Article Review

Standardized Reporting of Workflow Metrics in Acute Ischemic Stroke Treatment: Why and How? | Stroke: Vascular and Interventional Neurology (ahajournals.org)

Abstract: In acute ischemic stroke (AIS), every second counts. A typical patient with AIS with large-vessel or medium-vessel occlusion loses 1.9 million neurons per minute.[1, 2] Although both intravenous thrombolysis (IVT) and endovascular treatment (EVT) are effective treatments for AIS attributed to large-vessel occlusion, and preliminary encouraging data suggest efficacy in medium-vessel occlusion stroke as well,[3, 4] their effects are also highly time dependent. Although studies on workflow improvement in AIS are increasingly gaining attention, there is a lack of consensus and consistency regarding the definition, measurement, and reporting of AIS workflow times….

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Key Article Points

- Accurate Definition and Consistent Reporting of Workflow Metrics: Essential Prerequisites for Improving AIS Workflows
- Problems in Defining, Measuring, and Reporting Workflow Times in AIS
- Prehospital Versus In-Hospital Stage
- What Are Important Workflow Metrics?
- Who is “Responsible” for Which Workflow Times?
- Which Time Points are Most Important?
- Additional Considerations When Capturing Workflow Times
- How Should Workflow Times be Reported?
- Conclusions

Accurate Definition and Consistent Reporting of Workflow Metrics: Essential Prerequisites for Improving AIS Workflows

To facilitate workflow metric assessment, it is highly desirable to have harmonized definitions of temporal events that are applied uniformly by all stakeholders in regional systems of acute stroke care.

Stroke Initiatives by following groups to provide operationalized definitions:

Government Agencies National Institutes of Health Common Data Elements for Stroke, National Emergency Medical Services Information System)

Multicenter care quality consortia (eg, the Safe Implementation of Thrombolysis in Stroke, Get With the Guidelines–Stroke)

Accreditation programs (eg, the Joint Commission and Det Norske Veritas)

Specialty society and consensus group guidelines (eg, American Heart/Stroke Association

Issues: Although offering valuable guidance, these existing sources provide incomplete and sometimes conflicting workflow metric definitions. In addition, they largely fail to take advantage of emerging automated sensing technologies capable of documenting key care event times with high precision.

Proposal: To address these limitations, this consensus statement provides a detailed listing of key time metrics meriting documentation in acute stroke care, offers insights regarding their optimal definition and coding, integrates traditional and emerging time stamp approaches, and suggests reporting formats regarding time care intervals that facilitate effective and continuous quality improvement.

Problems in Defining, Measuring, and Reporting Workflow Times in AIS

Defining Workflow Times

Define key metrics in precise definitions.

Examples include to define “door”, “needle”, “imaging”, “arrival”, “scene” in addition to key time intervals such as “door to needle”, “door to CT”, door in door out, etc…

Measuring Workflow Times

Manual data entry is costly & error prone

Strive to utilize automated data entry i.e. imaging times, dispatch, other time stamps

Important to ensure internal clocks in imaging devices are continuously synchronized to actual world time

Prehospital Versus In-Hospital Stage

Stroke Metrics divided into Pre-Hospital & In-Hospitals
Historically more focused on in-Hospital metrics
Pre-Hospital Issues

- Mild symptoms not recognized
- Patients driving themselves
- Less developed EMS systems
- LVO intervention interrupted by stop at PSC

Transfer Collaboration

What Are Important Workflow Metrics?

Defined by time points that:
Index a distinct event that can be measured consistently, reliably, and accurately in all patients
Directly relevant to patient management or clinical outcome
Can be automatically captured and require no manual input
Robust against bias and unwanted variability

Who is "Responsible" for Which Workflow Times?

Engagement of Stroke Team Members are Key to Success:

- Prehospital team: prehospital personnel, that is, dispatchers, standard ambulance emergency medical technologists, and paramedics are responsible for the patient during the time from first contact to PSC/CSC door
- CSC in-hospital non-interventional team: the ED, stroke neurology, diagnostic radiology staff, including CT/MRI technicians, and pharmacy personnel who comprise the CSC in-hospital noninterventional team are responsible for the door-to-needle phase in patients who receive IVT and the door-to-imaging phase in patients who do not receive IVT.
- Joint in-hospital non-inverventional stroke team and neurointerventional team: these groups share responsibility for the phase from IVT administration to angiography suite arrival in patients who receive IVT and the phase from image acquisition to angiography suite arrival in patients who do not receive IVT.
- Neurointerventional team: the neurointerventional team, including the neuro interventionalist, angiography technicians, catheterization laboratory nurses, and anesthesia staff if anesthesia is used, is responsible for the phase from patient arrival at the neuro angiography suite to reperfusion.
- PSC team: the ED, neurology, and diagnostic radiology staff, including CT/MRI technicians, and pharmacy personnel who comprise the in-hospital PSC team are responsible for the care phase from PSC arrival to PSC departure, also known as the door-in-door-out phase.

Which Time Points are Most Important?

1. Time last known well (if possible): defined as the last time at which the patient was known to be at their prestroke baseline.
2. Time of symptom discovery (if possible): defined as time stroke symptoms were first observed by the patient or a collateral witness.
3. Time of initial call for help: defined as the time of the incoming call from the patient or a bystander contacting EMS for help or, if patients arrive at the hospital in their private vehicles, the time at which they present at the emergency desk.
4. Time EMS unit arrived on scene: defined as the time at which the ambulance arrives at the patient location..
5. Time EMS unit left scene: defined as the time at which the ambulance departs from the patient location..
6. Door time: defined as the time of entering the hospital building for the first time, that is, the time at which the first hospital door through which the patient enters is passed. Currently some organizations define door time as the time of patient handoff from EMS to ED staff or time of entry of first vital signs in the ED. However, this definition is suboptimal, as it fails to reflect “wall time”—the time that paramedics spend in the hallway awaiting ED bed and staff availability. Wall time is under hospital rather than prehospital control and so is best categorized into the in-hospital phase of care that begins at the “door.” Capturing the door time requires manual data entry, unless a live patient tracking system is used.[24]
7. Time brain imaging first initiated: defined as the time the first noncontrast CT or parenchymal MRI image is acquired.
8. Time vascular imaging first initiated: defined as the time the first CT angiography (CTA) or MR angiography image is acquired. Times of first vascular image acquisition can be automatically retrieved from the time stamp of the image in the DICOM headers. This time point marks the time that information regarding whether the ischemic stroke is attributed to a large or medium-sized vessel occlusion first becomes available.
9. Needle time: defined as time at which the IVT agent is started. Capturing needle time requires manual data entry, but it is routinely captured in most centers.
10. Arterial puncture time: defined as time of arterial puncture in the neuroangiography suite. The time stamp of the first DSA image can be used as a proxy for arterial puncture time if the neurointerventionalist routinely acquires an image immediately post puncture.
11. Time of first deployment of a mechanical reperfusion device: defined as the time at which an aspiration catheter is first applied to the target occlusion, stent retriever first opened within the target occlusion, angioplasty balloon or stent first expanded within the target occlusion, or macerating wire first passed through the target occlusion. The time stamp of the first DSA image showing device engagement with the target occlusion is best used as a source for this time point as it is not subject to unconscious bias in reporting. This also means that DSA images that show engagement of the endovascular device with the thrombus should be routinely obtained and saved.
12. Time of first successful reperfusion: defined as the time an expanded Thrombolysis in Cerebral Infarction (eTICI) score of ≥2b is first achieved. The time stamp of the first DSA image showing an eTICI 2b–3 result is best used as a source for this time point, that is, the DSA run on which eTICI 2b–3 reperfusion is first seen should be routinely saved.
13. Time of departure (for transfer patients only): time at which the patient leaves the PSC hospital building. Capturing the time of departure requires manual data entry unless a live patient tracking system is use

Key Time Points Illustration

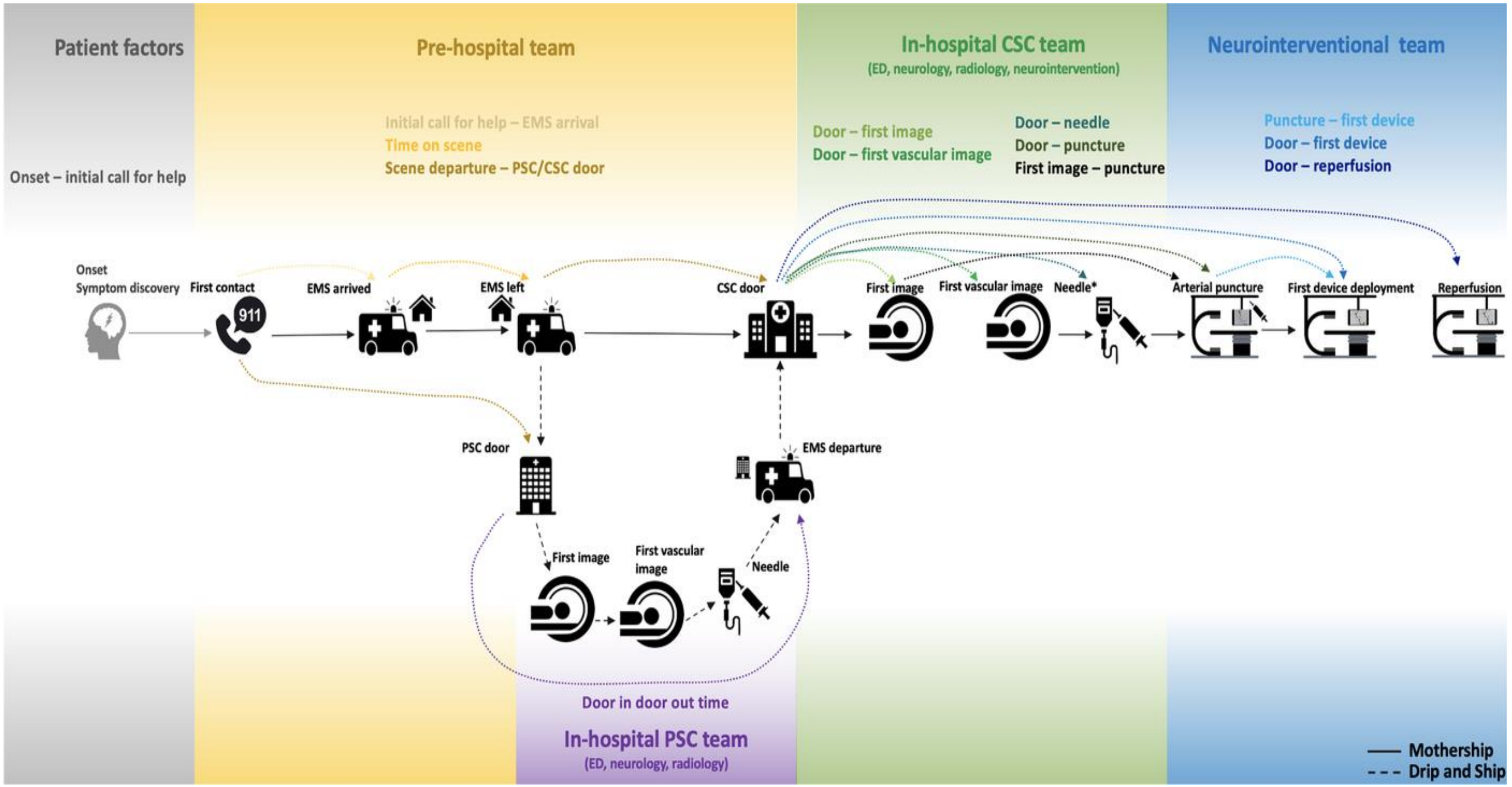


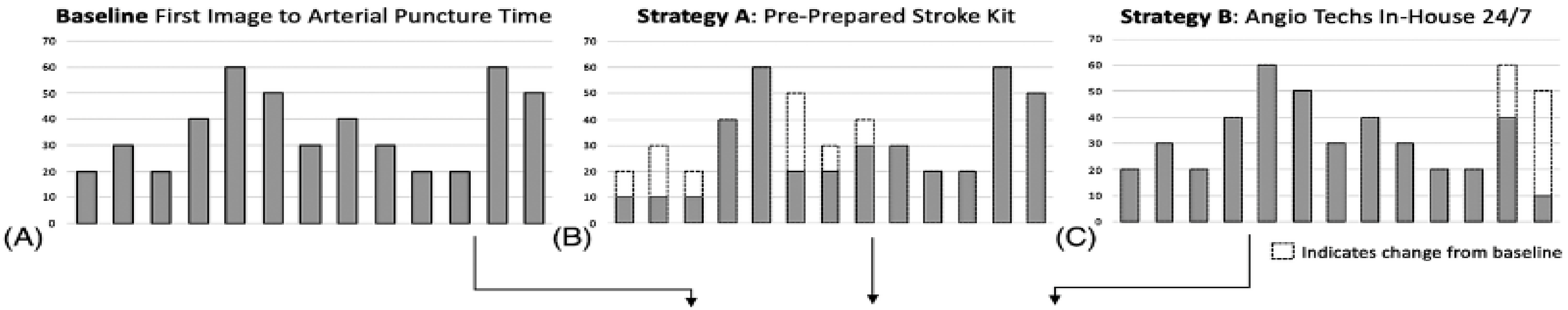
Figure 1. Illustration of recommended workflow time points and workflow interval times to be captured in AIS workflow studies. The suggested 11 time points that should be captured (besides time of last known well and time of symptom discovery, which should be captured if possible, but are often unknown) are as follows: (1) time of initial call for help, (2) time EMS unit arrived on scene, (3) time EMS unit left scene, (4) door time (time of PSC/CSC arrival), (5) time of imaging first initiated, (6) time of vascular imaging first initiated, (7) needle time (which can occur before the time of last image acquisition), (8) arterial puncture time, (9) first device deployment time, (10) time of first reperfusion, and (11) departure time (for transfer patients only).

Additional Considerations When Capturing Workflow Times

Door to Direct to Angiography
Mobile Stroke Units
Telemedicine
Impact of Anesthesia

How Should Workflow Times be Reported?

Best to repc
Example:



	Baseline	Strategy A	Strategy B
Median	30	**20**	30
Mean	36.2	**29.2**	**31.5**
90th Percentile	58	58	**48**

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Figure 2. Impact of different time-saving strategies on the first image to arterial puncture time median, mean, and 90th percentile. (A) The baseline situation. (B) Using a preprepared stroke kit (strategy A) reduces workflow times of patients in the “middle range” but has no effect on the outliers, that is, the patients with the longest workflow times during nights and weekends, because the angiography technicians and nurses, who have to come in the hospital from home during off hours, are the limiting factors (reduction in first image to arterial puncture time is shown with dashed bars). In the hypothetical example above, using a pre-prepared stroke kit reduces the median time from 30 to 20 minutes and the mean time from 36.2 to 29.2 minutes. There is no effect on the 90th percentile. (C) Establishing 24/7 availability of an in-house angiography technician team reduces last image to arterial puncture times of the “outliers,” that is, patients who present during nights and weekends and had the longest workflow times, but this has no effect on patients in the middle range. This reduces the 90th percentile from 58 to 48 minutes. It also slightly reduces the mean first image to arterial puncture time from 36.2 to 31.5 minutes. There is no effect on the median first image to arterial puncture time.

Conclusion

Defining, measuring, and reporting workflow time metrics in a consistent, accurate, and reliable fashion is an essential prerequisite for improving AIS workflow times—

It is imperative to "***speak the same language***" to monitor improvements longitudinally and compare the effects of various time-saving strategies.