



# IDENTIFYING BEST PRACTICES TO IMPROVE EVALUATION AND MANAGEMENT OF IN-HOSPITAL STROKE

A Scientific Statement for Healthcare  
Professionals from the American Heart  
Association and American Stroke Association

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# SLIDES PREPARED BY MEMBERS OF THE STROKE PROFESSIONAL EDUCATION COMMITTEE

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# IN-HOSPITAL STROKE

# DEFINING IN-HOSPITAL STROKE (IHS)

- Stroke that occurs during hospitalization for another diagnosis

# DEFINING THE PROBLEM

# IHS IDENTIFICATION AND TREATMENT OFTEN DELAYED

- Leads to higher morbidity & mortality
- Reducing delays could improve outcomes
- Scientific statement calls for optimization of in-hospital stroke care



# PROPOSED CORE ELEMENTS FOR OPTIMIZATION

## STROKE TRAINING TO ALL STAFF

- Patient assessment
- IHS alert activation

## CREATE RAPID RESPONSE TEAMS

- Dedicated stroke training
- Immediate access to neurologic expertise

## STANDARDIZE EVALUATION OF HIS PATIENT

- Exam
- imaging

## ADDRESS BARRIERS TO TREATMENT

## ESTABLISH QUALITY OVERSIGHT

- Data-driven performance feedback
- Targeted QI efforts





# EPIDEMIOLOGY

# THE NUMBERS

## 35,000-75,000 PER YEAR IN US

- Overall felt to be 2-4%
- Reported rates varied in terms of percentage of strokes
  - Stroke Data Bank (1983-1986) reported 7%
    - 92% ischemic, 8% hemorrhagic
  - Ischemic stroke registries 2.2-4.4%
  - Single-center studies up to 17%
- Likely under reported

# RISK FACTORS

## NO LARGE, VALIDATED, MULTIVARIABLE STUDIES, BUT HIGHER RISK:

- Within 24 hrs of cardiac or neurovascular procedure
  - TAVR, CABG, angiogram, carotid stent or endarterectomy
  - About half are from vascular procedures
- With the following underlying diagnoses:
  - Infectious endocarditis
  - Acute coronary syndrome with intracardiac thrombus
  - Dehydration
  - Elevated hemoglobin
  - Infection
  - Sickle cell anemia
  - Drug use disorder
  - Fever
  - Leukocytosis
  - Elevated or unstable blood pressures
  - Malignancy



# PATIENT DEMOGRAPHICS

AS COMPARED TO COMMUNITY-ONSET STROKES, PATIENTS WITH IHS HAVE:

- More medical comorbidities
- Older age
- Lower pre-morbid functioning
- More cardio-embolic strokes
- More likely to have prior stroke or recent TIA or MI



# IHS EVALUATION

# SYMPTOM RECOGNITION

## SYMPTOM RECOGNITION OFTEN DELAYED

- Confounding variables to assessment
  - Pain
  - Sedation
- Misattribution of symptoms
  - Pain rather than weakness
  - Medication effects rather than focal deficits



# DELAYS IN EVALUATION

## ONCE SYMPTOMS IDENTIFIED, DELAYS PERSIST

- Delays from symptom recognition to neuroimaging
  - IHS 4.5 hrs vs ED 1.2 hrs in one study



# IHS EVALUATION LESS STANDARDIZED

## ED STROKE RESPONSES

- Organized response teams
- Standardized protocols
- Quality benchmarks





# RECOMMENDATIONS

## DEVELOPMENT OF FORMAL PROTOCOLS, INCLUDING:

- Staff education
- Simplified assessment method
- Defined IHS alert activation process
- Dedicated team to respond to IHS alerts



# STAFF EDUCATION

## TRAINING OF ALL STAFF TO:

- Recognize potential stroke
- Activate stroke code
- Stabilize patient
- Begin diagnostic work-up



# STAFF EDUCATION

## TRAINING METHODS:

- Videos
- Simulation
- Bedside training



[Stroke Simulation: Know the signs. Call 911 quickly. - YouTube](#)



# PATIENT ASSESSMENT

## CONSIDER SIMPLIFIED ASSESSMENT TOOL

- Insufficient evidence to recommend any specific tool
- Consider:
  - 2CAN
  - FAST
  - BE-FAST
- NIHSS



# PATIENT ASSESSMENT: 2CAN

## FOUR KEY RISK FACTORS THAT INDEPENDENTLY PREDICT STROKE

- Clinical deficit score
  - Recent cardiac procedure
  - History of atrial fibrillation
  - Within 24 hours of admission
- 
- Score  $\geq 2$ 
    - Sensitivity 92%
    - Specificity 70%
    - PPV 94%

# F

## Face Drooping

Does one side of the face droop or is it numb? Ask the person to smile. Is the person's smile uneven or lopsided?

# A

## Arm Weakness

Is one arm weak or numb? Ask the person to raise both arms. Does one arm drift downward?

# S

## Speech

Is speech slurred? Is the person unable to speak or hard to understand? Ask the person to repeat a simple sentence.

# T

## Time to Call 9-1-1

If the person shows any of these symptoms, even if the symptoms go away, call 9-1-1 and get them to the hospital immediately.



# BE FAST

**B:** Balance

**E:** Eyes

**F:** Face

**A:** Arm

**S:** Speech

**T:** Time



# NATIONAL INSTITUTES OF HEALTH STROKE SCALE

Item	Title	Responses and Scores	Item	Title	Responses and Scores
1a.	Level of consciousness	0—alert 1—drowsy 2—obtunded 3—coma/unresponsive	6.	Motor function (leg)	0—no drift 1—drift before 5 seconds 2—falls before 5 seconds 3—no effort against gravity 4—no movement
1b.	Orientation questions (2)	0—answers both correctly 1—answers one correctly 2—answers neither correctly	a. Left		
1c.	Response to commands (2)	0—performs both tasks correctly 1—performs one task correctly 2—performs neither	b. Right		
2.	Gaze	0—normal horizontal movements 1—partial gaze palsy 2—complete gaze palsy	7.	Limb ataxia	0—no ataxia 1—ataxia in 1 limb 2—ataxia in 2 limbs
3.	Visual fields	0—no visual field defect 1—partial hemianopia 2—complete hemianopia 3—bilateral hemianopia	8.	Sensory	0—no sensory loss 1—mild sensory loss 2—severe sensory loss
4.	Facial movement	0—normal 1—minor facial weakness 2—partial facial weakness 3—complete unilateral palsy	9.	Language	0—normal 1—mild aphasia 2—severe aphasia 3—mute or global aphasia
5.	Motor function (arm)	0—no drift 1—drift before 10 seconds 2—falls before 10 seconds 3—no effort against gravity 4—no movement	10.	Articulation	0—normal 1—mild dysarthria 2—severe dysarthria
			11.	Extinction or inattention	0—absent 1—mild loss (1 sensory modality lost) 2—severe loss (2 modalities lost)





# IMPORTANT IHS MIMICS

# STROKE MIMICS

## HALF OF ALL ALERTS FOR POSSIBLE IHS ARE MIMICS

- Symptoms often non-focal
- Isolated altered mental status most often mimics
- Most common mimics:
  - Toxic-metabolic encephalopathy
  - Sedating medications
  - Seizures
  - Sepsis
  - Syncope

### **Stroke mimics**

#### **Alteration in mental status / non-focal impairment**

Toxic/metabolic encephalopathy

Medication induced

Metabolic disorders

Respiratory disorders

Infections/sepsis

Dementia with acute delirium

#### **Hemodynamic disorders**

Hypotension

Hypertensive emergency

Syncope

#### **Somatoform disorders**

Conversion disorder

Secondary gain

#### **Primary Neurologic disorders**

Seizure

Tumor

CNS infection

Peripheral neuropathy

# TREATMENT: AIS

# AIS TREATMENT

## INTRAVENOUS THROMBOLYSIS AND ENDOVASCULAR TREATMENT

- Treatment often delayed compared to community-onset
  - Symptom recognition to bolus 81 vs 60 minutes
- GWTG reported increased utilization of treatment 2008 to 2018
  - IV thrombolysis 9.1% vs 19.1%
  - Endovascular therapy 2.5% vs 6.4%

# AIS TREATMENT

## EXPANSION OF TREATMENT

- WAKE-UP
  - Utility of MRI diffusion and FLAIR mismatch to identify eligible patients for thrombolysis
  - Up to 9 hours from symptom onset
  - Potentially useful for patients awakening from anesthesia
  - Can be limited by MRI availability
- DAWN & DEFUSE
  - Expansion of time window for endovascular therapy
  - Need transfer protocols for facilities without endovascular expertise

# TREATMENT: ICH

# INTRACEREBRAL HEMORRHAGE (ICH)

## MANAGEMENT THE SAME AS SPONTANEOUS ICH

- Blood pressure control
- Reversal of anticoagulation
- Assess for and address underlying coagulopathy or thrombocytopenia
- Evaluation for mass effect requiring neurosurgical intervention





# INTRACEREBRAL HEMORRHAGE: SPECIAL POPULATIONS

## HEMORRHAGIC TRANSFORMATION AFTER THROMBOLYSIS

- Refer to AHA/ASA Statement on Treatment and Outcome of Hemorrhagic Transformation after Intravenous Alteplase in Acute Ischemic Stroke

## ICH FOLLOWING CEREBRAL HYPERPERFUSION

- Strict periprocedural blood pressure control
- Weight risks and benefits of holding antiplatelets
  - Especially in the case of stents



# IHS OUTCOMES

# IHS OUTCOMES WORSE OVERALL

- Treated patients (IV thrombolysis and endovascular) have similar outcomes to community onset strokes
- BUT, overall IHS patients:
  - Experience less improvement within 24 hours
  - Less improvement by discharge
  - Less likely to ambulate independently at discharge
  - Less likely to return directly home
  - More likely to die in the hospital



# WHY?

- More severe stroke deficits
- Less likely to receive IV thrombolysis
  - Delayed symptom recognition
  - Medical contraindications
- Increased comorbid conditions
- Less care on stroke units
- Overall delays in care



# CHALLENGES, LIMITATIONS, AND STROKE SYSTEMS OF CARE

# STAFF EDUCATION

## EDUCATION ACROSS STAFF

- Nurses recognize symptoms earlier than physicians or advanced practice providers
  - Median 2.0 vs 4.9 hours
- Earlier recognition means more opportunity for treatment
- Any staff who recognizes possible stroke should be empowered to activate IHS alert

# RESOURCES & SYSTEMS OF CARE

## NOT ALL HOSPITALS HAVE THE SAME STROKE RESOURCES

- Community hospitals have less consistent adherence to treatment guidelines
  - Less multidisciplinary assessment, workflow, education, etc.
- Variability in on-site neurology or interventional expertise
- If hospital does not have necessary resources, recommend transfer
- Establish transfer process
  - Recognize need for transfer, communicate to accepting institution, coordination & execution of transfer
- Telemedicine may help bridge gaps



# EDUCATION & FEEDBACK

# EDUCATION

- Education shown to improve time to assessment





# MULTIPLE FORMS OF STROKE EDUCATION

- Pocket cards
- Posters
- Lectures or grand rounds
- Simulation



# CONTENTS OF STROKE EDUCATION

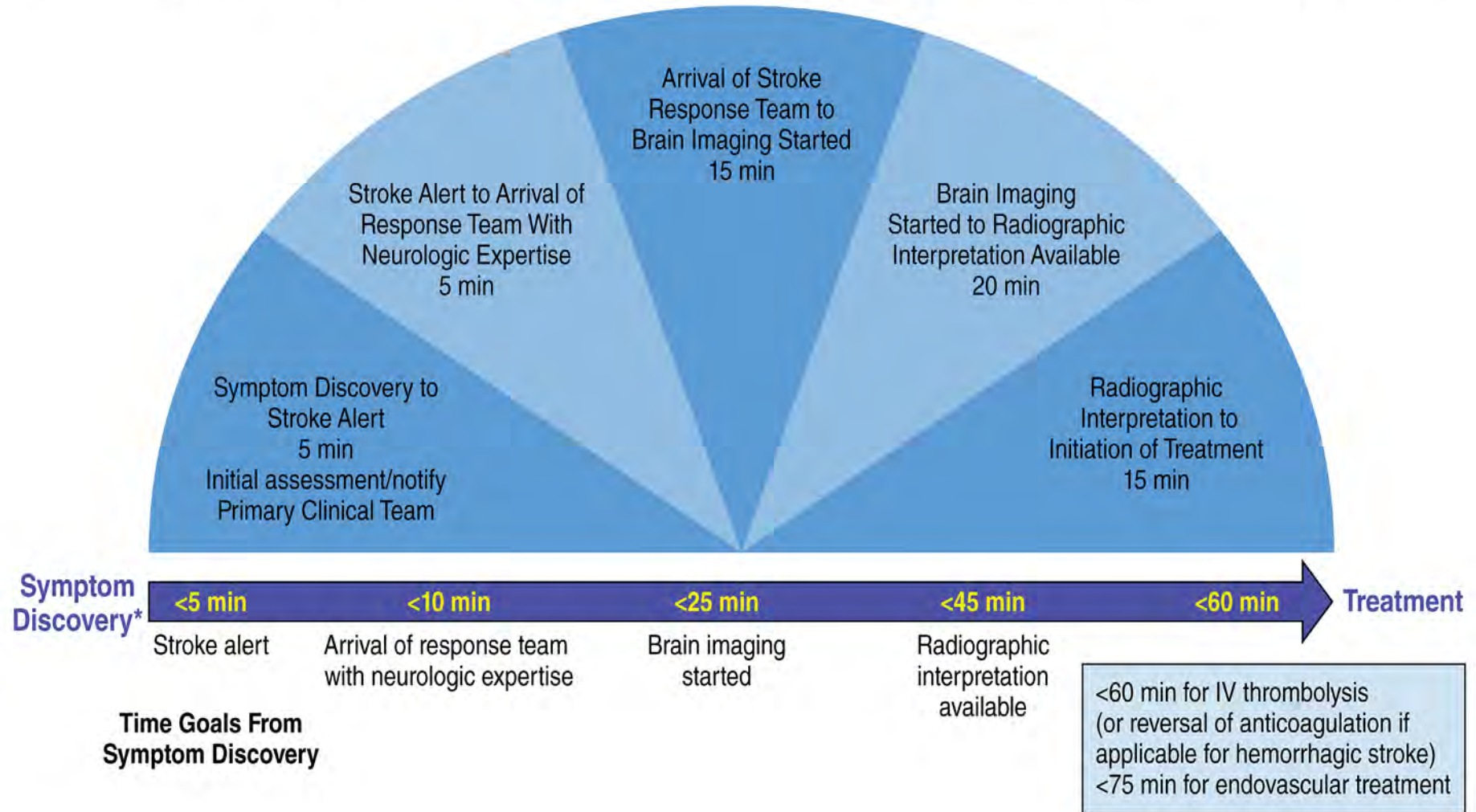
- Stroke signs and symptoms
- Importance of time/impact of delays
- Care pathways
- Roles and responsibilities of staff



# FEEDBACK

- Frequent, non-punitive, constructive
- Helpful to track and report each piece of process
- Discuss:
  - Individual alerts
    - Multidirectional feedback after each IHS alert
    - Case specific
  - Aggregate Data
    - Refine overall process

## Consider Dedicated Process Improvement Focused on Individual Step If Time Interval Exceeds



# TEAMS, PROCESSES, & OVERSIGHT

# IHS RESPONSE

- Insufficient data to inform evidence-based recommendation on composition or design of IHS response teams
- Recommend written protocols based on:
  - AHA guidelines
  - Hospital policy
- Ongoing modifications based on internal data



# CALL FOR ONGOING QI & TRACKING

# NEED FOR ONGOING STUDIES

- Focused efforts are needed to improve adherence to consensus quality metrics



# REVIEW

# RECOMMENDATIONS FOR OPTIMIZING IHS

- Education
- IHS Teams
- Standardized process and protocols
- Addressing challenges, barriers, and limitations
- Ongoing quality improvement



## Necessary Organizational Infrastructure

### Committee With Oversight of In-Hospital Stroke Quality

#### Rapid In-Hospital Stroke Response Mechanism

(Dedicated Stroke Response Team or Medical Emergency Rapid Response Team with stroke training)

#### Education of Hospital Staff on Signs and Symptoms of Stroke

(Urgency of evaluation, target time for treatment, and how to activate a stroke alert)

### Patient With Potential Stroke Symptoms

#### In-hospital stroke alert activated (any hospital staff can activate)

##### Primary Nurse

- Record time of symptom onset or time last known without deficit
- Document potential stroke symptoms
- Assess ABCs and vital signs
- Provide oxygen if SaO<sub>2</sub> <92%
- Notify Charge Nurse and remain with patient
- Obtain point-of-care blood glucose
- Ensure IV access (minimum 20-gauge AC)
- Draw blood for testing

##### Charge Nurse

- Notify primary physician of patient's status
- Coordinate safe transfer of patient to Radiology (with portable oxygen and cardiac monitor)
- Pharmacy and Radiology should be notified of incoming patient for emergency stroke evaluation (if not already part of Stroke Response Team)

##### Stroke Response Team

- Confirm initial stroke symptoms and perform rapid patient assessment, including NIHSS
- Order STAT brain imaging and labs (CBC, basic metabolic profile, PT/INR, PTT, troponin; HCG if appropriate)
- Assist Primary Nurse with transport to Radiology
- Communicate with Primary Clinical Team
- Define acute responsibility for evaluation and management
- Establish emergency contact information for patient's family

##### Primary Clinical Team

- Provide context based on comorbid illness
- Assist Stroke Response Team in consideration of stroke mimics, any contraindications to stroke treatment, and goals of care

##### Rapid Transport to Brain Imaging

- Primary Nurse and Stroke Response Team remain with patient throughout transport to Radiology (with portable oxygen and cardiac monitor)

##### Treatment Decision

- Team communicates assessment with Neurology or designee
- Evaluates inclusion and exclusion criteria for thrombolysis
- Determines if patient is candidate for treatment (IV and/or endovascular)
- Determines if patient needs acute neurosurgical evaluation and/or intervention

##### IV Thrombolysis

- Stroke Response Team sends thrombolytic orders to Pharmacy STAT (send runner for drug if needed)

##### Endovascular Thrombolysis

- Activate endovascular team and transport to endovascular suite, or arrange transfer to stroke center with endovascular capacity

## Best Practice Processes

### Bidirectional Performance Feedback Soliciting Suggestions for Improvement After Each In-Hospital Stroke Alert

#### Practice With Mock Stroke Alerts

(Particularly in clinical areas with less experience with stroke response)

