Register, recruited from 3 large cities in Japan	A multiple choice, mail-in survey including items related to general knowledge of stroke, early symptoms of stroke, information sources and what to do if a stroke is suspected.	Knowledge	The response rate was 49.0%. Mean age was 58 years. 53% of participants were female. Recognition of stroke symptoms: Sudden one-sided weakness: 86.6% Sudden confusion: 86.6% Sudden headache: 72.3% Sudden dizziness: 62.7% Sudden trouble seeing: 35.0% All 5 symptoms correctly identified: 23.0% 81.2% of participants indicated they would call an ambulance immediately in response to a suspected stroke. Mass media campaigns (particularly those appearing on television) were identified as the most common source of information (estimated fraction: 0.32), followed by newspapers (estimated fraction: 0.28). The internet and personal communication were the least common sources of information.

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Robinson et al. 2013 UK Cross-sectional survey	NA	1,300 individuals (39% male) representative of the general population were sampled from public areas, places of work, and academic institutions.	Items on the survey represented the following: 1) basic familiarity with the concept of stroke, 2) awareness of warning signs of stroke, 3) awareness of risk factors for stroke, and 4) knowledge of the FAST campaign.	Awareness of stroke warning signs and risk factors and knowledge of the FAST campaign.	70% of those surveyed were aware of the FAST campaign and 80% recalled the 'burning face' image. Over 75% of participants were able to recall all three FAST stroke symptoms and >90% were able to recall at least one. Stroke warning signs not included as part of the FAST campaign were not as well recognized (e.g., Visual loss=44%, Dizziness=47%). Hypertension, smoking, alcohol, and diabetes were identified as risk factors for stroke by 90%, 74%, 54%, and 51% of participants, while 68% of participants were aware that stroke affects the brain.
Lundelin et al. 2012 Spain Cross-sectional survey	NA	11,827 non-institutionalized adults living in Spain who had participated in the Study on Nutrition & Cardiovascular Risk in Spain (ENRICA) study	Participants were identified by multistage clustered random sampling. Data was collected using a telephone interview. 55% of the participants were also examined physically and provided a blood sample.	Stroke knowledge and predictors of knowledge, based on sociodemographic indicators	65.2% of participants could correctly identify 4-6 symptoms of stroke. 19% could identify all 6 symptoms correctly, while 11.4% were unable to identify a single symptom. Higher levels of education were associated with better knowledge. 81.1% of participants indicated that they would call an ambulance if they suspected someone was having a stroke. Persons who could identify more stroke symptoms were more likely to call for an ambulance.
Hickey et al. 2009 Ireland Cross-sectional survey	NA	2033 community-dwelling older adults. 57% female. The survey response rate was 68%.	Participants completed a survey with items addressing knowledge of stroke warning signs and risk factors.	Percentage of participants correctly identifying stroke warning signs and risk factors.	**Warning signs:** Slurred speech (54%), dizziness (44%), numbness (41%), weakness (38%), headache (29%), and vision problems (20%). **Risk Factors:** hypertension (75%), cholesterol (40%), smoking (30%), diabetes (11%), and alcohol use (10%).

Awareness of Stroke Signs & Symptoms among Persons with Previous Stroke

Study/Type	Quality Rating	Sample Description	Method	Outcomes	Key Findings and Recommendations
Faiz et al. 2018 **Norway** **Survey**	NA	173 patients admitted to a stroke unit following first-ever stroke. Mean age was 68 years, 63.6% were men.	Patients were asked two closed-ended questions: "Do you believe that stroke is a serious disorder?" and "Do you believe that time is of importance for stroke treatment?". In addition, patients were asked to list as many stroke risk factors, stroke symptoms and stroke treatment options as they could.	Knowledge	91.3% confirmed that they regarded stroke as a serious disorder and 148 patients (85.5%) considered time being of importance. 102 patients (59.0%) could not name any treatment option. 41 patients (23.7%) named one or more treatment options such as blood thinners or rehabilitation. The most commonly identified signs/symptoms of stroke included arm/leg paresis (60.7%), speech difficulties (50.3%) and facial droop (32.4%). The most commonly identified stroke risk factors included smoking (26.6%), hypertension (21.4%), obesity (12.1%) and alcohol abuse (11.6%).
Sooman et al. 2016 **Estonia** **Prospective study**	NA	195 patients admitted with confirmed stroke or TIA to a single institution during 2010. Mean age was 72 years, 49% were male. 84% were ischemic stroke, 10% were ICH and 6% were TIA.	Patients participated in a structured interview within 72 hours of admission. Patients were asked if they had any of: hypertension, atrial fibrillation (AF), ischemic heart disease (IHD), congestive heart failure (CHF), diabetes or previous stroke. Their medical histories were also reviewed.	Identification of stroke risk factors	154 patients (79%) had confirmed hypertension. Of those, 80% were aware. 74 patients (38%) had AF. Of those, 78% were aware. 35 patients (18%) had diabetes. Of those, 89% were aware. 67 patients (34%) had IHD or heart failure. Of those, 66% were aware. 40 patients (21%) had suffered from a previous stroke. Of those, 77% were aware.
Diez-Ascaso et al. 2015 **Spain** **Cross-sectional study**	NA	96 participants, ≥18 years with a history of prior ischemic stroke within the previous 3-12 months and a mRS of 0-3. Mean age was 62 years, 56% were male.21% of participants had	Data pertaining to knowledge of stroke risk factors was obtained through in-depth interviews and participant observation.	Identification of vascular risk factors (VRF)	90.6% of patients had ≥2 VRF HTN, aged ≥65 years and cigarette smoking were the most common confirmed VRFs (62.5%, 61.5% and 45.8%, respectively). When asked to identify VRFs related to stroke, those most commonly identified were stress

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		suffered from more than one previous stroke			(45.8%), dyslipidemia (29.2%), HTN (28.1%), cigarette smoking (28.1%) and diabetes (13.5%). Of the 94 participants with at least one VRF, when asked to identify their own VRFs, 41.7% of overweight persons identified obesity, 33.3% of those with HTN, recognized HTN, 30.6% with dyslipidemia recognized dyslipidemia. Similar values for diabetes, prior stroke and family history of stroke were 19%, 30% and 21.4%. 32.3% of participants with at least one VRF failed to recognize that they, themselves had any.
Sundseth et al. 2014 **Norway** **Prospective study**	NA	287 patients ≥18 years admitted to a single institution with suspected stroke or TIA who were able to answer open-ended questions. Mean age was 70 years, 58% were male. 34% of patients had experienced a previous stroke	Examination of knowledge of stroke symptoms and risk factors was collected by interview using a standardized questionnaire, within 72 hours of admission to hospital. Adequate knowledge of stroke symptoms was defined as being able to identify both numbness or weakness of the face, arm or leg and confusion or trouble speaking or understanding speech and facial weakness, arm weakness, and "speech disturbance. Adequate knowledge of stroke risk factors was defined as knowing at least 2 of the 3 risk factors of	Knowledge of stroke symptoms and risk factors	203 (70.7%) patients knew at least 1 symptom of stroke. 191 patients (66.6%) identified the stroke symptom, numbness or weakness of the face, arm or leg, 131 (45.6%) identified confusion or trouble speaking or understanding speech, while 123 (42.9%) patients were able to identify both symptoms of stroke. 48 patients (16.7%) knew all FAST elements. 124 patients (43.2%) were able to name at least 1 stroke risk factor. Smoking and HTN were the 2 most commonly cited risk factors of stroke (22.3% and 19.5%, respectively). 40 patients (13.9%) were able to identify at least 2 risk factors (smoking or HTN) or diabetes), while and only 5 patients (1.7%) knew all 3. Patients who were younger, with higher education, who had received previous information on stroke were more likely to be familiar with stroke symptoms and risk factors.

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			stroke, (HTN, smoking' and diabetes'). Patients were also asked if they had received information on stroke previously.		
Brenner et al. 2010 **USA** **Cross-sectional study**	NA	2,830 and 24,886 participants included in the REGARDS study who had/ had not suffered a previous stroke or TIA.	Information on stroke risk factors (diabetes, hypertension and hyperlipidemia) was obtained through telephone interview and home visit	Recognition and control of 3 stroke risk factors	Stroke survivors were more likely to have unrecognized hypertension, stage 2 hypertension and diabetes compared with those without a history of stroke (18.7% vs. 13.5%, p=0.0003; 4.4% vs. 2.2%, p=0.0006; and 4.2% vs. 3.2%, p=0.026, respectively). Stroke survivors were less likely to have unrecognized dyslipidemia (59.1% vs. 65.5%, p<0.0001). Among stroke survivors, increased BMI and African American race were predictors of unrecognized hypertension. Among stroke survivors, increased BMI and lower education were predictors of unrecognized diabetes. There was a higher prevalence of unrecognized dyslipidemia among stroke survivors with income <$20K annually and those with annual incomes of $35-75K.

Increasing Awareness of the Stroke Symptoms through Public Health Campaigns

Study/Type	Quality Rating	Sample Description	Method	Outcomes	Key Findings and Recommendations
Tan et al. 2022 **Singapore** **Systematic review & meta-analysis**	All studies were assessed as being at high risk of bias.	13 studies including 113,592 adults aged < 65 years recruited from the general population.	The effects of stroke education using mass media campaigns on stroke symptom recognition and intention to call emergency medical services, were estimated.	**Primary outcome:** Stroke symptom recognition and intention to call EM	Duration of the campaigns ranged from 3 weeks to two years. 4 studies used FAST as the basis of their campaigns. Mass media campaigns increased the likelihood of symptom recognition compared with pre-campaign (RR=1.20 (95% CI 1.07-1.36, n=5 studies). Mass media campaigns increased the likelihood that persons would call EMS, compared with pre-campaign (RR= 1.19, 95% CI 1.11 -1.28, 8 studies included).
Wolters et al. 2018 **UK** **Prospective study**	NA	2,243 consecutive patients from the e OxVasc study presenting with first TIA or stroke, seeking medical attention between April 1, 2002, and March 31, 2014. Mean age was 73.6, 50.2% were women.	Response to the FAST campaign (television + public transit displays), which ran from 2009 intermittently though 2014, was assessed.	**Primary outcomes:** Number of early recurrent strokes in patients who delayed or failed to seek medical attention, and the odds of seeking urgent attention after TIA and minor stroke before vs after initiation of the public education campaign.	825 (36.8%) patients were initially seen with TIA, 831 (37.0%) with minor stroke, and 587 (26.2%) with major stroke. For major stroke, the use of nonemergency services declined significantly from 2009 onward, while the use of EMS increased significantly (58.8% before April 1, 2009, vs 78.9% after April 1, 2009, p=0.001). In addition, first medical attention was sought more quickly (within 3 hours) after April 1, 2009 (67.6% vs. 81.3%; OR=2.08; 95% CI, 1.40-3.11; P < .001). Time to first seeking medical attention after TIA and minor stroke was similar before and after April 1, 2009, with 42.1% seeking medical attention within 3 hours prior to April 1, 2009 vs. 40.4%, after (OR= 0.79; 95% CI, 0.50-1.23). The corresponding values for patients seeking help within 24 hours of symptoms before and after the FAST campaign were similar (70.4% vs. 70.6%; OR=0.75; 95% CI, 0.48-1.19). 185 patients had a stroke within 90 days of their initial TIA or stroke, of whom 93 (49.5%) followed

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					unheeded TIAs for which no medical attention was sought. The number of strokes preceded by an unheeded TIA was similar before and after the FAST campaign (8.0% vs. 8.1%, p=0 .93).
Nordanstig et al. 2017 **Sweden** **Prospective study**	NA	1,500 randomly selected persons, aged 15 to 79 years from the Swedish population	The effect of a 27-month long public awareness campaign, designed to increase knowledge of the Swedish translation of FAST and, the need to call the Swedish emergency number, was evaluated. The campaign included television advertisements, spots on public service television, and paid advertisements and banners in newspapers and social media, plus a website and Facebook page. Telephone interviews were carried out with participants at 8 points: before, 3 times during, immediately after, and 9, 13 and 21 months after the campaign.	**Primary outcomes:** Knowledge of words in FAST mnemonic, need to call emergency services	The response rate decreased from 62% to 36% over time. 52% of respondents had seen as advertisement during the campaign, compared with 29% prior. From pre-campaign (survey 1) to end of the campaign (survey 8), the number of persons who: 1) had heard of FAST increased from 15%-50% (adj OR=1.30, 95% CI 1.26-1.33), p<0.0001), 2) could recall all keywords in the mnemonic increased from 0.3% to 2% (adj OR=1.34, 95% CI 1.15-1.55, p<0.0001), 3) could recall some/all keywords in the mnemonic had increased from 4% to 14% (adj OR=1.23, 95% CI 1.17-1.28, p<0.0001) and 4) intended to call emergency services increased from 65% to 73% (adj OR=1.05, 95% CI 1.03-1.08, p<0.0001). From during and directly after the campaign, to 21 months after the campaign, there was no change in the number of respondents who had heard about the campaign (51% vs 50%). During the same timeframe, the number of persons who: 1) could recall all keywords in the mnemonic decreased significantly from 3.4% to 2.3%, p=0.043, 2) could recall some/all keywords in the mnemonic had decreased significantly from 23% to 14%, p<0.0001, and 3) intended to call emergency services decreased significantly from 76% to 73%, p=0.037.
Advani et al. 2016 **Norway**	NA	All patients admitted to the ER with signs and symptoms of stroke	The effects of a 1-month mass media intervention (MMI), using advertising on television, posters,	**Primary outcome:** Changes in t-PA use after the MMI	The average number of patients treated with t-PA increased significantly from 7.3 to 11.3 patients per month (an increase of 54.7%, p=0.02) during the period from the 12 months preceding the MMI to

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Prospective study			social media and healthcare trust websites was used to promote signs of stroke symptoms, using the FAST mnemonic to encourage people to seek immediate medical attention. 1,400 telephone surveys were also conducted, before and after the campaign	**Secondary outcome:** Changes in the numbers of stroke admissions to the ER within 4.5 hours of stroke onset	the 6 months after the MMI (including the month during which the campaign ran). After the initial 6-month period, the average number of patients treated with t-PA dropped to 9.5, which was still significantly higher than the 12 months preceding the MMI. The average number of patients treated in the ER increased significantly from 37.3 to 72.8 patients per month (an increase of 95.7%, p<0.001) during the period from the 12 months preceding the MMI to the 6 months after the MMI (including the month during which the campaign ran). After the initial 6-month period, the average number of patients treated in the ER dropped to 52.6, which was still significantly higher than the 12 months preceding the MMI. Telephone survey results: the number of people who could name any stroke symptom increased from 66% to 75% after the MMI. Of those who could name a symptom, 52% recognized facial droop, 42% named speech difficulties and 42% named arm weakness.
Bray et al. 2015 **Australia** **Cross-sectional study**	NA	NA	The association between monthly volumes of ambulance dispatches for stroke and 12 National Stroke Foundation multimedia regional public awareness campaigns (2004-2014) was explored. The campaigns lasted on average for 6 weeks and	Changes in ambulance calls for stroke following public awareness campaigns, controlling for paid funding, timing of campaign exposure, number of days in the month, season, population size and population growth	11/12 campaigns were associated with increases in call volumes. The percentage increases by year were: 2004: 4.8% 2005: 7.6% 2006: -2.2% 2007: 1.0% 2008: 5.2% 2009: 4.7% 2010: 6.9% 2011: 5.7% 2014: 9.9% (campaign 1); 9.3% (campaign 2)

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			were both paid and pro bono. Most of the campaigns focused on FAST symptoms and the need for quick response		The effect persisted for approximately 3 months. In 2014, one of the campaigns was run nationally. There was an increase of 1478 calls (6.7%). The campaigns run in urban areas tended to be more successful than those in rural settings. Compared with regions that did not receive funding, those that did reported a relative increase of 10.2% in call volumes.
Wolters et al. 2015 **UK** **Prospective study**	NA	688 participants in the OXVASC study who had experienced a major stroke (NIHSS>3). Mean age was 77 years, 57% were female. Median stroke severity was 9.	Patient behavior for out of hospital strokes was compared before (2002-2008) and after (2009-2013) the introduction of UK-FAST (a public education television campaign Feb-Apr 2009)	Time from stroke onset to seeking medical attention and the type of medical attention sought.	There were 416 strokes pre-FAST and 252 post-FAST. Medical attention was sought by a by-stander in the majority of cases (553, 89.6%) The median time to seek first medical attention decreased significantly post-FAST (53 vs. 31 minutes, p=0.005). Median time to arrival to hospital decreased significantly post-FAST (185 vs. 119 minutes, p<0.0001). First contact with EMS or ED was made more frequently post FAST (74.8% vs. 57.2%, OR=2.20, 95% CI 1.55-3.13, p<0.0001), while first contact with non-emergency services (e.g., GP) decreased significantly (42.8% vs. 25.2%, OR=0.45, 95% CI 0.32-0.65, p<0.0001). The number of patients who arrived at hospital within 3 hours increased significantly post FAST (46.9% vs. 65.8%, OR=2.18, 95% CI 1.55-3.06, p<0.0001).
Flynn et al. 2014	NA	NA	The impact of the 3 national FAST campaigns, (Feb-Mar 2009, Nov-Dec 2009 and	Information-seeking behavior for stroke, emergency admissions, 911 calls,	There was significantly increased activity on the Stroke Associations' website following the first campaign (webpage views), information materials dispatched and calls to the help line, with

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UK **Time series evaluation**			Feb-Mar 2010) was assessed over time, using data from 3 databases	number of patients receiving thrombolytic treatment	decreases after the campaign ceased. The same pattern of activity was observed during campaigns 2 and 3. There were significantly greater number of emergency admissions over the 22-month period prior to the first campaign, and significant increases during the first campaign, but the increases thereafter were not significant. There was a significant increase in the number of patients treated with t-PA prior to the first campaign, with a non-significant increase following it. Following the first campaign, there was an increase of 3 patient/month treated with t-PA and again after the third campaign (3 patients/month).
Rasura et al. 2014 **Italy** **Review**	NA	22 intervention studies and 5 web-based stroke education campaigns. 14 studies targeted the general public using mass media campaigns, which varied in duration from 3 months to 4 years. 6 studies targeted specific groups with the interventions lasting 3 minutes-12 hours.	Narrative synthesis of included studies	Not stated *a priori*	3 popular stroke signs and symptoms were included in all of the studies using mass media campaigns: FAST, SUDDEN and Give-Me-Five. Effectiveness of the interventions was assessed in most studies through questionnaires administered pre and post intervention. Increases of emergency room presentations t-PA administration and ambulance dispatches, and reductions in pre-hospital delays were also used. The authors concluded that large public health campaigns using mass media are expensive and short lived and may not be effective, although the increased costs can be mitigated through more prompt treatment with t-PA. Lower cost, smaller scale educational campaigns can be delivered successfully in the community. The message being delivered must direct the person to call an ambulance. The dose of the campaign appears to be as important as the message.

Study/Type	Quality Rating	Sample Description	Method	Outcomes	Key Findings and Recommendations
					Television appears to be the most effective medium. Online campaigns can also be successful but tend to attract a self-selected group (e.g. well-educated women)
Dombrowski et al. 2014 **UK** **RCT**	CA: ☒ Blinding: Patient ☒ Assessor ☒ ITT: ☒	5,000 adults, sampled from the electoral register in a large urban community	Participants were randomized to receive a questionnaire + an Act FAST leaflet delivered by mail or to the questionnaire only. The Act FAST campaign was a mass media campaign designed to increase awareness of the FAST mnemonic	Awareness of the Act FAST campaign, and if so, what the acronym stands for. Stroke response and recognition were assessed using 16 vignette scenarios (12 stroke and 4 non-stroke)	Data from 1615 respondents (32.3%) were available. Mean age was 54 years. 57% were female. A higher proportion of participants in the leaflet group had heard of the Act FAST campaign (75% vs. 68%, p<0.001). Significantly more persons in the leaflet group correctly named the FAST elements (66% vs. 45%, p<0.001). There was no difference between groups in the number or participants who indicated they would call "999" in the event of a stroke. Using the 16 vignettes, there were no significant differences between groups in the numbers of participants who were able to correctly identify stroke symptoms, not even in the 6 FAST scenarios (78.4% **correct recognition** in the leaflet group vs. 79.0% in the non-leaflet group, p=0.55). The pattern of **correct response** was similar (65.6% vs. 64.0%, p=0.30).
Mellon et al. 2014 **UK** **Retrospective study**	NA	870 patients who had presented to the emergency department (ED) of 2 large teaching hospitals with symptoms of stroke over a one-year time frame (March 2010-Feb 2011)	Multivariable analysis to determine the impact of 3 waves of 3-week mass media FAST campaigns in May, August 2010 and January 2011	Factors related to onset of symptoms to ER arrival ≤3.5 hours and changes in presentations to the ED with stroke symptoms.	There were 284 confirmed strokes (32.6%) and 150 TIAs (17.4%). The remaining admissions were for non-stroke neurological and medical conditions. Independent predictors of arrival to ED ≤ 3.5 hours were arrival via ambulance (OR=3.1, 95% CI 2.23-4.23, p<0.001) and self-referral (OR=2.67, 95% CI 1.84-3.88, p<0.001). Exposure to the FAST campaign was not a significant predictor (OR=0.93, 95% CI 0.60-1.45, p=0.76).

Study/Type	Quality Rating	Sample Description	Method	Outcomes	Key Findings and Recommendations
					During the first wave of the campaign, there was an increase in the number of presentations to the ED with stroke symptoms, which dropped off after the cessation of the campaign. There was no such evidence of an impact of the FAST campaign during waves 2 or 3.
Bray et al. 2013

Australia

Cross-sectional survey | NA | 12,439 participants, ≥40 years of age randomly selected from the general population using an electronic telephone directory. | Surveys were administered via telephone over a 6-year period to determine the impact of a national multimedia stroke awareness campaign on knowledge of stroke warning signs, and awareness of the campaign. | Number of respondents aware of the advertising campaign, number of respondents able to recall ≥1, ≥2, and/or ≥3 stroke warning signs. | From 2004 to 2010, a significant increase was observed in the number of respondents aware of the campaign (31% vs 50%) and in the number or participants able to name ≥1 (69% vs 81%), ≥2 (43% vs 63%), and ≥3 (19% vs 32%) warning signs of stroke (all $p<0.001$).

Respondents who could identify ≥2 warning signs were significantly more likely to be aware of the campaign (OR= 1.88, 95% CI 1.74 to 2.04). |
| Trobbiani et al. 2013

Australia

Cross-sectional surveys (pre/post intervention) | NA | English sample: 1905 adults aged 16-55 years

Canadian sample: 2807 adults ≥18 years

Australian sample: 1002 adults >40 years, randomly selected from Victorian households | Comparison of 3 mass media stroke awareness campaigns conducted in England (FAST), Canada (SUDDENS) and Australia (FAST), designed to increase the public's recognition of stroke symptoms.

The surveys were conducted by telephone interviews (Canada, Australia) or in person (England) before and after exposure to the campaigns.

All of the campaigns used television and | Changes in the ability to recognize stroke symptoms following awareness campaigns.

Timing of data collection surveys (before/after campaign):
Canada: 1 month/2 months
Australia: 10 months/2 weeks
England: 6 weeks/1 month | The cost of the campaigns was €7 million (England), €700K (Canada) and €650K (Australia).

Head-to-head comparisons across the 3 groups was not possible.

Prior to the campaign, a significantly greater number of English participants could identify more FAST components compared with Australian participants (F: 67% vs. 44%, A: 62% vs. 30%, S: 56% vs. 21%, T: 42% vs. 14%, all $p<0.001$).

Following the campaign significantly more English participants had increased their knowledge (F: 19% vs. 3%, A: 12% vs. 6%, S: 10% vs. 6%, T: 6% vs. -1%, all $p<0.01$).

Prior to the campaign, a significantly greater number of Australian participants could identify ≥2 warning signs of stroke compared with Canadian participants (59% vs. 50%, $p<0.001$). Following the |

Study/Type	Quality Rating	Sample Description	Method	Outcomes	Key Findings and Recommendations
			radio, print newspapers and digital means.		campaign, the percent change (increase) was similar between groups (Canada 7% vs. Australia 9%). Higher percentages of participants in England and Australia indicated they would call emergency services in the event of a stroke, compared with those from Canada (97% and 90% vs. 67%).
Worthmann et al. 2013 **Germany** **Cross-sectional surveys (pre/post intervention)**	NA	1004 adult residents of the city of Hanover	Computer-assisted interviews were conducted before and immediately after a 6-month public awareness campaign, designed to increase knowledge of stroke knowledge warning signs and risk factors, emergency care seeking behavior. The campaign included mass media (posters, flyers, public lectures, newspapers and television advertisements).	Changes in the ability to recognize stroke symptoms following the awareness campaign.	There was a significant increase in the number of participants who identified paresis and weakness as signs of stroke (from 40% to 46%, p=0.007 and 24% to 31%, p<0.001, respectively). There was also a significant increase in the number of participants who identified impaired vision as a sign of stroke (8% to 11%, p<0.05). There were no significant increases in the number of participants who identified gait disorders, numbness, sudden headache, nausea or disorientation as a sign of stroke. Following the campaign, there was a significant increase in the number of participants who indicated that the first action to take after recognizing a possible stroke was to call for emergency care (from 74% to 84%, p<0.001). There was a non-significant increase in the number of participants who indicated this action should be taken immediately (from 81% to 84%)
Fogle et al. 2010 **USA** **Controlled study**	NA	Intervention group: 400 adults randomly selected, living in a single county with a census of 85,314. Median age was 40 years. Control group: 401 adults randomly selected, living in a comparable county, with a census of 81,763. Median age was 33 years.	Participants in the intervention group were exposed to a high-intensity public education campaign, conducted during 2, 10-week periods (2007-2008). The campaign included television, radio and newspaper	Changes in the ability to recall ≥2 stroke warning signs before and after campaign, stroke risk factors and intentions to call '911' if a stroke was suspected	There was a significant increase in the number of participants in the intervention group, but not the control group, who could identify ≥2 warning signs before/after the campaign (from 73% to 82% and 68% to 69%, respectively). There was a significant increase in the number of participants in the intervention group, but not the control group, who could identify ≥2 risk factors for

Study/Type	Quality Rating	Sample Description	Method	Outcomes	Key Findings and Recommendations
			advertisements that focused on stroke warning signs and actions to take. Participants in the control group were not exposed to the campaign. Computer-assisted telephone surveys of adults ≥45 years were conducted before and after the campaign.		stroke before/after the campaign (from 69% to 86% and 70% to 65%, respectively). There was a non-significant increase in the number of participants in the intervention group who indicated that they would call '911' if they suspected they, or someone else were having a stroke (from 81% to 84%), while there was a significant decrease among participants in the control group (from 82% to 74%, p<0.05).
Lecoutuier et al. 2010 **UK** **Systematic Review**	NA	10 studies examining the effectiveness of mass media campaigns designed to change stroke-related knowledge and/or behaviour following the onset of stroke. 4 studies targeted the public and 4 targeted both the public and healthcare professionals (HCP).	Narrative synthesis	Knowledge of stroke symptoms and the need for rapid response, access to emergency services, and early treatment with thrombolysis.	Each of the 6 studies targeting public awareness demonstrated a significant increase in knowledge of stroke symptoms; however, these interventions appeared to have little impact on emergency response behaviours. Four studies targeted both professionals and the public. In light of the dual purpose of these interventions, the authors concluded that it was difficult to "disentangle any active components that might explain any reported impact". The interventions appeared to be more effective for HCP than the public.
Jurkowski et al. 2010 **USA** **Controlled study**	NA	Intervention group: 994 adults ≥30 years, randomly selected, living in 3 counties with a total population of 603K. Mean age was 56 years. 65% female Control group: 795 adults living in one county with a total population of 376K. Mean age was 54 years. 63% female.	Participants in the intervention group were exposed to a 3-phase multimedia campaign, designed to increase public awareness of the FAST mnemonic. Each stage of the campaign lasted for 33 weeks	Percentage of respondents aware of the campaign, aware of the campaigns primary message, and who would call 9-1-1 in response to specific stroke symptoms identified in oneself and/or others.	The percentage of respondents who reported they would call 9-1-1 in response to specific stroke symptoms increased significantly more from pre-to post campaign for participants in the intervention group, with increases ranging from 9%-12% for specific symptoms identified in oneself and 4%-12% for specific symptoms identified in others.

Study/Type	Quality Rating	Sample Description	Method	Outcomes	Key Findings and Recommendations
			Participants in the control group were not exposed to the campaign. Telephone surveys were conducted before and during phase 3 of the campaign.		
Marx et al. 2010 Germany Surveys (pre/post intervention)	NA	501 adults residing in 5 counties in western Germany. The census from the area was 400K. Mean age was 52 years. 44% male.	Computer-assisted telephone surveys were conducted before and after a 3-month mass-media educational, program (billboard, flyers, radio, television, and 3 full day public events) designed to increase awareness of stroke signs and symptoms and response.	Gender differences in general stroke knowledge, knowledge of stroke warning signs and risk factors, response in the event of stroke and through what source(s) had participants gained this knowledge	Prior to the intervention, significantly more women than men could correctly answer the question "where does stroke happen in the body?" (87.2% vs. 70.3%, p<0.001) and knew the stroke emergency call number (33.3% vs. 24.4%, p<0.001). Significantly more women knew to call for emergency care (87.2% vs. 70.1%, p<0.001) Following the intervention, an increased number of both men and women could answer the 2 questions correctly. The percentage change from pre to post intervention was significantly higher for women, (Question 1: +2.8%, p=n/s; Question 2, +5.7%, p<0.005). There were increases in the mean number of stroke warning signs that could be named before and after the intervention (women: 5.4 to 6.2; men: 5.1 to 5.9). Men and women were equally likely to recall campaign messages from television, radio and flyers. Women were more likely to remember the messages from leaflets and advertisements in pharmacies and doctor's offices, while men were more likely to remember them from advertisements on buses and street cars.
Hodgson et al. 2007	NA	1,000 adults ≥45 years residing in the province of Ontario.	Telephone surveys were conducted before, during and following 2 paid	Identification of up to 5 stroke warning signs, and the	Over the 6 sampling points, there was a significant increase in the proportion of participants who could

Study/Type	Quality Rating	Sample Description	Method	Outcomes	Key Findings and Recommendations
Canada **Retrospective study**			television advertising campaigns that lasted for 8 and 9 months, conducted in 2003 and 2005, designed to increase awareness of the warning signs of stroke.	proportion of participants who could name ≥2 signs of stroke	correctly identify ≥2 stroke warning signs, and the mean number of warning signs (p<0.001). Prior to the first campaign, 52.1% of participant could correctly identify ≥2 stroke warning signs. Following the completion of the first campaign, this percentage increased to 67.8%. From part-way through the second campaign to 7 months following its completion, there was a significant decrease in the percentage of persons who could correctly identify ≥2 stroke warning signs (70.8% to 64.2%, p<0.001). Across all polls, significantly more women than men could name ≥2 stroke warning signs. Only a small percentage of participants could identify all 5 signs of stroke (paralysis, slurred speech, headache, blurred vision and dizziness). (1.3%, prior to the first campaign, to a maximum of 3.5%, immediately following the second campaign)
Morgenstern et al. 2007 **USA** **(Kids Identifying and Defeating Stroke (KIDS)** **RCT**	CA: ⊠ Blinding: Patient ⊠ Assessor ⊠ ITT: ⊠	294 students in 3 intervention schools and 279 students in 3 control schools. There were significantly more males in the intervention schools (55% vs. 41%, p=0.002)	Students in the intervention group received 4, 50-minute classroom-based lessons for 3 years, starting in grades 6, designed to increase stroke awareness and response. Homework assignments were designed to include (and educate) the student's parents. Students in the control group received no stroke education	3 domains (4 questions each): stroke pathophysiology (domain 1), stroke symptom knowledge (domain 2) and behavioral intent to call 911 in the event of stroke (domain 3).	47% of students in the intervention group and 46% in the control group completed the pre and post tests. Only 18% and 16% of the parents completed both tests. (no analyses were conducted). There was a significant increase in the proportion of students answering questions correctly in domains 2 and 3 in both groups; however, the improvement was significantly greater for students in the intervention group. For domain 1, there was an increase in correct responses from 29% to 34% in the intervention group and a significant decrease in the control group (from 28% to 25%, p=0.007).

Abbreviations

CA: concealed allocation	CI: confidence interval	EMS: Emergency Medical Services
FAST: face, arm, speech, time	HTN: hypertension	ITT: intention-to-treat
RR: relative risk	OR: odds ratio	

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