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A scoping review of stroke services within the Philippines

Angela Logan[1,2]*, Lorraine Faeldon[3], Bridie Kent[1,4], Aira Ong[1] and Jonathan Marsden[1]

Abstract

Background Stroke is a leading cause of mortality and disability. In higher-income countries, mortality and disability have been reduced with advances in stroke care and early access to rehabilitation services. However, access to such services and the subsequent impact on stroke outcomes in the Philippines, which is a lower- and middle-income countries (LMIC), is unclear. Understanding gaps in service delivery and underpinning research from acute to chronic stages post-stroke will allow future targeting of resources.

Aims This scoping review aimed to map available literature on stroke services in the Philippines, based on Arksey and O'Malley's five-stage-process.

Summary of review A targeted strategy was used to search relevant databases (Focused: MEDLINE (ovid), EMBASE (ovid), Cumulative Index to Nursing and Allied Health Literature (CINAHL), PsycINFO (ebsco); broad-based: Scopus; review-based: Cochrane Library, International Prospective Register of Systematic Reviews (PROSPERO), JBI (formerly Joanna Briggs Institute) as well as grey literature (Open Grey, Google scholar). The searches were conducted between 12/2022-01/2023 and repeated 12/2023. Literature describing adults with stroke in the Philippines and stroke services that aimed to maximize well-being, participation and function were searched. Studies were selected if they included one or more of: (a) patient numbers and stroke characteristics (b) staff numbers, qualifications and role (c) service resources (e.g., access to a rehabilitation unit) (d) cost of services and methods of payment) (e) content of stroke care (f) duration of stroke care/rehabilitation and interventions undertaken (g) outcome measures used in clinical practice.

A total of 70 papers were included. Articles were assessed, data extracted and classified according to structure, process, or outcome related information. Advances in stroke services, including stroke ready hospitals providing early access to acute care such as thrombectomy and thrombolysis and early referral to rehabilitation coupled with rehabilitation guidelines have been developed. Gaps exist in stroke services *structure* (e.g., low number of neurologists and neuroimaging, lack of stroke protocols and pathways, inequity of stroke care across urban and rural locations), *processes* (e.g., delayed arrival to hospital, lack of stroke training among health workers, low awareness of stroke among public and non-stroke care workers, inequitable access to rehabilitation both hospital and community) and *outcomes* (e.g., low government insurance coverage resulting in high out-of-pocket expenses, limited data on caregiver burden, absence of unified national stroke registry to determine prevalence, incidence and burden of stroke). Potential solutions such as increasing stroke knowledge and awareness, use of mobile stroke units, Tele-Medicine, TeleRehab, improving access to rehabilitation, upgrading PhilHealth and a unified national long-term stroke registry representing the real situation across urban and rural were identified.

*Correspondence:
Angela Logan
angie.logan@nhs.net
Full list of author information is available at the end of the article

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Conclusion This scoping review describes the existing evidence-base relating to structure, processes and outcomes of stroke services for adults within the Philippines. Developments in stroke services have been identified however, a wide gap exists between the availability of stroke services and the high burden of stroke in the Philippines. Strategies are critical to address the identified gaps as a precursor to improving stroke outcomes and reducing burden. Potential solutions identified within the review will require healthcare government and policymakers to focus on stroke awareness programs, primary and secondary stroke prevention, establishing and monitoring of stroke protocols and pathways, sustainable national stroke registry, and improve access to and availability of rehabilitation both hospital and community.

What is already known? Stroke services in the Philippines are inequitable, for example, urban versus rural due to the geography of the Philippines, location of acute stroke ready hospitals and stroke rehabilitation units, limited transport options, and low government healthcare insurance coverage resulting in high out-of-pocket costs for stroke survivors and their families.

What are the new findings? The Philippines have a higher incidence of stroke in younger adults than other LMICs, which impacts the available workforce and the country's economy. There is a lack of data on community stroke rehabilitation provision, the content and intensity of stroke rehabilitation being delivered and the role and knowledge/skills of those delivering stroke rehabilitation, unmet needs of stroke survivors and caregiver burden and strain,

What do the new findings imply? A wide gap exists between the availability of stroke services and the high burden of stroke. The impact of this is unclear due to the lack of a compulsory national stroke registry as well as published data on community or home-based stroke services that are not captured/published.

What does this review offer? This review provides a broad overview of existing evidence-base of stroke services in the Philippines. It provides a catalyst for a) healthcare government to address stroke inequities and burden; b) development of future evidence-based interventions such as community-based rehabilitation; c) task-shifting e.g., training non-neurologists, barangay workers and caregivers; d) use of digital technologies and innovations e.g., stroke TeleRehab, TeleMedicine, mobile stroke units.

Keywords Stroke, Stroke care, Low- middle-income countries, Developing countries, Philippines

Introduction

In the Philippines, stroke is the second leading cause of death, with a prevalence of 0·9% equating to 87,402 deaths per annum [1, 2]. Approximately 500,000 Filipinos will be affected by stroke, with an estimated US$350 million to $1·2 billion needed to meet the cost of medical care [1]. As healthcare is largely private, the cost is borne out-of-pocket by patients and their families. This provides a major obstacle for the lower socio-demographic groups in the country.

Research on implementation of locally and regionally adapted stroke-services and cost-effective secondary prevention programs in the Philippines have been cited as priorities [3, 4]. Prior to developing, implementing, and evaluating future context-specific acute stroke management services and community-based models of rehabilitation, it was important to map out the available literature on stroke services and characteristics of stroke in the Philippines.

Methods

The scoping review followed a predefined protocol, established methodology [5] and is reported according to the Preferred Reporting Items for Systematic Review and Meta-Analyses Extension for Scoping Reviews Guidelines (PRISMA-ScR) [6, 7]. Healthcare quality will be described according to the following three aspects: structures, processes, and outcomes following the Donabedian model [8, 9].The review is based on Arksey and O'Malley's five stages framework [5].

Stage 1: The research question:

What stroke services are available for adults within the Philippines? The objective was to systematically scope the literature to describe the availability, structure, processes, and outcome of stroke services for adults within the Philippines.

Stage 2: Identifying relevant studies:

The following databases were searched. Focused: MEDLINE, EMBASE, Cumulative Index to Nursing and Allied Health Literature (CINAHL), PsycINFO; broad-based: Scopus; review-based: Cochrane Library, Prospero, JBI (formerly Joanna Briggs Institute); Grey literature: Herdin, North Grey, Grey matters, MedRxiv, NIHR health technology assessment, Department of Health Philippines, The Kings Fund, Ethos, Carrot2. Additionally, reference lists of full text included studies were searched.

The targeted search strategy, developed in consultation with an information scientist, was adapted for each

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database (see supplemental data). Search terms were peer reviewed using the PRESS (Peer Review of Electronic Search Strategies) checklist [10].

The key search concepts from the Population, Concept and Context (PCC) framework were ≥ 18 years with a stroke living in the Philippines (*population*), stroke services aiming to maximize well-being, participation and function following a stroke (*concept*) and stroke services from acute to chronic including those involving healthcare professionals, non-healthcare related personnel or family or friends (*context*). Search tools such as medical subject headings (MESH) and truncation to narrow or expand searches were used. Single and combined search terms were included (see supplemental data). The search was initially conducted over two weeks in December 2022 and re-run in December 2023.

Studies were selected if they described stroke care in the Philippines in terms of one or more of the following: (a) patient numbers and stroke characteristics (b) staff numbers, qualifications and role (c) service resources (e.g., number of beds/access to a rehabilitation unit, equipment used) (d) cost of services and methods of payment (UHC, Insurance, private) (e) content of stroke care (f) duration of stroke care (hours of personnel contact e.g., Therapy hours per day); interventions undertaken (g) outcome measures used in clinical practice.

Additional criteria:

- Context: all environments (home, hospital, outpatients, clinic, academic institute).
- Date limits: published between 2002 onwards. This is based on the Philippines Community Rehabilitation Guidelines published in 2009 that would suggest that papers earlier than 2002 may not reflect current practice [11].
- Qualitative and quantitative studies including grey literature.
- Language: reported in English or Filipino only.
- Publication status: no limit because the level of rigor was not assessed.
- Type of study: no limit which included conference abstracts, as the level of rigor was not assessed.

Studies were excluded if they were in non-stroke populations or the full text article could not be obtained. Conference abstracts were excluded if there were insufficient data about methods and results.

Searches of databases were performed by one researcher (JM) and searches of grey literature were performed by one researcher (AO). All retrieved articles were uploaded into Endnote X9 software™, and

duplicates identified and removed before transferring them to Rayyan [12] for screening.

Stage 3: study selection

The title and abstract were selected using eligibility criteria. Two pairs of researchers independently screened abstracts and titles;(Databases: JM and AL and grey literature by AO and LF). Where a discrepancy existed for title and abstract screening, the study was automatically included for full text review and discussed among reviewers.

Two reviewers (JM and AL) undertook full-text screening of the selected studies. Discrepancies were resolved through consensus discussions without the need for a third reviewer. There were no discrepancies that required a third reviewer. Reason for exclusion were documented according to pre-determined eligibility criteria. References of included full text articles were screened by each reviewer independently and identified articles were subjected to the same screening process as per the PRISMA-ScR checklist (Fig. 1).

Stage 4: Charting the data

Two reviewers independently extracted the data using a piloted customized and standardized data extraction form including (1) Structure: financial (e.g., costs, insurance, government funding), resources (structure and number of stroke facilities, staff (number, profession/specialism, qualifications etc.), stroke characteristics (2) Process: duration of care, content of stroke care within acute, secondary care, community, outcome measures used; (3) Outcome: survival, function, patient satisfaction, cost (admission and interventions), and (4) year of publication, geographical location (including if Philippines only or multiple international locations) and type of evidence (e.g., policy, review, observational, experimental, clinical guidelines). Critical appraisal of included studies was not undertaken because the purpose of the review was to map available evidence on stroke services available within the Philippines.

Stage 5: Collating, summarising and reporting the results

The search identified 351 records from databases and registers. A total of 70 records are included and reasons for non-inclusion are summarized in Fig. 1.

Study descriptors

The characteristics of included studies are shown in Supplementary Material Table 1. Of the 70 included studies, 36 were observational with most being based on a retrospective review of case notes (*n*=31), two were audits, eight were surveys or questionnaires, four were consensus opinion and/or guideline development, three were randomized controlled trial (RCT) or feasibility RCT, 1
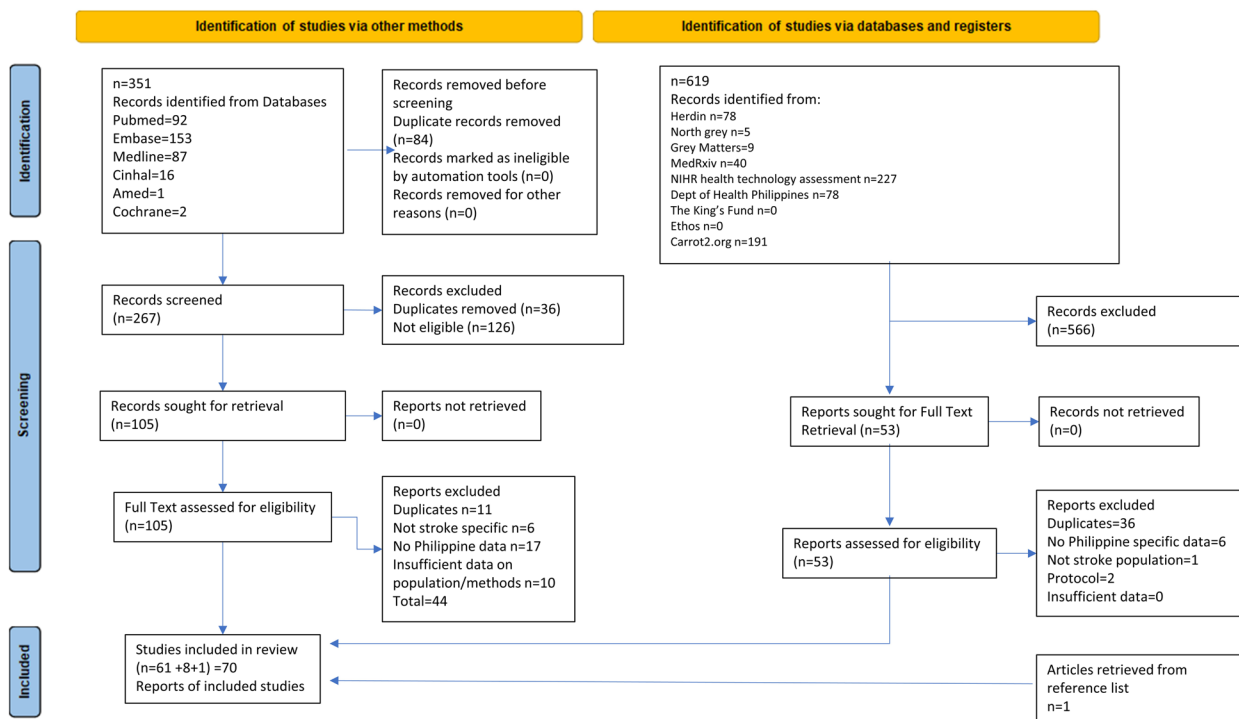
Fig. 1 PRISMA-ScR flow diagram

was a systematic review, two were policy and guidelines, 11 were narrative reviews or opinion pieces, two were case series or reports and one was an experimental study.

Of the 70 studies, 32 (45.7%) were based in a single tertiary hospital site. There were only three papers based in the community (4.3%). Papers that were opinion pieces or reviews were classified as having a national focus. Of the 22 papers classified as having a national focus, 10 (45.5%) were narrative reviews/ opinion pieces (Table 1).

The primary focus of the research studies (excluding the 11 narrative reviews and 2 policy documents) were classified as describing structure ($n=8$, 14%); process ($n=21$, 36.8%) or outcomes ($n=29$, 49.2%). The structure of acute care was described in seven studies out of eight studies ($n=7/8$ 87.5%) whilst neurosurgery structures were described in one out of eight studies (12.5%). Acute care processes were described in 11 out of 21 studies ($n=11/21$ 52.3%) whilst rehabilitation processes were described in six out of 21 studies (28.6%), with three out of 21 studies primarily describing outcome measurement (14.3%). The primary focus of the outcomes were stroke characteristics (25 out of 28 papers, 89.2%) in terms of number of stroke (prevalence), mortality or severity of stroke. Measures of stroke quality of life were not reported. Healthcare professional knowledge was described in two studies ($n=2/28$ 7.1%) whilst risk factors for stroke were described in one study ($n=1/28$,

3.6%). Carer burden was described in one study ($n=1/28$, 3.6%).

A summary of the findings is presented in Table 2.

Discussion

This scoping review describes the available literature on stroke services within the Philippines across the lifespan of an adult (> 18 years) with a stroke. The review has identified gaps in information about structures, processes and outcomes as well as deficits in provision of stroke services and processes as recommended by WHO. These included a low number of specialist clinicians including neurologists, neuro-radiographers and neurosurgeons. The high prevalence of stroke suggests attention and resources need to focus on primary and secondary prevention. Awareness of stroke is low, especially in terms of what a stroke is, the signs/symptoms and how to minimize risk of stroke [25]. Barriers exist, such as lack of healthcare resources, maldistribution of health facilities, inadequate training on stroke treatment among health care workers, poor stroke awareness, insufficient government support and limited health insurance coverage [22].

The scoping review also highlighted areas where further work is needed, for example, descriptions and research into the frequency, intensity, and content of rehabilitation services especially in the community setting and the outcome measures used to monitor recovery

Table 1 Summary of main focus, methods and population of the selected articles

Reference	Authors	Category	Design	Methods	Population and focus of interest
[13]	Baliguas 2018	Process Acute care	Audit	Assess adherence to the clinical practice guidelines of the stroke society of the Philippines in the management of ischemic stroke in young adults	3 tertiary hospitals (Bacolod City) May-October 2010 25 cases of ischaemic stroke in young (19-45 years) adults. Tertiary-multiple
[14]	Barcelon, Moll et al. 2016	Process Outcome Measure	Observational: prospective cohort	Correlate the Filipino and English version of the National Institute of health stroke scale	Consecutive patients (n=53) attending emergency or outpatient departments in a tertiary hospital. Tertiary-single
[15]	Baticulon, Lucena et al. 2023	Process: Neurosurgery	Survey	Online survey sent to all neurosurgeons (>1 year qualified) on the Philippines asking about neurosurgical procedures performed for different conditions.	People recruited from the database of the academy of Filipino neurosurgeons. Identified 174 neurosurgeons of which 102 responded. National
[16]	Berroya 2017	Process: Acute care	Observational: Retrospective Review of records	Retrospective review of notes of patients thrombolysed to determine the incidence of intracerebral hemorrhage	1 Tertiary hospital January 2010-February 2017 1695 brain attack calls of which 62 were thrombolysed. Tertiary-single
[17]	Carcel and Espiritu-Picar 2009	Outcomes: Stroke characteristics	Observational: Retrospective Review of records	Retrospective review of notes to determine circadian variations in stroke	Tertiary hospital 140 charts reviewed Jan 2008-May 2008 Tertiary-single
[18]	Cayco, Gorgon et al. 2019	Process: Rehabilitation	Case series	Describes outcomes proprioceptive neuromuscular facilitation (1 hr, x3/week for 6 weeks).	5 patients with a stroke seen in an outpatient clinic September 2016-May 2017. Tertiary-single
[19]	Co, Yu et al. 2020	Process: Acute care	Stroke care algorithm development during the COVID-19 pandemic	Stroke team and healthcare services reviewed previous infection control recommendations, stroke and emergency pathways.	Algorithm for people with acute stroke in tertiary hospital in Manila Tertiary-single
[20]	Co, Yu et al. 2020	Process: Acute care	Case report	Case report of a person with ischaemic stroke and COVID-19 positive receiving intravenous thrombolysis	Case report 62-year-old female with acute ischaemic stroke Tertiary-single
[21]	Collantes 2019	Process: Acute care	Observational Retrospective Review of records	Retrospective review using RES-Q databank to assess changes when using standardized stroke protocols in admission; diagnosis and acute management.	4 tertiary hospitals (out of 48 acute stroke units) using the RES-Q database. Tertiary-multiple
[22]	Collantes 2021	Structure, Process and Outcomes	Narrative review	Narrative review outlining Philippine-specific stroke education; establishment of acute stroke ready hospitals; stroke registry and stroke awareness and prevention campaigns	Not applicable National

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Table 1 (continued)

Reference	Authors	Category	Design	Methods	Population and focus of interest
[23]	Collantes, Navarro et al. 2022	Structure, Process and Outcomes	Narrative Review	Focus: To describe gaps in stroke care and the development of stroke systems of care in the Philippines	Search Medline, HERIN Plus Google Scholar and Philippines stroke society website searched. Search terms provided. National
[24]	Collantes, Yves Miel H. Zuñiga et al. 2022	Outcomes: Stroke characteristics	Systematic Review	Focus: Synthesize evidence on the incidence and prevalence of stroke in the Philippines, and associated risk factors	HERDIN, SCOPUS,WPRIM and Pubmed databases searched. Search terms and PRISMA diagram provided.13 articles included in synthesis National
[25]	Collantes, Zuñiga et al. 2021	Structure: Acute stroke care	Narrative review	Focus: Leadership and Governance, Financing, Access to r TPA, Service delivery, Health workforce, Health information Systems	Database search and search terms not provided National
[26]	Constantino and Soliven 2020	Process: Acute stroke care	Observational Retrospective Review of records	Retrospective review of notes to determine points of in hospital delays in thrombolytic therapy after a an acute ischemic stroke	42 patients who received thrombolysis 2014-2018. Tertiary-single
[27]	Constantino, Se ñ ga et al. 2023	Structure: Acute stroke care	Observational: Retrospective record review of people undergoing EVT	Retrospective review of patients post stroke undergoing mechanical thrombectomy. Assessed (a) Demographics and aetiology of stroke and type of intervention (b) NIHSS and m RS at baseline , 24 hrs post (NIHSS only) intervention and discharge (b) Modified thrombolysis in cerebral infarction (m TICI) measured reperfusion (c) CT scans assessed haemorrhagic transformation via radiographs and symptomatic intracerebral haemorrhage scale.	Records of 924 people admitted for an acute ischaemic stroke (October 2018-August 2021) in 1 tertiary centre. 31 patients had mechanical thrombectomy Tertiary-single
[28]	Dans, Punzalan et al. 2005	Outcomes: Stroke characteristics	National Survey	Stroke related outcomes: Stroke prevalence determined from a stroke questionnaire and a history of stroke diagnosis by a clinician Cardiovascular disease and potential risk factors (e.g. age, smoking history)	2,636 households (17 regions and 79 provinces) September- December 2003 Data on people over 20 years reported National

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Table 1 (continued)

Reference	Authors	Category	Design	Methods	Population and focus of interest
[29]	De Castillo and Collantes 2019	Structure and outcomes: Acute stroke care	Observational Retrospective Review of records	Retrospective review of notes to describe use of thrombolysis within 4.5 hrs and clinical outcomes	General Hospital January 2016-May 2017 38 out of 1774 (2.14%) acute stroke patients admitted less than 4.5 hours post ictus Tertiary-single
[30]	de Castillo, Diestro et al. 2021	Outcomes: Stroke characteristics	Observational Retrospective Review of records	Retrospective review of notes to describe incidence and outcome (at discharge and 30 days post event) with a cardiocerebral infarction	3-year data collection window-out of 1682 acute ischaemic strokes(AIS) and 1983 acute myocardial infarctions (AMI) there were 29 patients with both an AIS and AMI Tertiary-single
[31]	Delfino and Carandang-Chacon 2023	Structure: Acute stroke care	Observational Retrospective Review of records	Use of RES-Q database to compare stroke quality of care (door to scan time; door to needle time) before and during the COVID-19 pandemic	1 centre: 151 patients in pre COVID-19 period compared to 108 in COVID-19 period with acute ischaemic stroke Tertiary-single
[32]	Department of Health 2016	Structure and Process: Prevention	Government Document	National Policy on Strengthening the Prevention and Control of Chronic Lifestyle Related Non-Communicable Diseases	Not Applicable National
[33]	Department of Health 2020	Structure and Process: Prevention and acute stroke care	Government Document	The National Policy Framework on the Prevention, Control and Management of Acute Stroke in the Philippines	Not Applicable National
[34]	Diestro, Omar et al. 2021	Structure: Acute stroke care	Observational: Retrospective Review of records	In-hospitalization cost of stroke care determined from billing records, non-profit organisations and retail price Collect demographics, GCS on admission, treatments	Adult stroke admitted June 2017-May 2018 in a public tertiary hospital 863 records Tertiary-single
[35]	Duenas, Ranoa et al. 2019	Outcomes: Carer burden	Observational Retrospective Review of records	Cross sectional study of post-stroke carer burden using the modified caregivers strain index	74 caregivers recruited Community
[36]	Duya, Hernandez et al. 2019	Outcomes: Stroke characteristics	Observational Retrospective Review of records	Retrospective review of notes to describe the clinical characteristics (including echocardiographic profile) of patients admitted with an acute cardioembolic stroke	Tertiary hospital: 126 patients over a 2-year period. Tertiary-single

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Table 1 (continued)

Reference	Authors	Category	Design	Methods	Population and focus of interest
[37]	Espiritu and San Jose 2021	Structure and Process: Prevention and acute stroke care	Narrative review	Focus: Primary healthcare role in stroke management from prevention, acute care, secondary care and post stroke rehabilitation	Database search (Pubmed/Medline, Scopus, HERDIN) and search terms provided. National
[38]	Gambito, Gonzalez-Suarez et al. 2015	Process: Rehabilitation	Update of Contextualization of guidelines by PARM.	Discussion / debate followed by smaller writing groups to contextualise and update 2012 Filipino-contextualized stroke and low back pain guidelines PARM writing guide used to guide evaluation of evidence.	35 physiatrists members of PARM Working group of rehabilitation physicians and allied health practitioners National
[39]	Gelisanga and Gorgon 2017	Process: Outcome measures	Experimental	Assess the inter-rater reliability and retest reliability of the upright motor control test and its concurrent validity with the motricity index.	Convenience sample from a government run hospital in Manilla. 50 adults with a subacute stroke (mean, SD time post stroke =68 (48) days. Tertiary-single
[40]	Gonzalez-Suarez, Grimmer et al. 2015	Process: Rehabilitation	Audit	10% of records over past 12 months Assess indicators of good practice (a) Referral to rehabilitation less than 25% of LOS (b) referral at least 2 days prior to discharge (c) Continuous rehabilitation provided	17% of hospitals with rehabilitation units 1683 records National
[41]	Gonzalez-Suarez, Grimmer et al. 2018	Outcomes: Acute stroke care	Observational Retrospective Review of records	Retrospective review of notes to describe medical complications post stroke and factors predicting complications.	49 hospitals participated with 1683 records reviewed. Tertiary-multiple
[42]	Gonzalez-Suarez, Grimmer-Somers et al. 2012	Process: Rehabilitation	Contextualisation of western guidelines led by PARM	Working groups (n=2). 4 main stages: 1)Establish patient pathway and guideline aims 2)Systematic search, appraisal, and synthesis 3)Contextualisation 4) Implementation Presentation to 85% PARM members + Feedback on guidelines + sent to Neurology and Physical Therapy associations	2 working groups with 26 PARM members 4 guidelines included in guideline contextualization for stroke National
[43]	Gonzalez-Suarez, Margarita et al. 2013	Process: Rehabilitation	Protocol for implementation of Stroke Rehabilitation guidelines	Working group (a) design an audit protocol to describe current stroke care (b) identify methods for guideline dissemination (c) establish implementation strategies	Working group with 7 physiatrists, 2 physiotherapists, 2 occupational therapists. National

Table 1 (continued)

Reference	Authors	Category	Design	Methods	Population and focus of interest
[44]	Ignacio, Diestro et al. 2022	Outcomes: Stroke characteristics	Observational Retrospective Review of records	Cross sectional study: administration of hospital anxiety and depression scale along with a review of notes to determine prevalence of depression and anxiety and predictive factors in young onset stroke	Tertiary hospital: 114 people with young(18-49 yrs) stroke. Tertiary-single
[45]	Inting and Canete 2021	Outcomes: Stroke characteristics	Observational Retrospective Review of records	Retrospective review of notes to describe stroke subtypes using the TOAST and ASCO subtypes.	519 adult stroke patients admitted January 1-December 31, 2019 Tertiary-single
[46]	Jaca, Chacon et al. 2021	Outcomes: Stroke characteristics	Observational: Retrospective Review of records	Retrospective review of notes of patients with COVID-19 infection and stroke	584 cases of COVID reviewed March-August 2020 with 27 patients with a stroke Tertiary-single
[47]	Jamora, Corral et al. 2017	Outcomes: Stroke characteristics	Observational: Retrospective Review of records and interview	Assess stroke recurrence, myocardial infarction, and adverse reaction to aspirin monthly over 2-year period	People with a first Ischaemic stroke randomised to a multicentre trial of Aspirin dose n=262 Tertiary-multiple
[48]	Jamora, Prado et al. 2022	Outcomes: Stroke characteristics	Observational: Retrospective Review of records	Retrospective cohort study: review of confirmed cases of COVID-19	Review 10,881 cases of COVID-19 admitted to 37 referral hospitals 3.4% with COVID-19 and stroke Tertiary-multiple
[49]	Juangco and Mariano 2016	Process: Acute stroke care	Observational: Retrospective Review of records	Retrospective Review of records to assess the use of intraarterial thrombolysis in a tertiary hospital	Six patients with acute ischaemic stroke using intraarterial thrombolysis 2011-2015 Tertiary-single
[50]	Leochico, Austria et al. 2023	Process and outcomes: Rehabilitation	Pilot study	Determine the feasibility acceptability and safety of use of a 2 week youtube based telerehabilitation for community-dwelling persons with stroke	19 ambulatory non-aphasic members of a stroke support group recruited during the COVID-19 pandemic Community
[51]	Loo and Gan 2013)	Outcomes: Stroke characteristics	Narrative Review	Focus: Prevalence and incidence of stroke, Prevention and rehabilitation strategies	Database search and search terms not provided National
[52]	Mansouri, Ku et al. 2018	Structure: Neurosurgery	Survey including case scenarios to develop consensus opinion	Phase 1 provide information on hospital characteristics and procedures Phase 2 exploration of reasonable timeframes for access to and provision of neurosurgical specialist care	Convenience sample of 20 neurosurgeons across 6 LMICs including 13 from Manilla Regional

Table 1 (continued)

Reference	Authors	Category	Design	Methods	Population and focus of interest
[53]	Mendoza 2009	Structure: Acute stroke care	Observational Retrospective Review of records	Retrospective review of notes of acute ischemic stroke patients who underwent thrombolysis with recombinant tissue plasminogen activator therapy. Assessment of door to treatment time and outcomes	10 people admitted to 1 hospital who presented to the brain attack team. Dates of review not provided Tertiary-single
[54]	Navarro 2005	Outcomes: Stroke characteristics	Community based survey	Prevalence of stroke: Survey validated against the clinical diagnosis of a trained neurologist, but no neuroimaging	19,113 participants surveyed out of a population of 36,800 in Morong Rizal (southwest of Manilla) Regional
[55]	Navarro and Venketasubramanian 2021	Structure and outcomes: Stroke characteristics and acute stroke care	Narrative Review	Focus: Prevalence of stroke, stroke related risk factors and stroke service provision	Database search and search terms not provided National
[56]	Navarro, Baroque et al. 2013	Process: Education	Report/opinion piece	Focus: Stroke education in Philippine academic institutions	Description of certified stroke medicine courses. National
[1]	Navarro, Baroque et al. 2014	Outcomes: Stroke characteristics	Narrative review	Focus: Prevalence of stroke, stroke costs and stroke related risk factors	Database search and search terms not provided National
[57]	Navarro, Chen et al. 2017	Outcomes: Stroke characteristics	Randomised controlled trial 21 month follow up data	21 month follow up of participants recruited in the Philippines for an RCT of MLC601 (Neuroaid) versus placebo (CHIMES Chinese Medicine Neuroaid Efficacy on Stroke recovery study) Assessment in person and via phone of m RS and Modified Barthel Index	378 participants (192 Neuroaid, 186 placebo) from the Philippines Tertiary-multiple
[58]	Navarro, Escabillas et al. 2021	Process: Acute stroke care	Observational: Retrospective Review of records	Compare admissions to stroke unit (SU) versus general ward (GW) in terms of demographics, mortality, functional outcomes	11 institutions with stroke units (23.9% of planned sample) from January 2016-April 2017 1025 pw Stroke (503 SU and 522 GW) Tertiary-multiple
[59]	Navarro, San Jose et al. 2018	Outcomes: Stroke characteristics	Observational: Retrospective Review of records	Assess in patient and 3-month mortality. Presence of intracranial haemorrhage and functional outcome (m RS)	157 patients out of 11,874 receiving rTPA in 10 institutions from 2014-2016 Tertiary-multiple

Table 1 (continued)

Reference	Authors	Category	Design	Methods	Population and focus of interest
[60]	Ng, Churojana et al. 2019	Structure: Acute stroke care	Pilot survey to neuroradiologists providing acute stroke EVT	Data collected: (1) availability of acute stroke thrombectomy devices,(2) current number of EVT sites and INRs, (3) present number of EVT procedures in each country and (4) projected growth in number of EVT cases	Neuroradiologists providing acute stroke EVT in 6 South East Asia countries surveyed in 2017 National
[61]	Ocampo, De Leon-Gacrama et al. 2021	Process: Acute stroke care	Observational: Retrospective review of notes from Brain Attack Team 2014-2017	Assess number of stroke mimics (defined by negative neuroimaging and /or lab results confirmed by stroke consultant) for demographics, initial and final diagnosis, costs of laboratory or imaging tests	1485 records from emergency department and in hospital over 4-year period in 1 hospital (Quezon City) of these 30.2% (448) were diagnosed as stroke mimics Tertiary-single
[62]	Pascua and Hiyadan 2023	Outcomes: Neurosurgery	Observational Retrospective Review of records	Retrospective review of notes to assess the outcome of decompressive hemicraniectomy in supratentorial intracerebral haemorrhage.,	One tertiary government hospital; 65 patients (January 2017-August 2022) Tertiary-single
[63]	Prado, Jamora et al. 2022	Outcomes: Stroke characteristics	Observational Study (abs) Retrospective Review of records	Retrospective cohort study: review of confirmed cases of COVID-19	Review 10,881 cases of COVID-19 admitted to 37 referral hospitals 3.4% with COVID-19 and stroke Tertiary-multiple
[64]	Qua, Tiqui et al. 2022	Outcomes: Acute stroke care	Observational study Retrospective Review of records	Retrospective analysis of notes to assess predictors of early deterioration of people with acute ischaemic stroke from Hematological, Lipid Profile, and Metabolic Parameters	Tertiary hospital: 37 patients (Jan -Dec 2021) with stroke Tertiary-single
[65]	Que, Cuanang et al. 2020	Outcomes: Stroke characteristics	Observational study (abs) Retrospective Review of records	Retrospective analysis of notes to assess clinical characteristics and management of people with a cerebral venous thrombosis	Tertiary Hospital: 18 people with venous thrombosis Tertiary-single
[66]	Quiles, Diamante et al. 2022	Outcomes: Stroke characteristics	Observational study: Retrospective Review of records	Retrospective, comparative study. Assessed: Classification of ischaemic and haemorrhagic stroke; stroke severity (NIH), discharge outcome	Adult stroke patients admitted between pre-COVID-19 (February 2019-January 2020 N=385) and COVID-19 periods (February 2020-January 2021 N=316) who presented to the emergency department in 1 hospital Tertiary-single

Table 1 (continued)

Reference	Authors	Category	Design	Methods	Population and focus of interest
[67]	Roxas 2002	Outcomes: Prevention	Case-control study Face to face questionnaire	Questions completed via face to face interview asking about recall of risk factors including medical history; smoking, contraceptive pill, alcohol use, snoring, BMI, stress	Patients with first ever stroke (SAH excluded) recruited from July-December 1999 by 32 neurologists practicing in 13 out of 16 administrative regions. Controls had no history of stroke. 1922 subjects (961 cases and 961 age and sex matched controls) National
[68]	Roxas 2002	Outcome: Healthcare professional knowledge	Survey	Structured self-administered questionnaire to determine knowledge and perceptions of stroke among barangay health workers	103 out of 110 barangay health workers in Plaridel Municipality Community
[69]	Sasikumar and Bengzon Diestro 2020	Structure: Acute stroke care	Narrative/ opinion piece	Focus: Narrative description of the management of a stroke code	Response to a stroke in Manila, Philippines and Ontario, Canada narratively described Tertiary-single
[70]	Senga and Reyes 2019	Outcomes: Acute stroke care	Observational study (abs) Retrospective Review of records	Retrospective review of the clinical profile of patients with Cerebral venous sinus thrombosis	Tertiary Hospital: Patients (n=31) admitted 2013-2018 Tertiary-single
[71]	Sese and Guillermo 2023	Structure and Process: prevention	Narrative review and opinion piece	Conceptual framework outlined for stroke prevention and awareness in the Philippines	Not applicable National
[72]	Suwanwela, Chen et al. 2018	Outcomes: Stroke characteristics	RCT : Follow up	There month follow up assessment to determine whether combining MLC601 (NeuroAiDTM) and rehabilitation affects outcomes	6 countries participate. In the Philippines n=326 (total cohort at follow up=807) recruited with 32.8% receiving rehabilitation Tertiary-multiple
[73]	Talamera and Franco 2011	Process: Outcome measures	Observational: Prospective validation study	Compare the Siriraj Stroke Score with CT results	298 participants (67.45% with ischaemic stroke) recruited 2009-2010. Tertiary-single
[74]	Tan and Navarro 2014	Outcomes: Acute stroke care	Observational Retrospective Review of records	Retrospective review of notes to assess outcomes and management of patients with a primary intracerebral haemorrhage	Single centre January-December 2011 514 patients with 23% having an intracerebral haemorrhage. Tertiary-single
[75]	Tangcuangco, Bitanga et al. 2010	Process: Acute stroke care	Observational Retrospective Review of records	Retrospective review of notes to describe the use of Intravenous recombinant tissue plasminogen activator (IV-rtPA) in acute ischemic stroke	Private tertiary hospital: review 2007-2009. N=18 admitted and given IV-rTPA. Tertiary-single
[76]	Tsang, Yang et al. 2020	Process: Acute stroke care	Survey	multi-national survey in Asia to assess accessibility of endovascular thrombectomy for acute ischemic stroke	Three neurology respondents within the Philippines National

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Table 1 (continued)

Reference	Authors	Category	Design	Methods	Population and focus of interest
[77]	Vatanagul and Cantero-Auguis 2015	Outcome: Healthcare professional knowledge	Questionnaire	Questionnaire to determine from family medicine and internal medicine residents the level of awareness on acute stroke diagnosis	145 resident physicians in Metro Cebu surveyed July 2013-August 2014. Regional
[78]	Vatanagul and Rulona 2015	Outcomes: Stroke characteristics	Observational Prospective cohort	Assess prospectively depression incidence in acute stroke using the hospital anxiety and depression scale	Tertiary Hospital (Cebu): 100 patients recruited (January-July 2014) Tertiary-single
[79]	(atanagul, Rulona et al. 2013	Outcomes: Stroke characteristics	Observational Retrospective Review of records	Retrospective review of notes to assess to describe clinical presentation and outcomes of cerebral venous sinus thrombosis	One tertiary hospital: Notes reviewed June – August 2012: 4 patients (2 with superior sagittal sinus and 2 with transverse sinus thrombosis. Tertiary-single
[80]	Venketasubramanian, Yoon et al. 2017	Outcomes: Stroke characteristics	Narrative Review	Focus: Epidemiology of stroke in South, East and SE Asia	Search in PubMed, search terms provided and Philippines-specific data described. National
[81]	Yu, San Jose et al. 2002	Process: Acute stroke care	Observational: Interview and review of records from stroke data bank dataset	Determine time from symptom onset to (a) neurology assessment and (b) CT scanning. Demographic and medical factors associated with delays	Level III hospital patients admitted May-October 2000 259 patients analysed Tertiary-single

and impairment. PARM published stroke rehabilitation clinical practice guidelines in 2012, which incorporated an innovative approach to contextualize Western clinical practice guidelines for stroke care to the Philippines [42]. Unfortunately, availability and equitable access to evidence-based rehabilitation for people with stroke in the Philippines pose significant challenges because of multiple factors impacting the country (e.g., geographical, social, personal, environmental, educational, economic, workforce) [25, 40, 43].

The number of stroke survivors with disability has not been reported previously, thus, the extent and burden of stroke from acute to chronic is unknown. The recent introduction of a national stroke registry across public and private facilities may provide some of this data [82]. The project started in 2021 and captures data on people hospitalized for transient ischemic attack or stroke in the Philippines. National stroke registries have been identified as a pragmatic solution to reduce the global burden of stroke [83] through surveillance of incidence, prevalence, and outcomes (e.g., death, disability) of, and quality of care for, stroke, and prevalence of risk factors. For the Philippine government to know the full impact and burden of stroke nationally, identify areas

for improvement and make meaningful changes for the benefit of Filipinos, the registry would need to be compulsory for all public and private facilities and include out of hospital data. This will require information technology, trained workforces for data capture, monitoring and sharing, as well as governance and funding [83].

This scoping review has generated a better understanding of the published evidence focusing on availability of stroke services in the Philippines, as well as the existing gaps through the lens of Donabedian's *Structure*, *Process* and *Outcome* framework. The findings have helped to inform a wider investigation of current stroke service utilization conducted using survey and interview methods with stroke survivors, carers and key stakeholders in the Philippines, and drive forward local, regional and national policy and service changes.

Conclusions

This scoping review describes the existing evidence-based relating to structure, processes and outcomes of stroke services for adults within the Philippines. The review revealed limited information in certain areas, such as the impact of stroke on functional ability,

Table 2 Summary of structure, process and outcome data

Structure	
Stroke Services: Numbers	• 1,224 hospitals with 53% private and 47% government owned [25] • 53 acute stroke ready hospitals and 48 stroke units [21, 25] • 15.8% hospitals have rehabilitation units in 2015 [40] • 452 rehabilitation units [25]
Stroke services	• Acute stroke units providing early CT scans, thrombolysis teams with referrals to rehabilitation and dysphasia assessment. [21]
Staff: Patient Ratios	• 400 adult board-certified neurologists (2019) [25] • > 100 physiatrists [25] • 80% neurologists in Luzon, 12% Visayas, 8% Mindanao [25] • 1 neurologist for every 218,000 Filipinos which is significantly below the World Health Organisation recommended ratio of 106 neurologists per 100,000 population [1] • Neurosurgeons: 13 per million [52]
COVID-19	• Changes made to minimise delay may have worsened functional outcomes and avoid compromising staff safety, e.g., reduction of staff and telemedicine [19]
Current state of stroke systems of care and knowledge (Process)	
Training and Knowledge	• 5-year national stroke training program to aid in organising stroke teams and developing stroke ready hospitals and acute stroke units [25] • 2.5% of participants know stroke affects the brain [37] • 15% know stroke is an emergency [37] • Knowledge and awareness of stroke diagnosis and management among Family Medicine and Internal Medicine residents of Metro Cebu were high but 90% agreed with the need for continuing education and a desire to develop these stroke skills [77] • Medical training is also provided through university accredited courses [56] • Knowledge of stroke among barangay health workers was rated as fair to good [68]
Acute Care	*Delays in admission:* • Lack of knowledge/awareness of stroke, transportation problems and traffic, transfer from a primary hospital with minimal stroke care and incomplete facilities, overcrowding of public hospitals, lack of organized stroke network and lack of emergency medical services caused delays [25] • No significant change in the quality of acute ischemic stroke care during COVID-19 [20, 30] *Acute stroke care metrics*: • 62% felt symptoms were mild & 38% self-medicated [81] • Phone or contact physician 19% [81] • Primary care provider is first responder in Initial contact with non-neurologist in 97% of cases [37] • Median time hospital is2 hours to and median time to neurologist is 7.5 h [81] • The median time from presentation to brain imaging was significantly shorter for patients brought to CT-equipped facilities (2 h) than for those needing transfer to other hospitals (11.5 h) [81] • Stroke to door mean time = 12.7 h [59] *Diagnosis and Management*: • 27% hospitals did not have neuroimaging • 53% of patients had imagining within 6 h [81] • 12.5% had surgery (craniotomy and aneurysm clipping most common) [62] • Private sector dominates thrombectomy services [60] • Intravenous thrombolysis continued to be administered during COVID-19 [19] • Intravenous thrombolysis occurs in 3.7% [16, 34] with 2.1% admitted < 4.5 h post stroke [29]. Door to needle time varies 97–174.3 min [26, 29, 53, 59, 75]. From symptom-onset mean time of 97 min [59] • Herbal or Chinese medicines may be used e.g., MLC601 (NeuroAiD™) which was beneficial for functional recovery up to two years post-stroke [57]

Table 2 (continued)

Structure	
Rehabilitation	*Referral*: • Median time from admission to referral to rehabilitation = 3 days [40] • People with haemorrhagic stroke are less likely to be referred for rehabilitation but more commonly received continuous rehabilitation than other stroke types [40] • 25.4% referred for rehabilitation in first 25% of admission [40] • Referral earlier than two days prior to discharge in 75.6% of records [40] • Rehabilitation referral data is from eight public and 41 private hospitals with rehabilitation units; no data provided on referral to outpatient or home-based rehabilitation [40] *Access*: • Limited access to, and availability of, adequate rehabilitation facilities [40] • The Philippine Academy of Rehabilitation medicine (PARM) implementation strategy aims to optimize access to stroke care [43] • Telerehabilitation developed in response to the COVID-19 pandemic [50] *Duration/intensity*: • PARM endorses a minimum of 45 min of active practice per day, 5-days a week, for both physical therapy and occupational therapy. Duration and intensity of the program should be adjusted based on the patient's needs/abilities [38, 42] *Interventions*: • Proprioceptive neuromuscular facilitation program [18] • Chinese medicine (MLC601, NeuroAiD™) combined with stroke rehabilitation [72]
Outcomes	
Prevalence	• Stroke prevalence of population and hospital-based range from 0.48–6.59% [1, 24, 28, 51, 54, 55, 80] • Stroke prevalence is expected to grow due to the increasing risk factors and ageing population [28] • In 25 cases of Young Stroke (mean age of 36.05 years) 56% had a mild stroke or TIA and 44% a moderate stroke with only 28% (7 out of 25) being managed by a neurologist [13] • The incidence of stroke among patients with COVID-19 were 4.62% [46] and 3.4% [48]
Risk factors	• Primary and secondary stroke risk factors include hypertension, diabetes, diet, impaired glucose intolerance, obesity, smoking, air pollution, alcohol intake, hypercholesterolemia, and physical inactivity [1, 24, 28, 37, 55, 67] • In younger adults with ischemic stroke, the most common risk factors were oral contraceptive pill use (42%) in females and hypertension (46%) in males [13] • Combined community-based prevention and targeted public awareness campaigns has been proposed to reduce risk factors [71]
Secondary stroke prevention	• For Filipinos taking Aspirin for first-event non-cardioembolic ischaemic stroke, the risk for stroke recurrence was 7.9% in the first year and 12.4% in the second year [47]
Length of Stay (LOS)	• Median 7 days (range 0–63) [40] • Longer LOS for haemorrhage [40]
Clinical Presentation	• Cardioembolic stroke: Atrial fibrillation was the most common rhythm abnormality (67%) and 20% had rheumatic heart disease (RHD) [36] • Cerebral venous sinus thrombosis more common in women with risk factors of oral contraceptive pill use, smoking, pregnancy, primary antiphospholipid syndrome, hereditary thrombophilias [65, 79]. Case series reported [65, 79] with 54.86% less than 50 years old [70] • Cardiocerebral infarction (CCI) prevalence rate = 0.79% with patients presenting as moderate-severe acute ischemic strokes and high-risk acute myocardial infarction and death [30] • Ischemic strokes have a peak occurrence between 06.00 and 12.00 h. Haemorrhagic strokes have a higher occurrence between 18.01 and 23.59 h. [17] • Subtypes of stroke: small vessel disease (52.9%), cardioembolic (16.3%), large artery atherosclerosis (10%), other causes (0.39%) using *Trial of Org 10,172 in Acute Stroke Treatment* (TOAST) and ASCO phenotypic classification (Atherosclerosis, Small vessel disease, Cardiac source, Other) [45]
Complications and their prediction	• Pneumonia (50%), followed by respiratory failure (7.7%) and gastrointestinal bleeding (3.8%) were the most common medical post-stroke hospital-based complications [64] • Multiple variables predict pneumonia post-stroke including no swallow screen within the first 24 h and having a nasogastric tube inserted [41] • Routine laboratory parameters were unable to predict the early neurological deterioration of Filipino acute ischaemic stroke patients [64] • Post-stroke depression in young adults (18–49 years) was 20.2% and anxiety was 34.2%. Significant predictors of post-stroke depression were the presence of anxiety, level of disability (mRS 3–5) and diabetes. Significant predictors of post-stroke anxiety included depression and level of dependency (Barthel Index scores 95–100) [44]

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Table 2 (continued)

Structure	
Mortality	• Mortality 19.4% [34] • Mortality rate post thrombolysis: 14.6% in hospital and 18.3% 3-months [59]. In hospital mortality associated with intracranial haemorrhage [59] • Less likely to die within 6 months if admitted to Stroke Units [58] • 29% died following endovascular thrombectomy (EVT) [27] • Significantly higher mortality during COVID-19 pandemic than pre-COVID-19 (7% vs. 13%) [63, 66] • All-cause mortality for patients with primary intracerebral hemorrhage during admission was 14% and case mortality was 11% [74]
Independence	• Functional independence higher if admitted to Stroke Units versus General ward admission [58]: • Significantly higher proportion of patients with moderate (National Institutes of Health Stroke Scale (NIHSS) 6–20) and severe stroke (NIHSS ≥ 21) during COVID-19 pandemic due to delays seeking medical help [66]. Higher functional dependence on discharge compared to pre-pandemic (86% versus 80%) • Following EVT, favourable outcomes seen in only 22.6% who had moderate to severe post-stroke disability, while 15 (48.4%) remained functionally dependent at discharge [27]
Costs	*Hospitalisation*: • Typically free in government hospitals, however, a significant amount of expenses are borne out-of-pocket by patients and their families, depending on the severity of stroke and its associated complications [47] • Median cost $329.64, mean cost $751.43 [34] • PhilHealth, Philippines national health insurance system only reimburses $560 and $760, thus expenses incurred by the average Filipino family can cause poverty, especially those in lower-income classes [47] • PhilHealth reimburses $560 for ischaemic and $760 for haemorrhagic stroke [25] *Thrombolysis*: • Up to $2733–4573 in private hospitals. $65–718 in government hospitals [25, 69] •Intravenous thrombolysis was approved in the Philippines in 1999 but utilization has been significantly limited due to its prohibitive cost [59] *Rehabilitation*: •Coverage is considered insufficient due to the absence of a dedicated package of rehabilitation services. Costs range from $53.50-$4,591.60 and largely borne out-of-pocket [25] Although out-of-pocket costs were reported, the included articles did not report nor discuss catastrophic out-of-pocket costs
Outcome measures	*Severity*: • National Institutes of Health Stroke Scale (NIHSS) has been translated and culturally adapted into a Filipino version; Fil-NIHSS [14] • Siriraj Stroke Score (SSS) deemed valid in Filipinos for bedside scoring in the absence of CT brain scans to clinically diagnose stroke [73] *Impairment and functional outcomes*: • Upright Motor Control Test Knee Extension (UMCT-KE) and Knee Flexion subscales (UMCT-KF), Motricity index [39]
Caregiver strain	• 35.14% of post-stroke caregivers are predisposed to caregiver strain. Those predisposed to caregiver strain were caring for people with moderately severe disability (modified Rankin Scale 4 (mRS)) [35] • 13.51% had severe caregiver strain and 40% were caring for people with moderately severe disability (mRS 4) and 60% had severe disability (mRS 5) [35] • Caregiver strain was lower in caregivers who were closely related to the patient (spouses and first-degree relatives) and was found to be higher in more distant relatives (second-degree relatives and in-laws) [35]

participation in everyday life, and quality of life; the content and intensity of rehabilitation both in the hospital or community setting; and the outcome measures used to evaluate clinical practice. Developments in stroke services have been identified however, a wide gap exists between the availability of stroke services and the high burden of stroke in the Philippines. Strategies are critical to address the identified gaps as a precursor to improving stroke outcomes and reducing burden. Potential solutions identified within the review will require a comprehensive approach from healthcare policymakers to focus on stroke awareness programs, primary and secondary prevention, establishing and monitoring of stroke protocols and pathways, implementation of a compulsory national stroke registry, use of TeleRehab, TeleMedicine and mobile stroke units and improve access to and availability of both hospital- and community-based stroke rehabilitation. Furthermore, changes in PhilHealth coverage and universal credit to minimize catastrophic out-of-pocket costs.

Limitations
Although a comprehensive search was undertaken, data were taken from a limited number of located published studies on stroke in the Philippines. This, together with data from databases and grey literature, may not reflect the current state of stroke services in the country.

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Supplementary Information

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Supplementary Material 1.

Availability of data and materials

Not applicable.

Data availability

No datasets were generated or analysed during the current study.

Declarations

Ethics approval and consent to participate

Not applicable.

Consent for publication

Not applicable.

Competing interests

The authors declare no competing interests.

Author details

[1]Faculty of Health, Intercity Place, University of Plymouth, Plymouth, Devon PL4 6AB, UK. [2]Royal Devon University Healthcare NHS Foundation Trust, William Wright House, Barrack Road, Exeter, Devon EX2 5DW, UK. [3]De La Salle University-Evelyn D. Ang Institute of Biomedical Engineering and Health Technologies, 2401 Taft Avenue, Malate, Manila 1004, Philippines. [4]The University of Plymouth Centre for Innovations in Health and Social Care: A JBI Centre of Excellence, Faculty of Health, Intercity Place, University of Plymouth, Plymouth, Devon PL4 6AB, UK.

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