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Stroke is Not an Accident: An Integrative Review on the Use of the Term 'Cerebrovascular Accident'

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Short Title: Use of the Term Cerebrovascular Accident

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ABSTRACT

Background: Cerebrovascular accident (CVA) is an outdated term for describing stroke as it implies stroke is an accident. We conducted an integrative review to determine use of CVA in terms of 1) frequency in major medical journals over time; 2) associated publication characteristics (e.g., number of authors, senior author country, topic); and 3) frequency in medical records.

Methods: We searched Google Scholar for publications in leading neurology and vascular journals (Quartile 1) across two 5-year periods (1998-2002 and 2018-2022) using the terms "cerebrovascular accident" or "CVA." Two reviewers independently reviewed full-text publications and recorded the frequency of CVA use. Rates of use (per 1,000 articles/year) were calculated for each journal and time period. Associations of publication characteristics with CVA use were determined using multivariable logistic regression models. In addition, admission and discharge forms in the Auckland Regional Community Stroke Study (ARCOS V) were audited for frequency of use of the term CVA.

Results: Of the 1,643 publications retrieved, 1,539 were reviewed in full. Of these, CVA was used ≥1 time in 676 publications, and ≥2 times in 276 publications (129 in 1998-2002; 147 in 2018-2022). The terms CVA and stroke both appeared in 57% of publications where CVA was used ≥2 times in 1998-2002, compared to 65% in 2018-2022. Majority of publications were on the topic of stroke (22% in 1998-2002; 20% in 2018-2022). There were no associations between publication characteristics and the use of CVA. The highest rate of CVA use in 2018-2022 was in *Circulation*, and increased over time from 1.3 uses per 1,000 publications in 1998-2002 to 1.8 uses per 1,000 publications in 2018-2022. The largest reduction the use of CVA was in *Neuroepidemiology* (2.0 uses per 1,000 publications in 1998-2002 to 0 uses in 2018-2022). The term CVA was identified in 0.2% of stroke admission and discharge forms audited (17/7808).

Conclusion: We found evidence of changes in the use of CVA in the scientific literature over the past two decades. Editors, authors and clinicians should avoid the use of the term CVA as it perpetuates the use of a non-specific, non-diagnostic, and non-scientific term.

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INTRODUCTION

Cerebrovascular accident (CVA) is an outdated term for describing stroke, as it implies that stroke is an 'accident', rather than a potentially avoidable event. CVA is a "non-specific, nondiagnostic, nonscientific"[1] term that is mistakenly used to describe all aetiologies of stroke, including transient ischaemic attack.[2] The term CVA implies a traumatic cause, and while traumatic brain injury increases the risk of stroke,[3] traumatic intracerebral or subarachnoid haemorrhages are not characterised as strokes.[4] Over 95% of all ischaemic strokes have at least one vascular risk factor,[5] and modifiable risk factors such as high blood pressure, smoking, inadequate physical activity, and unhealthy diet account for over 80% of the population attribution risk of all stroke.[6]

There have been calls from the medical community to stop using CVA in medical terminology dating back to the mid-1970s.[1,2,7,8] In many countries where English is the predominant language, the term CVA is still used in conversation and medical documentation to describe stroke. Terms used to describe stroke have evolved over time in response to advancement in research and clinical knowledge of stroke. Referring to stroke as CVA may perpetuate confusion amongst clinicians, researchers, the general public and patients, and undermine the efforts for stroke prevention.[2]

Clinical documentation of imprecise terms like CVA in a patient's medical record may contribute to clinical coding errors and prevent assignment of more granular International Classification of Diseases (ICD) codes. In turn, this affects funding of clinical care, research, and policy development.[9] Clear and accurate clinical documentation is needed to ensure administrative data for stroke are reliable.[10,11]

The aims of this integrative review were to determine the 1) frequency of the term CVA in publications in leading neurology and vascular journals for the periods 1998-2002 and 2018-2022; 2) characteristics associated with use in publications, including number of authors, profession and country of senior author, publication type and topic; and 3) frequency of CVA use in a large New Zealand dataset of medical records.

METHODS

This integrative review was guided by the framework developed by Whittemore and Knafl.[12] Our multidisciplinary co-author group developed and registered the protocol in advance.[13] The search was conducted in Google Scholar across two 5-year periods (1 January 1998 – 31 December 2002 and 1 January 2018 – 31 December 2022).

Identification of publications

Publications containing the exact phrase "cerebrovascular accident" or "CVA" were identified in Quartile 1 journals of the *Web of Science Journal Citation Report* categories of *Peripheral Vascular Disease* and *Clinical Neurology* (May 2023). The *Journal of Stroke and Cerebrovascular Diseases*, and *Cerebrovascular Diseases* were also included based on advice from co-authors (V.F. and L.S.). Following removal of duplicates, two authors (C.B. and A.S.) independently screened full-text publications using the below criteria, with a third author (M.F.K.) involved in consensus discussion when required.

Eligibility of publications

Publications not in English language, conference abstracts, letters to the editor, editorial comments, obituaries and theses were excluded. Publications were also excluded where the use of CVA was limited to the: a) reference list; b) keyword list; c) abbreviation list (including footnotes); d) search strategy for a review; e) proper name of a study or collaboration (e.g. Re-éducation Mécanisée après Accident Vasculaire Cérébral–Mechanized Rehabilitation After Cerebrovascular Accident); f) direct reference to the title of ICD codes; g) name of an existing measure (e.g. Consumer Quality Index: Cerebrovascular Accident); h) direct quote from documentation in a medical record; or i) direct quote from another study included in a review.

Included publications

One author (C.B.) undertook data extraction in REDCap, hosted by Monash University.[14,15] Data extracted included the publication details (e.g., year, journal, topic, citations), author characteristics (e.g. number of authors, profession of senior author, country of senior author), and the frequency and context of CVA use. We counted 'cerebrovascular accident' immediately followed by its abbreviation ('CVA') as a single unit. All data were extracted from the publication, apart from the senior author's profession which was obtained from publicly available websites (e.g., institution website, LinkedIn, ResearchGate). A 10% sample of extracted data were

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checked for accuracy by a second author (A.S.). Relevant publications were aggregated by the publishing journal.

Statistical analysis

Descriptive statistics were used to summarise the characteristics of the included publications for each period. Rates of use (per 1,000 articles/year) were calculated per journal and time period. The denominator (total number of publications per journal during each time period) was determined by searching the International Standard Serial Number (ISSN) of each journal in Web of Science, limited by publication type (article, editorial material, review article), English language and year. Where the journal was not indexed in Web of Science, the same search was replicated on the official journal website. Changes in rate of CVA use between the periods were calculated for journals active for the entire duration of both time periods only.

Multivariable logistic regression models were used to examine the association between publication characteristics (number of authors, senior author profession and high-income country of work, topic, type of publication) and use of CVA (≥2 times in a publication). Results were reported as odds ratios with corresponding 95% confidence intervals (CIs). The significance threshold was set at *p* value of ≤0.05. All data were analysed using Stata SE 18.0 (StataCorp, Texas).

In the main analyses, publications were included if CVA was used two or more times. A sensitivity analysis was undertaken to describe any use of CVA in stroke-specific publications. For this analysis, the denominator (total number of relevant publications per journal during each time period) was determined using the same methodology as above, and limited to publications with 'stroke' in the title or abstract.

Use of CVA in medical records

To supplement the findings from the journal publications, one author (N.H.) conducted a keyword search audit of the admission notes and discharge forms in the Auckland Regional Community Stroke Study 5 (ARCOS V) project dataset using R statistical software, v4.1.2.[16] The total count and proportion of use of the term CVA was reported. The ARCOS V study was a 12-month, prospective population-based register of new stroke cases in the Greater Auckland region of New Zealand, from 2020 to 2021. The study covered a population of 1,141,605 individuals aged ≥15 years. Data were collected from multiple overlapping sources, including hospital records, brain scans, discharge registers, and death certificates, ensuring comprehensive case ascertainment. The ARCOS V study aimed to provide robust data on stroke incidence, treatment outcomes, and long-term impacts in the Auckland population.[17]

RESULTS

Search Results

The search strategy yielded 1,643 publications, of which 1,539 underwent independent full-text review by two authors after removing duplicates (Figure 1), and 676 publications were included (1998-2002: 292; 2018-2022: 384). The main reasons for exclusion were that the term CVA was used in a manner permitted by our criteria (e.g., in a reference list), or the term was not found in the publication. There were 276 publications in which the term CVA was used ≥2 times (1998-2002: 129; 2018-2022:147).

Overall use of CVA

For publications in which CVA was used ≥2 times, the median use per publication was 3 (interquartile range [IQR] 2-6) in 1998-2002 and 3 (IQR 2-5) in 2018-2022 (p=0.85). The highest number of uses of the term CVA in a publication was 70 in 1998-2002 (*Stroke*, publication cited 194 times), and 86 in 2018-2022 (*Journal of Cerebrovascular Diseases*, publication cited 15 times). The terms CVA and stroke both appeared in 57% of publications in which CVA was used ≥2 times in 1998-2002, compared to 65% in 2018-2022.

Publication Characteristics

Publications including CVA ≥2 times were predominately on the topic of stroke (1998-2002: 22%; 2018-2022: 20%; Table 1). Most publications were written by 2-9 authors (1998-2002: 84%; 2018-2022: 65%), and were original research articles (both periods: 84%). Within each publication, CVA was mostly used in the body of the manuscript (1998-2002: n=98; 2018-2022: n=106), followed by tables (1998-2002: n=82; 2018-2022: n=103). In 2018-2022, most senior authors were non-cardiovascular or non-neurological physicians (27%; e.g., psychiatrist, internist), cardiologists (19%), neurosurgeons (14%), and neurologists (10%; Figure 1). There was no association between any of the publication characteristics (number of authors, senior author profession and high-income country of work, topic and type of publication) and the use of CVA ≥2 times (Supplemental Table I).

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Comparison of journals over time (2018-2022 vs 1998-2002)

The highest rate of CVA use in 2018-2022 was observed in *Circulation* (1.8 uses per 1,000 publications; Table 2). Between the two periods, *Circulation* had increased the rate of CVA use by 0.4 per 1,000 publications from 1998-2002. Where a journal had publications containing the term CVA in both periods, the greatest reduction in the rate of CVA use between periods was observed in *Stroke* (-1.6 uses per 1,000 publications).

There were nine journals which eliminated the use of the term CVA in their publications from 1998-2002 to 2018-2022. The largest reduction in the use of CVA was observed in *Neuroepidemiology*, from 2.0 uses per 1,000 publications in 1998-2002 to zero uses in 2018-2022. In contrast, the term appeared in 10 journals in 2018-2022, despite no prior use in the earlier time period. The greatest increase was observed in *Angiogenesis*, from zero uses in 1998-2002 to 0.8 per 1,000 publications in 2018-2022.

Results for all included journals with any number of uses of the term CVA are in Supplementary Table II.

Stroke-specific publications

For publications specifically about stroke, the median number of uses of the term CVA did not differ significantly between periods. The terms CVA and stroke were both used in 97% of publications with any use of CVA in 1998-2002, and 99% in 2018-2022 (Supplementary Table III).

The highest rate of use of the term CVA in 2018-2022 was 10.5 per 1,000 publications in *CNS Drugs* (Supplementary Table IV). No publications were identified from this journal using the term CVA on the topic of stroke in 1998-2002. Of the ten journals with the highest rate of use of the term CVA in 2018-2022, six had reduced the rate of use of CVA between time periods. The largest reduction was observed in *Brain* (-11.3 uses per 1,000 publications).

Use of CVA in medical records

The findings from the ARCOS V audit showed low use of the term CVA in New Zealand. The term CVA was documented in 0.2% of stroke records audited (17/7,808).

DISCUSSION

In this integrative review, we found that use of the term CVA is limited, but still present in English language scientific literature and medical documentation. While any use of the term CVA is inappropriate, there are signs of improvement over the past two decades.

Overall rates of CVA use are low, with relatively few publications identified using CVA in both periods analysed. However, there was an increase in use in recent years. This finding is supported by a review that demonstrated a clear increase in the use of acronyms in scientific papers over time, with the use of acronyms in abstracts increasing from 0.4 per 100 words in 1956 to 4.1 per 100 words in 2019.[18] Use of the abbreviation CVA only saves two characters per use compared to the term stroke, but has the potential to cause confusion and negatively influence stroke prevention efforts. Reducing the use of abbreviations, such as CVA, ensures that what is written can be easily read and understood by a wide audience.[18-20] Journal editors are ultimately responsible for all content published,[21] but there is also an onus on authors to use appropriate terminology. The International Committee of Medical Journal Editors advise authors to avoid non-standard abbreviations as they can be confusing for readers.[21] The Journal of the American Medical Association (JAMA) guidelines also instruct authors to limit the use of abbreviations,[22] but currently include CVA in their list of common abbreviations.[23]

Use of CVA was low in the New Zealand audit of stroke records, demonstrating that avoiding the term CVA is possible. However, this is only one example, and the use of the term CVA may differ in other countries. While it is positive that CVA use is low in this sample of medical records, it is well known that the use of abbreviations in medicine can lead to errors. Abbreviations are often difficult to interpret by professionals from other medical specialties, which increases the risk of misinterpretation, compromising patient care,[24] medication safety,[25] and data collection in the form of clinical coding.[26]

There is evidence that the terminology used to describe stroke is changing in the community. National stroke charity websites predominately use contemporary stroke terminology within resources for the general public. For example, the term CVA is not included in the Stroke Foundation 'Strokesaurus' (https://enableme.org.au/strokesaurus; accessed 23 May 2024) a list of stroke related words and definitions for the general public. Similarly, the New Zealand Stroke Foundation website (https://www.stroke.org.nz/; accessed 23 May 2024) only uses the term CVA one time in the context "a stroke is also known as a cerebrovascular accident (CVA)."

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The term CVA is not used in ICD-11, which came into effect in January 2022.[27] This classification by the World Health Organization provides a global definition of stroke which aligns with the American Heart Association/American Stroke Association.[4] The removal of the term CVA from international classifications means there is no official governmental reference to CVA any more. Until Australia and New Zealand move to ICD-11, there is still confusion around the terms CVA and stroke. The Australian Coding Standards Tenth Edition[28] titled the relevant stroke standard '0604 Stroke', which changed to '0604 Cerebrovascular Accident' for Eleventh[26] and Twelfth Editions.[29] The Australia and New Zealand Stroke Coding Working Group have contacted the Independent Health and Aged Care Pricing Authority in Australia about the use of the term CVA in the Australian Coding Standards. As a result, the term CVA will be removed from this standard in the Thirteenth edition. The authors will continue to advocate with relevant organisation (e.g. World Stroke Organization), and government departments on terminology and classification issues. The authors plan to contact the Editors-in-Chief of journals with high rates of CVA use as identified in this review.

Future directions

The use of the term CVA in medical records of other countries (such as the US and Australia) is largely unknown due to de-centralised medical records and use of paper-based records in some settings. However, the gradual and increasing uptake of electronic medical records across health services may allow for easier audits of CVA in the future. To better understand the real-world use of the term CVA, future research could investigate the use of CVA in medical and allied health degree coursework, and Australian medical records. Future directions could include comparing these results with quartile 4 journals to determine whether the use of the term CVA changes with journal impact factor. Future reviews may repeat this analysis in other journal categories, such as public health, where authors may not have a clinical background. This may assist with understanding the use of the term CVA in broader research settings.

While it is outside the scope of this review, more work is needed to change stroke terminology in other languages. For example, stroke is translated to accident vasculaire cerebral in French, and accidente vascular cerebral in Spanish.

Strengths and limitations

This study provides new evidence on the contemporary use of CVA in leading scientific journals for neurology and peripheral vascular disease. These findings have already been used to support continued changes to stroke terminology in Australia to enhance consistency in medical and administrative data.

Despite the large number of publications reviewed, some uses of CVA may have been missed if they were present only in digital scans or images. We also did not review supplementary materials as these are not typically copy-edited by journals. In the New Zealand medical record audit, only admission and discharge forms of patients with stroke were included. This does not capture the potential use of CVA in other parts of the medical records, nor for patients admitted to hospital for other reasons with past history of stroke. Information was not extracted for the profession of the senior author for the period 1998-2002 as this information was not readily available online. We were unable to directly ascertain how the use of CVA in the medical literature may have influenced clinical documentation and subsequent assignment of ICD codes.

CONCLUSION

Authors of publications should avoid the use of the term CVA, as it may perpetuate its inappropriate use. As the source of reputable academic information, journals have a responsibility to promote the use of precise terms in medicine, including the use of stroke instead of the more ambiguous and inappropriate term CVA.

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Statement of Ethics

The ARCOS V study was approved by the Health and Disability Ethics Committee of New Zealand (19/NTA/177) and Auckland University of Technology Ethics Committee (20/71).

Conflict of Interest Statement

D.A.C. is the current Data Custodian for the Australian Stroke Clinical Registry (AuSCR). D.A.C., M.F.K., and G.D. are members of the AuSCR Steering or Management Committees. D.A.C. reports receiving restricted grants from Amgen Australia, Boehringer Ingelheim, Ipsen, Medtronic, and Shire outside the submitted work. M.F.K. reports receiving educational grants from Amgen Australia and GSK outside the submitted work. L.L.D. reports receiving an educational grant from GSK outside the submitted work. G.D. reports receiving grants from the Australian Medical Research Future Fund and consulting fees from Argenica Therapeutics and Astra Zeneca. V.F. and B.Na. report receiving grants from the Health Research Council of New Zealand. B.No. has received honoraria for work in the Data Monitoring Committee of the HOVID trial (Symbec Orion). All other authors report no conflicts.

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Author Contributions

C.B. was responsible for the search strategy, screening articles, data extraction, formal analysis, and drafting the original draft. A.S. was responsible for screening articles, verifying the extracted data, and drafting the original manuscript. N.H. was responsible for the medical record audit. M.F.K. was responsible for supervision. All authors contributed to the conceptualization, methodology and were responsible for reviewing and editing the manuscript for intellectual content.

Data Availability Statement

Data that support the findings of this review are available from the corresponding author (M.F.K.) upon reasonable request. Due to ethical and legal restrictions, patient-level data from the medical record audit cannot be shared.

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Figure Legend

Figure 1. Summary of the search strategy and included publications. CVA indicates cerebrovascular accident.

Fig 2. Profession of the senior author of publications where the term cerebrovascular accident was used (2018-2022)

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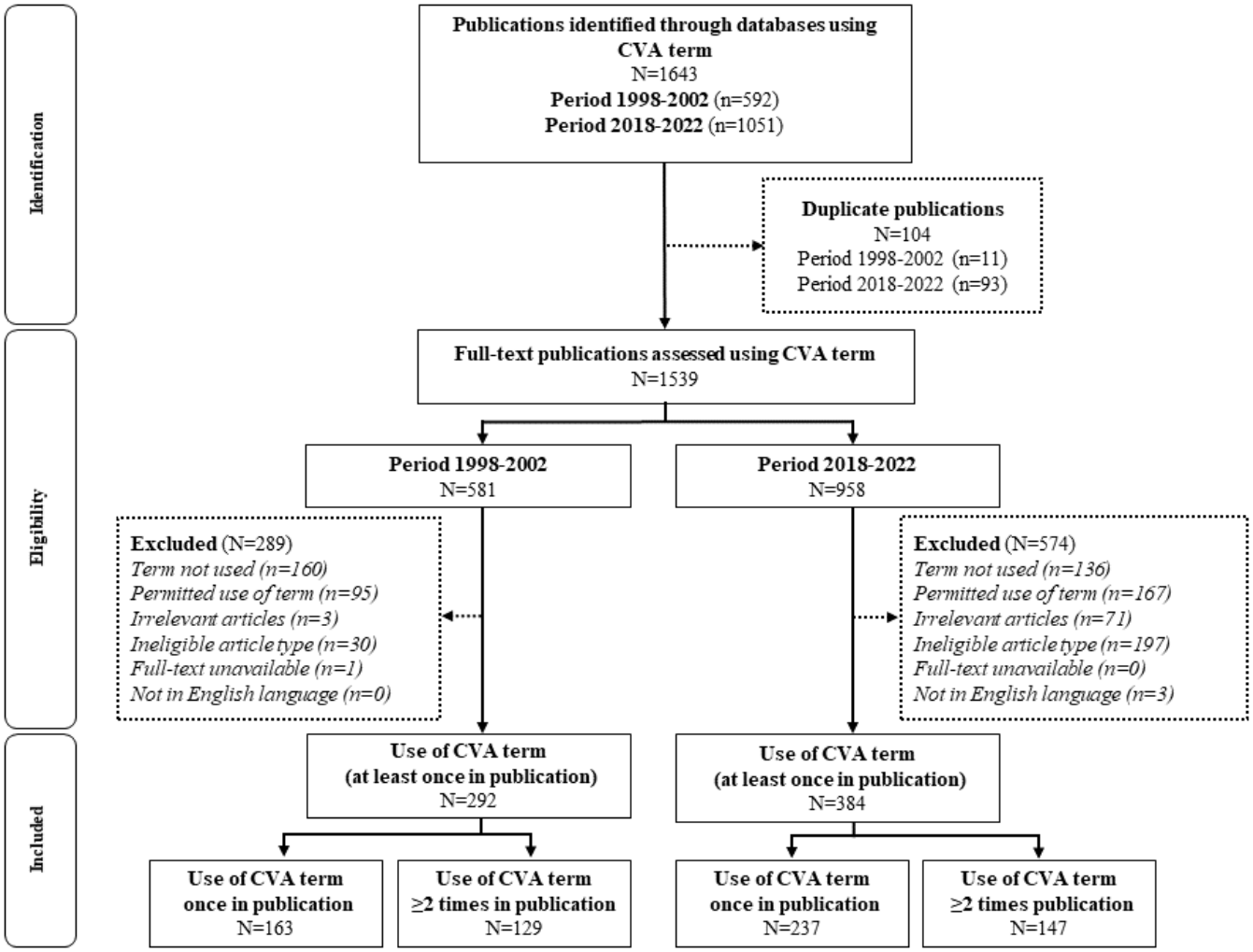

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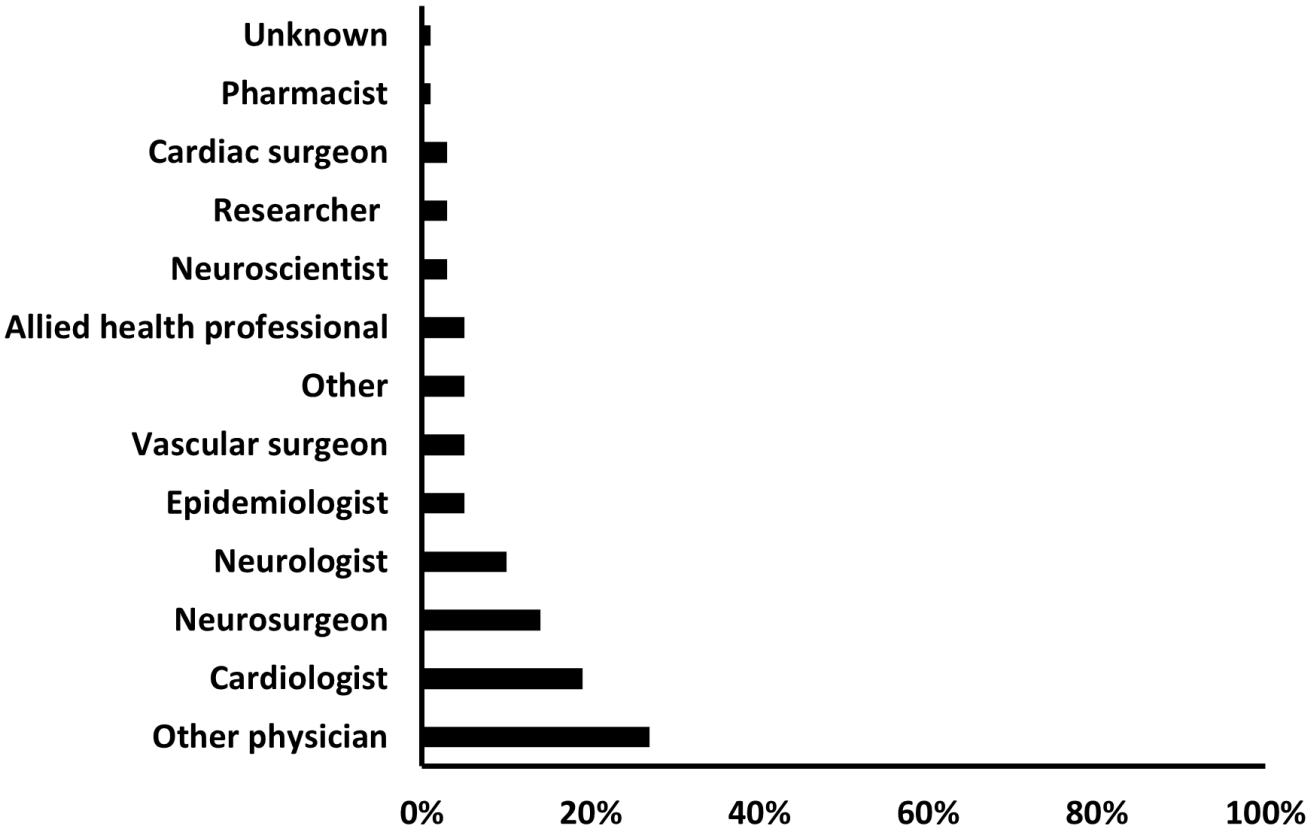

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Table 1: Characteristics of publications including cerebrovascular accident, by time period

Characteristic	1998-2002 N=129 n (%)	2018-2022 N=147 n (%)
Publication context (disease of interest)		
Stroke	29 (22)	29 (20)
Heart disease	27 (21)	18 (12)
Other cardiovascular disease	22 (17)	26 (18)
Other neurological disease	29 (22)	12 (8)
Medication	7 (5)	12 (8)
Infection	0	9 (6)
Trauma	0	5 (3)
Diabetes	0	4 (3)
Sleep	0	4 (3)
Cancer	0	3 (2)
Other	15 (12)	25 (17)
Author details		
Number of authors		
1 only	7 (5)	1 (1)
2-9	108 (84)	95 (65)
10-19	14 (11)	44 (30)
20+	0	7 (5)
Senior author country of work		
United States	62 (48)	70 (48)
United Kingdom	14 (11)	13 (9)
The Netherlands	11 (9)	13 (9)
Other	42 (33)	51 (35)
Type of publication		
Original research	108 (84)	123 (84)
Review	15 (12)	17 (12)
Editorial	1 (1)	1 (1)
Other	5 (4)	6 (4)
Both stroke and CVA terms used	74 (57)	96 (65)

CVA: cerebrovascular accident

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Table 2. Changes in the publishing of the term 'CVA' among journals* with the greatest contemporary use

			1998-2002 publications			2018-2022 publications			
Journal	**JIF**	**First issue**	**Number of publications with the term CVA**	**Total number of publications**	**Rate†**	**Number of publications with the term CVA**	**Total number of publications**	**Rate†**	**Change in rate†**
Circulation	39.922	1950	36	5476	**1.3**	24	2740	**1.8**	**0.4**
European Journal of Vascular and Endovascular Surgery	6.427	1987	6	1056	**1.1**	13	1636	**1.6**	**0.5**
Journal of Stroke and Cerebrovascular Diseases‡	2.677	1991	4	290	**2.8**	20	2940	**1.4**	**-1.4**
Atherosclerosis	6.851	1961	2	1576	**0.3**	10	1627	**1.2**	**1.0**
CNS Drugs	6.497	1994	2	386	**1.0**	2	434	**0.9**	**-0.1**
Neurosurgery	5.315	1955	4	6573	**0.1**	12	2685	**0.9**	**0.8**
Cerebrovascular Diseases	3.104	1991	2	514	**0.8**	2	489	**0.8**	**0**
Angiogenesis	10.658	1997	0	155	**0**	1	253	**0.8**	**0.8**
Neuropathology and Applied Neurobiology	6.25	1975	0	260	**0**	1	322	**0.6**	**0.6**
Journal of Neurosurgery	5.526	1944	0	2291	**0**	6	2251	**0.5**	**0.5**

CVA: cerebrovascular accident; JIF: Journal Impact Factor for 2021.
* Including only journals that existed in both periods; † Unadjusted rate, per 1,000 publications; ‡ Journal is Quartile 3 or Quartile

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