

Fusing real-time location with clinical and operational data for high-precision characterization of stroke workflows

BACKGROUND

The Emergency Department (ED) is, by definition, a continuum of interacting, overlapping, conflicting, non-compatible needs for care. Ultra-acute Care, and its dynamic setting, makes understanding its process and impact on patient outcomes challenging. An example is the care for patients suspected of having a stroke.

Stroke care, particularly in ischemic (thrombotic) events, is time sensitive. Brain tissue behind the blockage is deprived of oxygen; therapy is done by dissolving the clot or by intra-arterial suction of the clot. Timely intervention can create an intensely positive impact on quality of life, the ability to partake in social and professional interaction, and in the cumulative cost for lifelong care.

However, the window of opportunity is small: scientifically, time of incident-to-therapy, ED door- to-therapy (door-to-needle, i.e. to actual therapy of ± 60 minutes) times have been defined for the risk-to-benefit-balance. To facilitate this care, pathways (Fig 1: Stroke pathway, ETZ 2019) describing the steps, responsibilities, etc., have been developed.

Characterizing such a pathway is difficult, as it requires understanding multiple issues such as the context, logistics, nursing, laboratory and medical care aspects, which cannot be done in a classic patient-by-patient method. The pilot demonstrates how real-time location data can be fused with clinical and operational data in order to accurately characterize the care pathway of stroke patients.

GOAL

This poster describes the preparatory steps needed to deploy a real-time locating system (RTLS) in order to accurately capture all workflow (sub) steps that potentially affect the stroke care pathway. The captured data is used to measure various KPIs in a level-1 Neuro and Trauma Center ED.

Figure 2: RTLS in ED ETZ



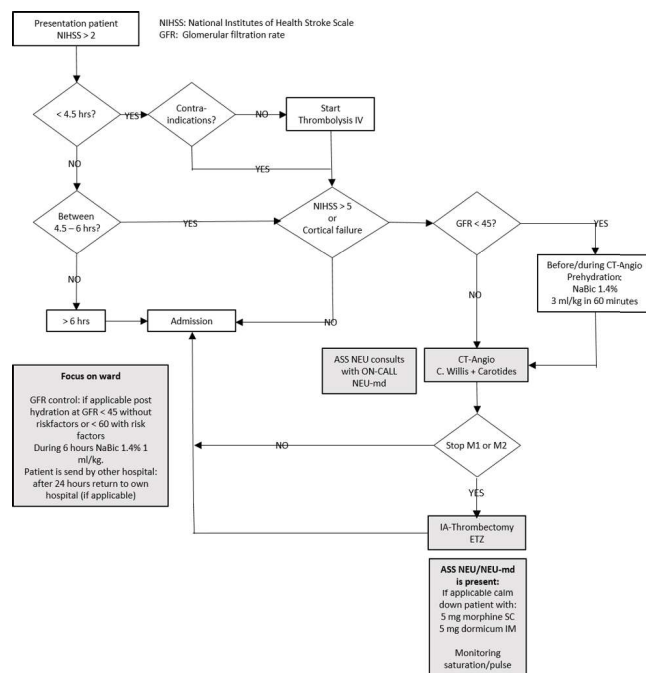
Table 1: Overview of steps and aspects in stroke pathway

Item (source)	Aspects / Impact
Patient delay (pre-hospital, communication)	Potentially exclusive to therapy
EMS interventions (paramedical, communication)	Source data (medication, timing, situation) focusing expectations. Information to coordinator ED (allowing pathway to start)
Coordinator(s) ED	Information to (designated) nurse, technicians, room available, inform NEU-md. Monitors for arrival and continuing process (resource management)
Preparation phase (communication, material) - ED-md & NEU-md - RN - Technicians (RAD, CAR, ...)	Available at arrival (inclusive or exclusive, history, PE, Rx) Available at arrival (time restrictive -> Lab) CT available, available at arrival (determining CT-angio)
Initial contact with patient (start the clock)	Move to stretcher / CT table from EMS Focused assessments (parallel where possible), serial where necessary ? high index of suspicion stroke pathway ! ? (very) low index of suspicion: exclude causes
Call-out team(s) (communication)	On-call RAD int-md and technicians On-call ANE-md (if support seems needed) On-call ICU-md (if bed expected to be needed)
Thrombolysis, high dependency bed	ALL Requirements met/ results available ? strategy ?
Thrombectomy, angio suite (material, personnel)	Team(s) complete and reception capable, briefing ? Sign in procedure
Procedure (stop the clock)	Reperfusion time later than needle time Some awake, sedated, or under full anesthesia (complications)
Recovery and definitive bed	Variable on vital functions. co-morbidity, status.

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Figure 1: Stroke pathway, ETZ 2019



METHODOLOGY & OUTCOMES

In order to migrate from a patient-oriented approach to a Big Data and RTLS method (Fig 2: RTLS in ED ETZ) an analysis of variables and impacts was needed, based on the initial care pathway. A multi-disciplinary committee was formed.

- 1) Main aspects assessed are visualized in Table 1, high reliability pathway already exists and functions, but:
 - At least 10 and up to 25 professionals are involved, 'ownership' strongly NEU
 - More than 40 separate (logistic, techno, communication) steps are involved
 - At least 5 'knock out' information aspects, which can block progress
 - Both hard (i.e. lab, CT-angio) and soft (timing, medication, history) data impact course
 - Delays are both incremental (i.e. minute here and there) and incidental (i.e. call-out team)
 - Context on ED as whole may influence pathway everywhere
- 2) RTLS location of caregivers, material, and patient is a strong, non-Hawthorne sensitive, manner to observe and analyze this multi-factorial, highly dynamic, setting and process, allowing maximal professional anonymity. RTLS and electronic medical data together should allow valuable insight and resource management.
- 3) This approach and experience may lay the groundwork for valuable assessment of less clearly defined groups of hyper-acute care, such as sepsis patients.

TAKE HOME MESSAGE

The fusion of real-time location data with clinical and operational data is well suited for analysis of multi-step, multi-factorial, context dependent care processes. RTLS allows non-biased, high accuracy insights into critical times and locations. This has the potential to save lives, reduce costs, and decrease workloads.