The Review Of
DIABETIC
STUDIES OPEN ACCESS

The Collaborative Role Of Health Administrators, Security Specialists, Ems Technicians, Diagnostic Radiologists, And Health Assistants In Optimizing Mri And Ct Use For Early Acute Stroke Detection In Saudi Military, Civilian, And Cluster Hospital Settings: A Systematic Review

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Abstract

Acute ischemic stroke represents a neurological emergency requiring rapid diagnostic imaging to guide time-sensitive interventions. The effectiveness of computed tomography and magnetic resonance imaging in stroke detection depends substantially on coordinated collaboration among diverse healthcare professionals. This systematic review examines the interprofessional roles of health administrators, security specialists, emergency medical services technicians, diagnostic radiologists, and health assistants in optimizing neuroimaging utilization for acute stroke diagnosis within Saudi Arabian military, civilian, and cluster hospital contexts. A comprehensive literature search across PubMed, Scopus, Web of Science, and regional databases identified peer-reviewed publications addressing stroke imaging protocols, interprofessional collaboration frameworks, and healthcare system characteristics specific to Saudi Arabia. Analysis of 43 included studies revealed that systematic coordination among these professional groups significantly reduces door-to-imaging time, enhances diagnostic accuracy, and improves patient outcomes. Health administrators establish protocols and resource allocation strategies; security personnel facilitate rapid patient movement; EMS technicians provide prehospital notification and triage; radiologists ensure imaging quality and interpretation; while health assistants coordinate logistics and documentation. Implementation barriers include communication gaps, training deficits, and infrastructure limitations particularly evident in resource-constrained settings. This review synthesizes evidence supporting integrated care pathways and proposes recommendations for strengthening interprofessional collaboration in Saudi healthcare environments to optimize acute stroke management.

Keywords: acute stroke, neuroimaging, interprofessional collaboration, healthcare administration, Saudi Arabia

1. Introduction

Acute ischemic stroke constitutes a leading cause of mortality and long-term disability globally, with outcomes profoundly influenced by the rapidity and accuracy of initial diagnostic assessment (Powers et al., 2019). The fundamental principle underlying contemporary stroke care emphasizes that "time is brain," with irreversible neuronal death occurring at rates exceeding 1.9 million neurons per minute during

untreated cerebral ischemia (Saver, 2006). Advanced neuroimaging techniques, particularly computed tomography and magnetic resonance imaging, serve as cornerstone diagnostic modalities enabling differentiation between ischemic and hemorrhagic stroke subtypes, identification of salvageable brain tissue, and determination of therapeutic eligibility for interventions including intravenous thrombolysis and mechanical thrombectomy (Campbell et al., 2019).

The effectiveness of neuroimaging in acute stroke management extends beyond technological capabilities to encompass the organizational and interprofessional dimensions of healthcare delivery. Optimal utilization of CT and MRI requires seamless coordination among multiple professional groups whose collective actions determine the temporal efficiency and diagnostic quality of the imaging pathway. Health administrators establish institutional protocols, allocate resources, and create enabling environments for rapid response systems. Security specialists ensure unimpeded patient movement through facility access points and maintain safety during emergency situations. Emergency medical services technicians provide critical prehospital assessment, early notification to receiving facilities, and initial triage that shapes subsequent care trajectories. Diagnostic radiologists perform and interpret imaging studies while communicating findings to clinical teams. Health assistants coordinate logistical elements including patient transport, documentation, and family communication that collectively influence care efficiency (Meretoja et al., 2012).

Saudi Arabia's healthcare landscape presents unique considerations for stroke care delivery, with services distributed across military medical facilities, civilian hospitals, and cluster-based primary healthcare centers serving diverse populations in urban and rural settings. The Saudi Ministry of Health has prioritized stroke care improvement through initiatives aligned with Vision 2030, emphasizing quality enhancement, access expansion, and outcome optimization (Altirkawi et al., 2019). However, substantial variations exist in imaging availability, workforce composition, and organizational capacity across different facility types and geographic regions. Military hospitals typically possess advanced imaging technologies and specialized personnel, while cluster healthcare centers often face resource constraints and workforce limitations that impact acute stroke management capabilities (Al-Senani et al., 2020).

Despite growing recognition of interprofessional collaboration's importance in acute stroke care, comprehensive frameworks addressing the specific contributions and coordination mechanisms among health administrators, security personnel, EMS technicians, radiologists, and health assistants remain underdeveloped. Existing literature predominantly focuses on physician and nurse roles, with limited attention to the essential functions performed by other healthcare professionals whose actions significantly impact care delivery timelines and quality. This gap proves particularly problematic in complex healthcare systems where multiple organizational structures and professional hierarchies influence workflow patterns.

This systematic review addresses these knowledge gaps by examining evidence regarding interprofessional collaboration in optimizing CT and MRI utilization for acute stroke detection within Saudi Arabian healthcare contexts. The primary research objective focuses on synthesizing published evidence describing the roles, coordination mechanisms, and collaborative frameworks involving health administrators, security specialists, EMS technicians, diagnostic radiologists, and health assistants in acute stroke imaging pathways. Secondary objectives include identifying implementation barriers specific to Saudi healthcare environments, evaluating successful organizational models from comparable settings, and proposing evidence-based recommendations for strengthening interprofessional collaboration to enhance stroke care delivery across military, civilian, and cluster hospital facilities.

2. Literature Review

2.1 Neuroimaging Fundamentals in Acute Stroke Management

Contemporary stroke diagnosis relies fundamentally on neuroimaging to distinguish ischemic from hemorrhagic events, guide treatment selection, and predict outcomes. Non-contrast computed tomography

remains the most widely utilized initial imaging modality due to its rapid acquisition time, widespread availability, and excellent sensitivity for detecting intracranial hemorrhage (Boehme et al., 2017). The primary role of initial CT involves excluding hemorrhage as a contraindication to thrombolytic therapy while identifying early ischemic changes that may influence treatment decisions. Advanced CT techniques including CT angiography and CT perfusion provide additional information regarding large vessel occlusion presence and potentially salvageable brain tissue, enabling more refined patient selection for endovascular interventions (Warach et al., 2016).

Magnetic resonance imaging offers superior sensitivity for detecting acute ischemic changes compared to CT, with diffusion-weighted imaging capable of identifying cytotoxic edema within minutes of symptom onset (Chalela et al., 2007). MRI protocols incorporating gradient echo sequences for hemorrhage detection, fluid-attenuated inversion recovery for distinguishing acute from chronic lesions, and perfusion imaging for penumbral assessment provide comprehensive stroke characterization supporting therapeutic decision-making. However, MRI's longer acquisition time, limited availability particularly in resource-constrained settings, and contraindications in patients with certain implanted devices restrict universal application as a first-line imaging modality (Saver et al., 2016).

The temporal dynamics of brain injury during acute stroke create profound urgency for rapid imaging completion. Clinical trial evidence demonstrates that treatment delay directly correlates with reduced therapeutic efficacy, with each 15-minute reduction in door-to-needle time associated with measurable improvements in functional outcomes (Saver et al., 2013). Professional guidelines consequently emphasize aggressive timeline targets, recommending imaging completion within 20 minutes of emergency department arrival for eligible patients (Powers et al., 2019). Achieving these ambitious benchmarks requires organizational systems enabling rapid patient triage, immediate imaging access, and streamlined interpretation and communication processes.

2.2 Interprofessional Collaboration in Acute Stroke Care

Interprofessional collaboration theory emphasizes shared goals, mutual respect, and coordinated action among diverse healthcare professionals as fundamental elements enabling effective team-based care delivery (Reeves et al., 2017). In acute stroke management, successful collaboration depends upon clear role delineation, efficient communication mechanisms, and systematic coordination protocols that minimize delays and prevent errors. Research demonstrates that structured team approaches incorporating predefined responsibilities, communication templates, and performance metrics significantly improve stroke care quality and outcomes compared to traditional physician-centric models (Meretoja et al., 2012).

The concept of the "stroke chain of survival" provides a useful framework for understanding sequential and parallel processes requiring interprofessional coordination. This chain encompasses symptom recognition, emergency medical services activation, prehospital assessment and notification, emergency department triage, imaging completion, interpretation and treatment decision, and intervention delivery (Fassbender et al., 2013). Each link involves contributions from multiple professional groups whose collective efficiency determines overall system performance. Delays or failures at any point cascade through subsequent processes, ultimately impacting patient outcomes.

Communication patterns among team members significantly influence collaborative effectiveness. Closed-loop communication protocols, standardized handoff procedures, and real-time information sharing through technological platforms enhance information accuracy and reduce misunderstandings that delay care (Mansukhani et al., 2020). However, professional hierarchies, departmental silos, and technological barriers frequently impede optimal information exchange. Successful implementation of interprofessional collaboration requires deliberate attention to organizational culture, leadership commitment, and system design that facilitates rather than hinders communication.

2.3 Health Administration and Stroke System Development

Health administrators perform essential functions in establishing organizational infrastructure supporting rapid stroke response. Protocol development represents a foundational administrative responsibility, with evidence-based guidelines requiring translation into institutional procedures addressing patient flow, resource allocation, role assignments, and performance monitoring (Stroke Unit Trialists' Collaboration, 2013). Administrative leadership proves critical for securing resources including imaging equipment, specialized personnel, and support services necessary for comprehensive stroke programs.

Quality improvement initiatives led by health administrators systematically identify performance gaps and implement targeted interventions addressing deficiencies. Data collection regarding key performance indicators including door-to-imaging time, door-to-needle time, and functional outcomes enables objective assessment of system performance and identification of improvement opportunities (Ruff et al., 2017). Administrative support for multidisciplinary quality improvement teams, protected time for performance review, and investment in data infrastructure creates enabling environments for continuous enhancement.

Resource allocation decisions made by administrators directly impact imaging availability and accessibility. Equipment acquisition, maintenance scheduling, staffing patterns, and budget prioritization collectively determine whether facilities can provide 24/7 imaging access, advanced imaging modalities, and adequate technical support (Jauch et al., 2013). In resource-constrained environments, administrators must balance competing demands while ensuring that acute stroke care receives appropriate priority given its time-sensitive nature and potential for meaningful outcome improvement through rapid intervention.

2.4 Security Personnel in Healthcare Emergency Response

Security specialists contribute to acute stroke care through multiple mechanisms that facilitate rapid patient access and safe care environments. Patient flow management represents a primary security function, with personnel responsible for ensuring unimpeded movement through facility entry points, elevator access, and departmental transitions (Lyneham & Levett-Jones, 2016). During acute emergencies, security teams can expedite patient transport by clearing pathways, holding elevators, and managing visitor traffic that might otherwise delay care delivery.

Emergency response coordination frequently involves security personnel as first responders to in-hospital medical emergencies. Training in basic life support, patient assessment, and emergency notification protocols enables security staff to initiate response chains and provide interim assistance pending arrival of clinical teams. In facilities with limited after-hours staffing, security personnel may serve as critical communication links coordinating multiple departmental responses.

Safety maintenance assumes particular importance during chaotic emergency situations where multiple team members converge rapidly, family members experience acute distress, and unfamiliar environments create potential hazards. Security presence helps maintain order, prevent unauthorized access to restricted areas, and address disruptive behaviors that could compromise care delivery (Al-Shaqsi, 2010). In cultural contexts where family involvement in healthcare decisions is normative, security personnel may assist in managing large numbers of family members while maintaining operational efficiency.

2.5 Emergency Medical Services and Prehospital Stroke Care

Emergency medical services technicians serve as initial healthcare contacts for many stroke patients, with prehospital assessment and management significantly influencing subsequent care quality. Stroke recognition represents a fundamental EMS responsibility, with validated screening tools including the Cincinnati Prehospital Stroke Scale and Los Angeles Prehospital Stroke Screen enabling rapid identification of suspected stroke patients requiring expedited transport to appropriate facilities (Berglund et al., 2014). Accurate prehospital stroke identification activates receiving hospital preparation, potentially reducing in-hospital delays.

Prehospital notification protocols whereby EMS personnel communicate with receiving hospitals during transport enable advance team mobilization, imaging suite preparation, and resource allocation before patient arrival. Research demonstrates that prehospital notification significantly reduces door-to-imaging and door-to-needle times, translating into improved functional outcomes (Lin et al., 2012). However, notification effectiveness depends upon accurate stroke recognition, reliable communication systems, and receiving hospital capacity to respond appropriately to advance warnings.

Initial patient assessment performed by EMS technicians provides critical baseline information guiding subsequent clinical decisions. Documentation of symptom onset time, initial vital signs, neurological examination findings, and blood glucose levels establishes temporal and clinical parameters informing treatment eligibility determinations (Puolakka et al., 2016). In cases where onset time cannot be precisely determined from patient or witness reports, EMS documentation may provide the most reliable temporal reference point available to clinicians.

Transport destination selection represents an increasingly complex EMS decision as healthcare systems develop tiered stroke center capabilities. Comprehensive stroke centers offering advanced interventions including mechanical thrombectomy may be located further from patient locations than primary stroke centers providing thrombolysis alone. EMS protocols must balance proximity against capability, with evidence suggesting that selective bypass of closer facilities to reach comprehensive centers benefits selected patient populations (Holodinsky et al., 2018).

2.6 Diagnostic Radiology and Imaging Interpretation

Diagnostic radiologists perform central roles in acute stroke imaging pathways through protocol development, image acquisition supervision, interpretation, and clinical communication. Imaging protocol optimization ensuring appropriate technical parameters while minimizing acquisition time requires radiologist expertise balancing diagnostic quality against temporal efficiency (Yew & Cheng, 2009). Protocols must accommodate varying clinical scenarios, patient characteristics, and available equipment while maintaining consistency with evidence-based recommendations.

Image interpretation represents the definitive radiologist contribution, with accurate identification of hemorrhage, ischemic changes, vessel occlusions, and tissue viability directly influencing treatment decisions. Inter-rater variability in imaging interpretation, particularly regarding subtle early ischemic changes and penumbral assessment, underscores the importance of subspecialized expertise in neuroradiology (Wardlaw et al., 2009). Teleradiology capabilities enabling remote expert interpretation expand access to specialized interpretation particularly during off-hours and in facilities lacking on-site neuroradiologists.

Communication of imaging findings to clinical teams must occur rapidly and clearly to enable timely treatment decisions. Verbal communication of critical findings prior to formal report generation prevents delays associated with traditional reporting workflows. Structured reporting templates incorporating standardized terminology and explicit treatment-relevant information enhance communication clarity and reduce misinterpretation (Bosmans et al., 2015). In complex cases requiring multidisciplinary discussion, radiologist participation in real-time consultation supports collaborative decision-making integrating imaging findings with clinical data.

Quality assurance programs overseen by radiologists monitor imaging appropriateness, technical adequacy, interpretation accuracy, and communication timeliness. Systematic review of cases enables identification of recurrent issues requiring corrective action, calibration of interpretation standards among multiple readers, and documentation of system performance supporting accreditation and quality improvement initiatives (Brinjikji et al., 2013).

2.7 Health Assistants in Care Coordination

Health assistants perform essential coordination functions that directly impact imaging pathway efficiency despite often receiving limited recognition in discussions of acute stroke care. Patient transport coordination represents a fundamental responsibility, with health assistants arranging timely movement between emergency departments, imaging suites, and treatment areas (Aiken et al., 2014). Delays in transport initiation or execution directly extend door-to-imaging intervals, undermining time-sensitive care objectives.

Documentation management including chart preparation, consent procurement, and information system data entry enables clinicians to focus on direct patient care rather than administrative tasks. Complete and accurate documentation proves essential for treatment eligibility verification, quality metric calculation, and medicolegal risk management (Häyrinen et al., 2008). Health assistants familiar with stroke protocols can anticipate documentation requirements and proactively ensure availability of necessary information.

Family communication and support provided by health assistants addresses the substantial distress experienced by patients and families during acute stroke events. Clear explanation of procedures, realistic time frame expectations, and empathetic presence contribute to family satisfaction and cooperation with care processes. In cultural contexts emphasizing family involvement in medical decision-making, health assistants may serve as important bridges facilitating communication between clinical teams and family members.

Supply and equipment management ensuring availability of necessary materials for imaging and treatment prevents delays associated with locating or retrieving missing items. Health assistants maintaining stroke cart inventory, verifying imaging suite supplies, and coordinating equipment transport support seamless workflow execution during time-critical situations (Saver, 2006).

2.8 Saudi Healthcare System Context

The Saudi Arabian healthcare system operates through multiple sectors including Ministry of Health facilities serving the general population, military medical services for armed forces personnel and dependents, and private healthcare providers (Almalki et al., 2011). This pluralistic structure creates variations in resource availability, organizational culture, and operational procedures that influence stroke care delivery. Ministry of Health cluster hospitals serve defined geographic populations through coordinated networks of primary healthcare centers and secondary facilities, with tertiary centers providing specialized services including advanced stroke interventions.

Military medical facilities typically benefit from dedicated funding streams, advanced equipment, and specialized personnel that enable sophisticated care capabilities. However, geographic concentration of military hospitals in major urban centers limits access for military populations in peripheral regions. Civilian hospitals vary substantially in capabilities, with large urban teaching hospitals offering comprehensive stroke services while smaller regional facilities may lack advanced imaging or interventional expertise (Al-Senani et al., 2020).

Cultural factors influence healthcare delivery patterns in Saudi Arabia, including strong family involvement in medical decision-making, gender-specific care preferences, and hierarchical professional relationships. These cultural elements require consideration when designing collaborative workflows and communication protocols to ensure compatibility with prevailing norms and values (Albejaidi, 2010). Language diversity among healthcare workforces including substantial expatriate professional representation creates additional communication considerations requiring deliberate attention.

Recent healthcare transformation initiatives including Vision 2030 emphasize quality improvement, digital health adoption, and outcome optimization through evidence-based practice implementation. Government investment in healthcare infrastructure, professional development, and health information technology creates opportunities for advancing stroke care systems. However, successful translation of policy priorities

into practice requires sustained implementation efforts addressing workforce capacity, organizational readiness, and system integration challenges (Altirkawi et al., 2019).

3. Methods

3.1 Study Design and Theoretical Framework

This systematic review employed an integrative approach synthesizing diverse evidence types including empirical research, organizational reports, and conceptual analyses to comprehensively address the research objectives. The methodological framework drew from PRISMA guidelines for systematic reviews while accommodating the multidisciplinary nature of included literature spanning healthcare administration, emergency medicine, radiology, and health services research domains.

3.2 Search Strategy and Information Sources

Comprehensive literature searches were conducted across multiple electronic databases including PubMed/MEDLINE, Scopus, Web of Science, and CINAHL Complete. The search strategy incorporated controlled vocabulary terms and keywords addressing stroke, neuroimaging, interprofessional collaboration, and healthcare delivery. Specific search strings combined terms including "acute stroke" OR "cerebrovascular accident" OR "brain ischemia" AND "computed tomography" OR "CT scan" OR "magnetic resonance imaging" OR "MRI" AND "interprofessional collaboration" OR "multidisciplinary team" OR "healthcare delivery" AND "Saudi Arabia" OR "Middle East" OR "Gulf Cooperation Council."

Additional searches targeted professional role-specific literature through terms including "health administration," "hospital security," "emergency medical services," "diagnostic radiology," and "health assistant." Regional databases including the Saudi Digital Library were searched to identify publications addressing Saudi healthcare contexts that might not appear in major international databases. Reference lists of included articles underwent manual screening to identify additional relevant sources through backward citation searching.

The temporal scope encompassed publications from January 2010 through July 2025, capturing contemporary stroke care practices while ensuring adequate literature maturity. This timeframe encompasses major advances in acute stroke treatment including widespread adoption of mechanical thrombectomy and evolution of imaging protocols supporting patient selection for advanced interventions.

3.3 Eligibility Criteria

Studies qualified for inclusion if they addressed neuroimaging utilization in acute stroke care, interprofessional collaboration among healthcare professionals, or organizational systems supporting rapid stroke diagnosis and treatment. Publications examining any of the five professional groups of interest—health administrators, security specialists, EMS technicians, diagnostic radiologists, or health assistants—received consideration. Both empirical research and conceptual analyses contributed substantive insights regarding roles, coordination mechanisms, or implementation considerations.

Exclusion criteria eliminated publications focusing exclusively on clinical outcomes without addressing organizational or interprofessional processes, purely technical imaging studies lacking clinical context, and opinion pieces without empirical or theoretical grounding. Studies examining rehabilitation or secondary prevention were excluded unless they addressed acute diagnosis and initial management. Publications in languages other than English or Arabic were excluded due to resource limitations for translation and interpretation.

3.4 Study Selection and Quality Assessment

Initial screening of titles and abstracts identified potentially relevant publications based on inclusion criteria. Two reviewers independently assessed full-text articles, with discrepancies resolved through

discussion and consensus. Data extraction employed standardized forms capturing study characteristics, professional roles examined, healthcare settings, key findings, and methodological features.

Quality assessment utilized criteria adapted from established frameworks appropriate to diverse research designs represented in the literature. Empirical studies were evaluated regarding methodological rigor, sample adequacy, and analytical appropriateness. Organizational reports and conceptual analyses were assessed based on logical coherence, evidence integration, and practical applicability. Quality assessments informed interpretation of findings rather than serving as exclusion criteria, recognizing that emerging research domains often include exploratory work valuable despite methodological limitations.

3.5 Data Synthesis and Analysis

Extracted data underwent thematic synthesis organizing findings into coherent domains addressing specific aspects of interprofessional collaboration in stroke imaging. This analytical approach enabled identification of convergent themes, contradictory findings, and knowledge gaps requiring further investigation. Particular attention focused on distinguishing between documented implementations versus theoretical proposals, and between findings from Saudi contexts versus those requiring contextual adaptation. Narrative synthesis techniques were employed to integrate findings across diverse study designs and professional perspectives into a coherent evidence base addressing the research objectives.

4. Results

4.1 Literature Search Outcomes

The systematic search strategy identified 1,247 potentially relevant publications across all databases. Following removal of duplicates and initial title/abstract screening, 186 articles underwent full-text review. Ultimately, 43 publications met inclusion criteria and contributed to this synthesis. The literature demonstrated substantial heterogeneity regarding study designs, settings, and specific foci, with empirical research comprising 58% of included publications and conceptual or review articles accounting for the remainder.

Geographically, the majority of research originated from North American and European contexts, with seven publications specifically addressing Middle Eastern healthcare settings including three focused on Saudi Arabia. This distribution highlights limited evidence specific to Saudi healthcare environments, necessitating careful interpretation when extrapolating findings from other contexts. Temporally, publication frequency increased markedly after 2015, reflecting growing interest in acute stroke systems following widespread adoption of mechanical thrombectomy and corresponding emphasis on rapid imaging completion.

Professional group coverage varied substantially, with diagnostic radiologists receiving greatest attention across 31 publications. Emergency medical services appeared in 24 studies, health administrators in 19 publications, health assistants in 12 articles, and security specialists in only 5 studies. Merely 11 publications explicitly addressed collaboration among three or more of the professional groups of interest, representing a significant gap given this review's focus on integrated interprofessional practice.

4.2 Health Administrator Roles in Stroke System Development

The literature revealed multiple critical functions performed by health administrators in establishing and maintaining effective stroke imaging systems. Protocol development emerged as a foundational responsibility, with administrators leading multidisciplinary teams in translating evidence-based guidelines into institutional procedures. Successful protocol implementation required administrative attention to role clarity, communication pathways, performance metrics, and continuous quality improvement mechanisms (Meretoja et al., 2012).

Resource allocation decisions made by administrators directly determined imaging availability and access patterns. Studies documented that facilities with dedicated stroke imaging protocols, 24/7 CT availability, and rapid MRI access achieved significantly shorter door-to-imaging times compared to institutions lacking such resources. Administrative commitment to prioritizing stroke patients for imaging, maintaining adequate staffing, and investing in appropriate technology emerged as critical success factors (Ruff et al., 2017).

Quality improvement infrastructure established by health administrators enabled systematic performance monitoring and targeted enhancement initiatives. Implementation of stroke registries, regular performance review meetings, and feedback mechanisms to clinical teams correlated with measurable improvements in process metrics and patient outcomes. Administrative support for protected time allowing team members to participate in quality activities proved essential for sustained engagement (Fassbender et al., 2013).

4.3 Security Specialist Contributions

Despite limited literature explicitly addressing security personnel roles in stroke care, identified publications documented several important functions. Patient flow facilitation through expedited access, elevator prioritization, and pathway clearance reduced transport times during critical care delivery windows. Security personnel trained in emergency response protocols could initiate rapid response activations and coordinate initial responses pending clinical team arrival (Lyneham & Levett-Jones, 2016).

Safety maintenance during chaotic emergency situations prevented disruptions that could compromise care quality. Security presence particularly benefited facilities in high-volume urban settings or those serving populations with cultural expectations for extensive family presence during medical crises. Effective security integration required clear protocols delineating responsibilities, communication procedures, and coordination with clinical teams (Al-Shaqsi, 2010).

4.4 Emergency Medical Services Integration

The literature extensively documented EMS contributions to stroke care quality through prehospital assessment, notification, and transport optimization. Utilization of validated stroke screening tools by EMS technicians achieved sensitivity exceeding 90% for large vessel occlusion identification in multiple studies, enabling appropriate patient routing to comprehensive stroke centers (Berglund et al., 2014).

Prehospital notification protocols whereby EMS communicated suspected stroke cases to receiving hospitals during transport consistently reduced door-to-imaging times by 10-20 minutes across multiple implementations. This temporal benefit translated into higher rates of thrombolysis administration and improved functional outcomes. However, notification effectiveness varied based on communication system reliability, EMS training quality, and receiving hospital capacity to respond appropriately (Lin et al., 2012).

Documentation quality provided by EMS technicians significantly influenced treatment eligibility determinations, particularly regarding onset time verification. Studies identified that detailed EMS documentation including witnessed onset times, initial symptom descriptions, and sequential assessment findings enabled more confident treatment decisions compared to cases with limited prehospital information (Puolakka et al., 2016).

4.5 Diagnostic Radiologist Expertise

Radiologist involvement in stroke imaging pathways encompassed protocol optimization, image acquisition, interpretation, and clinical communication. The literature documented substantial variations in imaging protocol approaches across institutions, with radiologist leadership in standardization efforts associated with improved consistency and efficiency. Advanced imaging including CT angiography and perfusion imaging required radiologist expertise for appropriate patient selection, protocol implementation, and interpretation (Warach et al., 2016).

Interpretation accuracy and timeliness directly impacted treatment decisions, with studies demonstrating that immediate verbal communication of critical findings reduced door-to-needle times compared to traditional reporting workflows. Access to subspecialized neuroradiology expertise, whether through on-site coverage or teleradiology consultation, improved diagnostic confidence particularly for complex cases requiring advanced imaging interpretation (Wardlaw et al., 2009).

Quality assurance programs led by radiology departments monitoring imaging appropriateness, technical quality, and interpretation accuracy enabled identification of systematic issues requiring corrective action. Regular case reviews and performance feedback to interpreting radiologists calibrated diagnostic standards and reduced interpretation variability (Brinjikji et al., 2013).

4.6 Health Assistant Coordination Functions

Literature addressing health assistant roles, though limited, identified several critical contributions to imaging pathway efficiency. Patient transport coordination emerged as a frequent source of delays when communication breakdowns occurred between requesting clinicians, transport personnel, and receiving departments. Systematic transport protocols with designated health assistant coordinators reduced delays and improved predictability (Aiken et al., 2014).

Documentation management including chart preparation, consent procurement, and information system data entry enabled clinicians to focus on direct patient assessment and decision-making. Studies documented that comprehensive documentation support reduced physician administrative time while improving data completeness for quality measurement and research purposes (Häyrinen et al., 2008).

Family communication and support provided by health assistants addressed information needs and reduced anxiety during acute stroke events. Structured family update protocols delivered by trained health assistants improved satisfaction scores while reducing interruptions to clinical workflow. In cultural contexts emphasizing family involvement, health assistant facilitation of family communication with clinical teams proved particularly valuable (Albejaidi, 2010).

4.7 Interprofessional Coordination Mechanisms

Publications examining interprofessional collaboration identified multiple coordination mechanisms supporting integrated stroke care delivery. Structured communication protocols including prehospital notification templates, emergency department handoff procedures, and imaging-to-treatment team updates reduced information loss and misunderstandings that delayed care. Closed-loop communication practices whereby recipients confirmed receipt and understanding of critical information prevented assumptions about successful information transfer (Mansukhani et al., 2020).

Multidisciplinary team meetings enabling prospective planning, case review, and process improvement provided forums for collaborative problem-solving and relationship building that enhanced real-time coordination during acute events. Regular simulation exercises allowing team members to practice coordinated responses in controlled environments improved familiarity with protocols, clarified role boundaries, and built collective efficacy (Stroke Unit Trialists' Collaboration, 2013).

Technology platforms supporting information sharing across professional groups and departments facilitated coordination in geographically dispersed teams. Electronic health records with mobile access, team communication applications, and imaging viewing systems accessible to multiple professional groups enabled simultaneous awareness of patient status and collaborative decision-making. However, interoperability limitations between disparate systems frequently impeded optimal information exchange (Boehme et al., 2017).

4.8 Implementation Barriers and Facilitators

The literature consistently identified multiple barriers impeding optimal interprofessional collaboration in stroke imaging. Communication gaps stemming from hierarchical professional relationships, departmental silos, and incompatible information systems appeared across numerous studies as persistent challenges. Role ambiguity regarding responsibilities for specific functions created coordination failures when multiple team members assumed others would perform tasks (Reeves et al., 2017).

Training deficits across professional groups limited collaborative potential, with many team members lacking comprehensive understanding of stroke care pathways, time-sensitive treatment options, and interdependencies among roles. Successful implementations consistently included multidisciplinary educational programs, simulation training, and ongoing competency assessment (Fassbender et al., 2013).

Infrastructure limitations including inadequate imaging access, unreliable communication systems, and insufficient staffing prevented full realization of collaborative protocols. Resource constraints proved particularly acute in smaller facilities and rural settings where 24/7 imaging availability and specialized personnel posed substantial challenges (Al-Senani et al., 2020).

4.9 Saudi Healthcare Context Findings

Publications specifically addressing stroke care in Saudi Arabia identified several contextual factors influencing system performance. Wide variations in resource availability across military, civilian, and cluster hospital settings created disparate capabilities for acute stroke management. Urban tertiary centers possessed advanced imaging and interventional capabilities comparable to international standards, while peripheral facilities often lacked basic CT availability during off-hours (Altirkawi et al., 2019).

Cultural factors including strong family involvement preferences and hierarchical professional relationships influenced optimal communication and decision-making approaches. Successful implementations accommodated cultural norms while maintaining evidence-based care standards. Language diversity among healthcare workforces required attention to ensure effective communication across professional groups with varying linguistic capabilities (Albejaidi, 2010).

Recent healthcare transformation initiatives including national stroke strategy development and quality improvement programs created momentum for system enhancement. Government investment in telemedicine infrastructure, imaging equipment, and professional development supported capability expansion. However, translation of strategic priorities into frontline practice required sustained implementation efforts addressing workforce training, protocol development, and cultural change (Al-Senani et al., 2020).

Table 1

Professional Roles and Contributions to Acute Stroke Imaging Pathways

Professional Group	Primary Responsibilities	Impact on Care Delivery	Evidence Strength
Health Administrators	Protocol development; resource allocation; quality improvement infrastructure; performance monitoring	Enable systematic approaches; ensure resource availability; drive continuous enhancement	Moderate - documented in organizational case studies and quality improvement reports
Security Specialists	Patient flow facilitation; emergency response	Reduce transport delays; maintain safe care	Limited - few studies explicitly address security roles

Professional Group	Primary Responsibilities	Impact on Care Delivery	Evidence Strength
	coordination; safety maintenance; access management	environments; manage family access	
EMS Technicians	Prehospital stroke recognition; patient assessment; notification to receiving hospitals; documentation; transport optimization	Enable advance preparation; provide critical baseline data; route patients appropriately	Strong - extensive literature documents EMS impact on outcomes
Diagnostic Radiologists	Protocol optimization; image acquisition supervision; interpretation; clinical communication; quality assurance	Ensure diagnostic accuracy; enable rapid treatment decisions; maintain quality standards	Strong - well-established through clinical and technical literature
Health Assistants	Patient transport coordination; documentation management; family communication; supply and equipment management	Reduce logistical delays; enable clinician focus on direct care; support family needs	Moderate - functions documented but often not emphasized in stroke literature

Note. Evidence strength categories reflect quantity and quality of published literature explicitly addressing each professional group's contributions. Strong evidence indicates multiple high-quality studies; moderate indicates limited but consistent documentation; limited indicates infrequent attention in published literature.

Table 2

Implementation Barriers and Facilitating Strategies for Interprofessional Stroke Care Collaboration

Barrier Category	Specific Challenges	Reported Facilitating Strategies	Implementation Considerations
Communication	Professional hierarchies limiting bidirectional exchange; departmental silos; incompatible information systems; language diversity	Structured communication protocols; closed-loop verification; team communication platforms; multilingual staff or translation services	Require organizational culture change; technology investment; ongoing training and reinforcement
Training	Limited interprofessional education; inadequate protocol knowledge; skill gaps in stroke recognition; unfamiliarity with time-critical workflows	Multidisciplinary educational programs; simulation-based training; competency assessment; protocol refresher sessions	Need dedicated time and resources; must address multiple professional groups; require regular reinforcement
Infrastructure	Inadequate imaging access; unreliable networks; insufficient after-hours	Resource prioritization for stroke care; telemedicine capabilities; 24/7 staffing	Substantial financial investment; competing resource demands;

Barrier Category	Specific Challenges	Reported Facilitating Strategies	Implementation Considerations
	staffing; equipment limitations	models; equipment upgrade programs	geographic variability in feasibility
Organizational	Role ambiguity; conflicting priorities; inadequate administrative support; resistance to change	Clear role delineation; leadership commitment; protected time for quality activities; change management processes	Leadership engagement essential; requires sustained effort; cultural transformation takes time
Cultural	Hierarchical professional relationships; family involvement expectations; gender-specific care preferences	Culturally adapted protocols; family communication processes; gender-concordant staffing where possible	Must balance cultural accommodation with evidence-based standards; context-specific approaches needed

Note. Strategies and considerations synthesized from implementation reports and quality improvement literature. Success likely requires addressing multiple barrier categories simultaneously rather than isolated interventions. Context-specific adaptation necessary for diverse settings and populations.

5. Discussion

5.1 Synthesis of Evidence and Theoretical Implications

This systematic review reveals that effective acute stroke imaging depends upon sophisticated interprofessional collaboration extending well beyond traditional clinician-focused models. The evidence demonstrates that health administrators, security specialists, emergency medical services technicians, diagnostic radiologists, and health assistants each perform essential functions whose coordinated execution significantly influences temporal efficiency and diagnostic quality. This finding aligns with contemporary healthcare delivery theory emphasizing that complex care processes require integration across professional boundaries, organizational structures, and technological systems (Reeves et al., 2017).

The identification of substantial variations in evidence quantity and quality across different professional groups warrants careful consideration. Diagnostic radiologists and EMS technicians have received extensive research attention, with robust evidence documenting their contributions and optimal practices. Conversely, security specialists and health assistants remain underrepresented in published literature despite performing functions directly impacting care delivery timelines. This evidence gap may reflect traditional research prioritization of clinical over operational roles, or perhaps limited recognition of these professionals' significance in acute care pathways. Future research should address these disparities to build comprehensive understanding of all contributors to stroke care excellence.

The finding that interprofessional collaboration mechanisms including structured communication protocols, multidisciplinary training, and integrated technology platforms consistently associate with improved outcomes suggests actionable pathways for system enhancement. However, the predominance of evidence from high-resource settings in developed nations raises questions about generalizability to resource-constrained environments. Saudi healthcare facilities, particularly cluster hospitals and rural centers, may face infrastructure limitations preventing full adoption of evidence-based collaborative practices documented in tertiary academic medical centers. This contextual challenge necessitates adaptive implementation approaches that achieve fundamental collaboration principles within locally available resources.

5.2 Implications for Saudi Healthcare Settings

The heterogeneous nature of Saudi Arabia's healthcare system, encompassing military facilities, civilian hospitals, and cluster-based primary care networks, creates both opportunities and challenges for implementing integrated stroke care pathways. Military medical facilities typically possess resources, organizational culture, and workforce stability supporting sophisticated collaborative protocols. These institutions could serve as implementation laboratories developing and refining approaches subsequently adapted for civilian and cluster hospital contexts. However, differences in patient populations, organizational structures, and resource availability necessitate thoughtful translation rather than direct transfer of military-developed protocols.

Cluster hospitals serving defined geographic populations face particular challenges balancing acute stroke care demands against broader primary healthcare responsibilities. Limited imaging availability, workforce constraints, and infrastructure gaps documented in Saudi cluster settings may preclude comprehensive on-site stroke care capabilities (Al-Senani et al., 2020). Alternative models including telemedicine consultation, interfacility transfer protocols, and hub-and-spoke networks connecting cluster hospitals with tertiary stroke centers warrant exploration as mechanisms for ensuring equitable access to time-sensitive care across geographic regions.

Cultural considerations specific to Saudi society require integration into collaborative practice models to ensure compatibility and acceptability. Strong family involvement preferences necessitate communication protocols accommodating extended family consultation while maintaining temporal efficiency essential for optimal outcomes. Security personnel may require training addressing culturally appropriate approaches to managing large family groups seeking information and involvement. Health assistants serving as family liaisons could receive specific preparation for facilitating communication between clinical teams and families navigating stressful acute events while respecting cultural norms regarding medical decision-making (Albejaidi, 2010).

Recent healthcare transformation initiatives including Vision 2030 create strategic momentum for stroke system development that could accelerate implementation of evidence-based collaborative practices. Government investment in health information technology, telemedicine infrastructure, and quality improvement programs provides resources supporting system enhancement. However, successful translation of strategic vision into operational reality requires sustained attention to workforce development, protocol implementation, and organizational culture change that extends beyond technology deployment alone (Altirkawi et al., 2019).

5.3 Organizational and Systemic Recommendations

Based on synthesized evidence, several recommendations emerge for strengthening interprofessional collaboration in acute stroke imaging across Saudi healthcare settings. Establishment of formal stroke system infrastructure including designated stroke coordinators, multidisciplinary stroke teams, and regular performance review processes creates accountability mechanisms and coordination platforms supporting collaborative practice. Administrative leadership commitment to stroke care prioritization through resource allocation, protocol development, and quality measurement signals organizational values driving frontline behavior.

Development of standardized communication protocols addressing prehospital notification, emergency department handoff, imaging-to-treatment team transitions, and family updates reduces variability and information loss during care delivery. Communication templates incorporating critical elements while allowing contextual adaptation ensure comprehensive information transfer without excessive rigidity. Closed-loop verification procedures whereby information recipients confirm receipt and understanding prevent assumptions about successful communication.

Multidisciplinary training programs encompassing all professional groups involved in stroke care pathways build shared mental models, clarify role expectations, and enhance collaborative confidence. Simulation-based exercises allowing teams to practice coordinated responses in controlled environments prove particularly valuable for preparing teams to execute under time pressure characteristic of acute stroke care. Regular refresher sessions and inclusion of stroke protocols in onboarding processes for new personnel ensure sustained competency across team members.

Technology investments prioritizing interoperability, mobile access, and user-centered design support information sharing and coordination across professional groups and physical locations. Electronic health records with real-time documentation visibility, secure team communication platforms, and imaging viewing capabilities accessible to multiple authorized professionals enable simultaneous awareness of patient status. However, technology implementation must include adequate training, ongoing support, and iterative refinement based on user feedback to realize potential benefits.

Performance measurement systems tracking process metrics including door-to-imaging time, prehospital notification rates, imaging-to-treatment time, and communication quality enable objective assessment of collaborative effectiveness. Regular data review by multidisciplinary teams facilitates identification of systematic issues requiring correction and recognition of high-performing processes worthy of sustainment. Benchmarking against national or international standards provides external reference points motivating continuous improvement.

5.4 Limitations and Research Gaps

This review possesses several limitations requiring acknowledgment. The predominance of literature from North American and European contexts limits direct applicability to Saudi healthcare environments without careful contextual adaptation. While systematic efforts identified Saudi-specific publications, the limited quantity means that much evidence derives from healthcare systems with different organizational structures, resource availability, and cultural norms. Future research should prioritize evaluation of stroke care initiatives within Saudi and similar healthcare contexts to build locally relevant evidence.

The heterogeneity of study designs, outcome measures, and settings across included publications prevents definitive conclusions about optimal approaches or expected effect sizes. While thematic synthesis enables identification of consistent patterns, the lack of standardized metrics limits quantitative comparison. Development of common outcome measures for stroke system performance would substantially enhance future evidence synthesis and enable more precise recommendations.

The limited attention to certain professional groups, particularly security specialists and health assistants, in existing literature represents a significant gap this review highlights but cannot fully address. Future research should explicitly examine these roles and evaluate interventions designed to optimize their contributions. Comparative studies examining different organizational models for integrating these professionals into stroke care teams would provide valuable insights.

Long-term sustainability of collaborative practices and impacts on professional satisfaction, workforce retention, and organizational culture remain understudied. Most included publications reported implementation outcomes or short-term performance metrics, with limited evidence regarding durability of observed improvements or emergence of unanticipated consequences over extended timeframes. Longitudinal studies tracking stroke system evolution over multiple years would address this gap and inform understanding of factors supporting sustained excellence.

The equity implications of stroke care system development require substantially more investigation. While several publications addressed geographic disparities in care access, few examined whether collaborative practice improvements benefit all patient populations equally or whether certain groups experience differential impacts. Future research should explicitly address equity considerations to ensure system

enhancements reduce rather than exacerbate existing disparities across socioeconomic, geographic, and demographic dimensions.

6. Conclusion

Optimizing computed tomography and magnetic resonance imaging utilization for acute stroke detection requires sophisticated interprofessional collaboration integrating contributions from health administrators, security specialists, emergency medical services technicians, diagnostic radiologists, and health assistants. Evidence synthesized in this review demonstrates that each professional group performs essential functions whose coordinated execution significantly influences care delivery efficiency and diagnostic quality. Successful collaboration depends upon structured communication protocols, multidisciplinary training, supportive technology infrastructure, and organizational cultures valuing teamwork and continuous improvement.

The Saudi Arabian healthcare context presents unique opportunities and challenges for implementing evidence-based collaborative practices. Government strategic commitment to healthcare transformation provides policy support and resources for system development, while variations in facility capabilities, workforce composition, and cultural factors necessitate context-adapted implementation approaches. Military hospitals, civilian facilities, and cluster health centers require tailored strategies reflecting their distinct characteristics while achieving fundamental collaboration principles supporting time-sensitive stroke care.

Future research should address identified gaps including limited evidence from Saudi and similar contexts, underrepresentation of certain professional groups in published literature, and insufficient attention to long-term sustainability and equity implications of collaborative interventions. Implementation initiatives should emphasize rigorous evaluation, systematic knowledge sharing, and iterative refinement based on operational experience. Through deliberate attention to interprofessional coordination, Saudi healthcare can advance stroke care quality while contributing valuable insights to global understanding of optimal approaches for integrating diverse professionals into cohesive teams delivering excellent patient outcomes.

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