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Construction methods and clinical applications of knowledge graphs in cerebrovascular diseases: a systematic review

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ADMINISTRATIVE INFORMATION

Support - Sun Yat-Sen Eighth Affiliated Hospital Clinical Research Program.

Review Stage at time of this submission - The review has not yet started.

Conflicts of interest - None declared.

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Amendments - This protocol was registered with the International Platform of Registered Systematic Review and Meta-Analysis Protocols (INPLASY) on 13 September 2026 and was last updated on 13 September 2026.

INTRODUCTION

Review question / Objective What are the construction methods, ontology designs, data sources, and clinical applications of disease-specific knowledge graphs in cerebrovascular diseases (including ischemic stroke, intracranial atherosclerotic stenosis, and intracranial aneurysm), and what methodological gaps remain?

Condition being studied Knowledge graph technologies applied to cerebrovascular diseases, including ischemic stroke, intracerebral hemorrhage (hemorrhagic stroke), subarachnoid hemorrhage, intracranial atherosclerotic stenosis (ICAS), intracranial aneurysm, transient ischemic attack, and cerebral small vessel disease.

METHODS

Participant or population Not applicable in the conventional sense. The unit of analysis is research reports describing the construction or application of knowledge graphs in cerebrovascular diseases. No human participants are directly involved.

Intervention Knowledge graph construction and application techniques, including ontology/schema design, named entity and relation extraction, knowledge graph embedding, graph reasoning, and graph-based applications (diagnostic support, risk prediction, clinical decision support, knowledge discovery).

Comparator Not applicable (methodological systematic review without a control arm). Comparisons with traditional methods (clinical

scales, rule-based systems, conventional machine learning) will be recorded where reported.

Study designs to be included Original methodological studies, system prototype studies, and pilot application studies reporting construction or application of knowledge graphs in cerebrovascular diseases.

Eligibility criteria

- (1) Language: English or Chinese.
- (2) Time: no date restriction (database inception to the search date).
- (3) Peer review: peer-reviewed journal articles and full conference papers only; editorials, commentaries, letters, and conference abstracts without full text are excluded.
- (4) Disease specificity: only knowledge graphs specific to cerebrovascular diseases; general biomedical knowledge graphs not focused on cerebrovascular disease are excluded.
- (5) Technical substance: studies must report actual construction or application of a knowledge graph (entities, relations, and schema). Pure ontology studies without a graph structure, pure NLP studies, and graph neural network studies lacking a knowledge graph structure are excluded.
- (6) Grey literature: not systematically searched; only reference-list and citation snowballing from included studies is used.

Information sources Electronic databases (searched from inception to September 2026, in English and Chinese): PubMed/MEDLINE, the Cochrane Library, Web of Science Core Collection, Scopus, IEEE Xplore, ACM Digital Library, CNKI, and Wanfang Data.

Additional sources: reference lists of all included studies (backward citation search) and citing articles of included studies (forward citation search via Google Scholar). Corresponding authors of key studies will be contacted to clarify methods or request unpublished details where necessary. Trial registers and grey literature are not systematically searched given the methodological, non-interventional nature of this review. The PubMed search strategy is provided in the Searches field. All database strategies follow the same two-block structure (cerebrovascular disease terms AND knowledge graph terms) with field restrictions, and are available from the corresponding author upon request. Searches will be rerun before final analysis.

Main outcome(s)

- (1) Construction method characteristics: manual, semi-automated, or automated; number and types of entities and relations.

- (2) Ontology design: schema structure and coverage of clinical dimensions (disease, imaging, perfusion, treatment).

- (3) Data sources: literature mining, electronic medical records, imaging, multimodal sources.

- (4) Evaluation and performance: whether accuracy / F1 / AUC or clinical validation is reported.

Additional outcome(s)

- (1) Clinical application scenarios (diagnostic support, risk stratification, decision support, knowledge discovery).
- (2) Reproducibility and openness (open-source availability of graphs or code).
- (3) Reported methodological limitations.

Data management All records from the databases will be imported into Rayyan for de-duplication (using DOI and title as dual keys) and blinded screening. Two reviewers will independently screen titles/abstracts and full texts against the eligibility criteria; a large language model assistant will serve as one of the two independent screeners, with all conflicts resolved by a third human reviewer. This use will be disclosed in the publication. Data will be extracted independently by two reviewers using a piloted, standardized Microsoft Excel form covering study characteristics, disease domain, data sources, construction methods, ontology/schema, graph size, embedding/reasoning methods, application scenarios, evaluation metrics, baseline comparison, external validation, open-source availability, and ethical declarations. Discrepancies will be resolved by discussion or a third reviewer. Screening decisions, extraction forms, and the PRISMA flow diagram will be stored in the project workspace and archived on OSF with a time-stamped record.

Quality assessment / Risk of bias analysis Given the absence of a validated quality appraisal tool for methodological and system prototype studies, a purpose-built 8-item methodological quality checklist will be used, adapted from prior systematic reviews of healthcare knowledge graphs. The checklist covers: data source verifiability, reproducibility of construction methods, explicit schema definition, quantitative evaluation, baseline comparison, external or real-case validation, open-source availability, and ethical declaration. Studies will be rated as low (0–3), moderate (4–5), or high (6–8) quality. Low-quality studies will not be excluded but will be flagged in the narrative synthesis.

Strategy of data synthesis Narrative synthesis combined with structured evidence mapping. Due to substantial heterogeneity in construction methods, data sources, and evaluation approaches, quantitative meta-analysis is not planned. The synthesis will be organized along five dimensions: disease distribution, construction method spectrum, data source structure, evaluation practices, and application scenarios. If a sufficient number of homogeneous studies report comparable performance metrics, exploratory aggregation may be considered.

Subgroup analysis Subgroup narrative analyses by: disease type (ischemic stroke / hemorrhagic stroke including intracerebral and subarachnoid hemorrhage / ICAS / intracranial aneurysm / other), degree of construction automation (manual / semi-automated / automated), and data source type (literature / EMR / imaging / multimodal).

Sensitivity analysis Narrative synthesis combined with structured evidence mapping. Due to substantial heterogeneity in construction methods, data sources, and evaluation approaches, quantitative meta-analysis is not planned. The synthesis will be organized along five dimensions: disease distribution, construction method spectrum, data source structure, evaluation practices, and application scenarios. If a sufficient number of homogeneous studies report comparable performance metrics, exploratory aggregation may be considered.

Language restriction English / China.

Country(ies) involved China.

Keywords knowledge graph; cerebrovascular disease; ischemic stroke; intracranial atherosclerotic stenosis; intracranial aneurysm; systematic review.

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