

Nurses Are as Specific and Are Earlier in Calling In-Hospital Stroke Alerts Compared to Physicians

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Introduction: In-hospital stroke alerts are typically activated by nurses or physicians when a patient's neurological status acutely changes from baseline. It is unclear if knowledge of stroke symptoms translates to accurate activation of the acute stroke team. We hypothesized that nurses who activate the stroke alert system would correctly identify as great a proportion of acute strokes as physicians. We also investigated the time to activation of these in-hospital stroke alerts. **Methods:** We retrospectively reviewed consecutive inpatient stroke team calls over a 12-month period at a single, tertiary care center. Calls and exact times were identified from the acute stroke pager log. The type of provider who called the stroke alert, patient characteristics, last known well time, and acute stroke symptoms was prospectively collected and retrospectively verified through electronic medical record review. Patients with definite stroke then were retrospectively identified by World Health Organization Monitoring of Trends and Determinants in Cardiovascular Disease (WHO MONICA) criterion. **Results:** A total of 93 calls were analyzed. Nurses and physicians/midlevel providers activated the in-hospital stroke alert with a similar percentage of correct stroke diagnosis (62.7% versus 58.8%, $P = .82$). Nurses activated stroke alerts significantly earlier than physicians/midlevel providers (median 2 hours [IQR .5-6 hours] versus 4.9 hours [IQR 1.3-21.3 hours], $P = .0096$) from last known well time. **Conclusions:** Nurses identify in-hospital ischemic events with a similar percentage as physicians, and they activate the stroke alerts significantly earlier. The median nursing activation time fell within a 3-hour window for potential systemic thrombolytic or early endovascular therapy. An intensive, focused, collaborative education of nursing staff may further improve inpatient stroke outcomes. **Key Words:** In-hospital stroke—nursing—epidemiology—inpatient—stroke management.

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Introduction

Improvements in emergency medicine triaging, and identification and communication of stroke have led to more rapid evaluation, faster door-to-needle times of thrombolysis, and overall better trends in outcomes for patients.¹ Acute in-hospital strokes also represent an opportunity for rapid identification and treatment since patients are under observation and hospital resources are readily available for emergent interventions. Blacker et al noted that hospital-based registries found that about 7%-15% of all strokes occur among hospitalized patients and that some estimates put incidence between 35,000 and 75,000 cases each year.²⁻⁶ In-hospital stroke alerts are typically

activated when patients' neurological status acutely changes from their baseline. Although physicians, patient family members, and staff can report acute in-hospital strokes, nurses most often initially recognize acute neurological changes and stroke-like symptoms in the hospital setting.⁶ Time to evaluation of these patients should be minimal because there is nominal transportation requirement, medical history is usually known, and laboratory data such as coagulation factors, blood glucose, and complete blood counts as well as electrocardiogram are often readily available. Stroke symptoms among hospitalized patients are often confounded by alterations in mentation and systemic thrombolysis rates are generally low due to complex medical comorbidities and contraindications due to surgery and other pathology. Masjuan et al noted that even though thrombolysis is generally safe and effective for those without contraindications, in-hospital strokes are treated much more slowly than out-of-hospital strokes.⁷ Emergency departments are designed to act rapidly and its personnel are exposed more often to acute strokes. However, Alberts et al reported that a neurology team does not evaluate most hospitalized patients for a mean of 14.5 hours from symptom onset when not admitted on a neurology service.⁶ The etiology for an acute change in the neurological examination of an inpatient is often multifactorial and can occur due to factors unrelated to stroke such as metabolic encephalopathy, seizure, peripheral neuropathy, and other stroke mimics. Overtriaging false alerts can overwhelm resources and poses a challenge to stroke response teams. For this reason, there may be some discouragement to nurses and other nonphysician providers calling stroke alerts. There has even been some suggestion for studying whether physicians should be the only activators of a stroke alert in the hospital setting as other healthcare providers may not be as sensitive, specific, nor accurate at diagnosing acute stroke.⁸ However, Alberts et al found that in-hospital stroke patients were recognized most frequently by nurses (63%), and Adelman et al found that more than 85% of nursing staff seem to have adequate knowledge of stroke signs and symptoms.^{6,9} It is, however, unclear if this knowledge translates to appropriate activation of the acute stroke team. Accurate and timely identification of stroke symptoms and an immediate response from the stroke team are vital to reducing the morbidity and mortality of in-hospital strokes while properly and efficiently utilizing resources.

We hypothesized that nurses who activate the stroke alert system would identify as great a percentage of acute strokes as opposed to stroke mimics as physicians. Furthermore, we investigated the times to activation of the stroke alert system for all callers.

Methods

The hospital institutional review board reviewed and approved this study. We analyzed prospectively collected,

consecutive inpatient stroke team calls in a single Joint Commission-certified Comprehensive Stroke Center over a 12-month period during hours while the acute stroke nurse and stroke coordinator were available for consistent data recording. Calls from the neurological floor and the neurological intensive care units (ICUs) were excluded from this study as these units have alternative means of contacting the stroke team. The stroke team calls and exact times were identified from the stroke team pager log, which is the protocolized way stroke activation is alerted at our institution. For each activation, the caller was identified by name and employee type, and was asked a series of questions pertaining to the acute neurological change including the patient's last known well time, the stroke-like features of the neurological change, and when the change was first noted. Last known well time was ascertained and recorded during the initial call if it was a witnessed event and the time was known, and/or during the initial patient evaluation using the last documented baseline examination time of the patient or verbally reported baseline examination time if it was not a witnessed event. The demographics, medical history, and other patient specific details were later identified from a retrospective review of the electronic medical record. Over the past several years, as part of a nursing protocol to improve the sensitivity to strokes, nurses were encouraged to immediately call a stroke alert if stroke-like symptoms were recognized. For the purposes of this study, if a physician or a midlevel provider (MLP) noted stroke-like symptoms on examination and asked a nurse to activate the stroke alert for expedition of care, credit was given to the physician/MLP as the activator even though a nurse called the alert. All other nurse-activated stroke alerts were credited to the nurse.

The World Health Organization Monitoring of Trends and Determinants in Cardiovascular Disease (WHO MONICA) definition of definite stroke was then retrospectively identified in each stroke alert by a review of the chief complaint during stroke alert, computed tomography and/or magnetic resonance imaging, neuroradiology reports, vascular neurologist examination, and vascular neurology final assessment.¹⁰ The retrospective review was completed by C.R.N., D.R.W., and P.G. Demographic data, stroke mechanism, nursing unit, and reason for hospitalization were recorded. Baseline characteristics between alerts called by physicians/MLPs and nurses were analyzed by *t*-test mean, analysis of variance, Welch's test, chi-square test, and two-tailed Fisher's exact test. The proportion of patients with true stroke versus a mimic was compared via chi-square analysis and two-tailed Fisher's exact test. The time from symptom onset to stroke team activation was analyzed by nonparametric Wilcoxon rank sum test and was stratified by physician/MLP versus nurse. A median test with interquartile ranges (IQR) was used to compare NIHSS (National Institutes of Health Stroke Scale) scores between groups in all patients and in only patients retrospectively identified to have stroke.

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