

# Outcomes of Nurse Practitioner-Delivered Critical Care

## A Prospective Cohort Study



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**BACKGROUND:** Acute care nurse practitioners (ACNPs) are increasingly being employed in ICUs to offset physician shortages, but no data exist about outcomes of critically ill patients continuously cared for by ACNPs.

**METHODS:** Prospective cohort study of all admissions to an adult medical ICU in an academic, tertiary-care center between January 1, 2011, and December 31, 2013. The primary end point of 90-day survival was compared between patients cared for by ACNP and resident teams using Cox proportional hazards regression. Secondary end points included ICU and hospital mortality and ICU and hospital length of stay.

**RESULTS:** Among 9,066 admissions, there was no difference in 90-day survival for patients cared for by ACNP or resident teams (adjusted hazard ratio [HR], 0.94; 95% CI, 0.85-1.04;  $P = .21$ ). Although patients cared for by ACNPs had lower ICU mortality (6.3%) than resident team patients (11.6%; adjusted OR, 0.77; 95% CI, 0.63-0.94;  $P = .01$ ), hospital mortality was not different (10.0% vs 15.9%; adjusted OR, 0.87; 95% CI, 0.73-1.03;  $P = .11$ ). ICU length of stay was similar between the ACNP and resident teams ( $3.4 \pm 3.5$  days vs  $3.7 \pm 3.9$  days [adjusted OR, 1.01; 95% CI, 0.93-1.1;  $P = .81$ ]), but hospital length of stay was shorter for patients cared for by ACNPs ( $7.9 \pm 11.2$  days) than for resident patients ( $9.1 \pm 11.2$  days) (adjusted OR, 0.87; 95% CI, 0.80-0.95;  $P = .001$ ).

**CONCLUSION:** Outcomes are comparable for critically ill patients cared for by ACNP and resident teams. CHEST 2016; 149(5):1146-1154

**KEY WORDS:** acute care nurse practitioner; critical care; critical care manpower standards; intensive care units; nurse practitioner; outcome assessment (health care); patient care team; physician assistant; quality of health care; retrospective studies

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**ABBREVIATIONS:** ACNP = acute care nurse practitioner; HR = hazard ratio; PA = physician assistant; UHC = University HealthSystem Consortium

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Despite increasing demand for critical care services, the number of intensivists is constant or declining.<sup>1</sup> Moreover, in academic medical centers, duty hour limitations for residents have diminished a traditional source of ICU manpower.<sup>1,2</sup> To address the resulting shortage, acute care nurse practitioners (ACNPs) and physician assistants (PAs) have been increasingly employed to provide critical care services, but few data exist regarding safety or efficacy of this practice.<sup>1-4</sup> Although in-hospital outcomes of patients for whom ACNPs or PAs provided a portion of the care have been reported, no study has examined the longer term outcomes of critically ill adults continuously cared for by ACNPs.<sup>5-11</sup>

## Methods

### Study Design

From January 1, 2011, through December 31, 2013, we collected observational data for all admissions to the three critical care teams in the closed, 34-bed medical ICU at Vanderbilt University Hospital. The protocol was approved by the Vanderbilt Institutional Review Board (#110005) with waiver of informed consent. Each of two resident teams was composed of one first-year and one upper-level resident; the nurse practitioner team consisted of one ACNP (e-Figure 1). Coverage models were complex and changed over time. For resident teams, upper level residents worked 24-h shifts and first-year residents worked 16-h shifts allowing for overlapping coverage during morning and evening handoffs. At the time of service implementation, ACNPs worked either 12- or optional 24-h shifts. The ACNP team transitioned to 16-h shifts with a morning overlap of 2 h for rounds and a 5-h evening overlap beginning in 2012 after a workflow analysis showed workload heaviest in the early evening. Critical care fellows and attending physicians rounded with each team twice a day, were onsite most of each day, and were available at night. Each team was responsible for the evaluation and management of their patients including conducting admissions, transfers, and discharges; obtaining and interpreting diagnostic tests; and performing critical care procedures, with supervision by fellows and attending physicians as needed.

As previously described, the implementation of the ACNP team was a labor-intensive process occurring over the 10 months before the study period.<sup>13</sup> Eight ACNPs were hired, underwent didactic, procedural, and simulation training, developed protocols, and were integrated into the ICU. Training consisted of 4 months of attending physician supervised hands-on patient care that included admitting patients, making differential diagnoses, performing procedures, ordering and interpreting diagnostic studies, ordering medications, interacting with consultants, and discharging patients. Daily informal feedback of the performance of each ACNP trainee was provided by the attending physician and weekly formal evaluations occurred during orientation. Ongoing performance evaluations of ACNPs were conducted every six months. Each ACNP had prior experience as a critical care registered nurse (mean, 7.0 ± 6.7 years) and half had worked previously as an ACNP (mean, 3.3 ± 2.6 years).<sup>12-14</sup>

Patients admitted to the ICU were evaluated by the critical care fellow and assigned to one of the three teams. Consideration was given to each team's census (total number of patients and their acuity of illness) and workload (recent admissions, pending procedures,

To meet increasing critical care demands, in late 2010, Vanderbilt Medical Center expanded the number of medical ICU beds by more than 50%, which prompted the creation of a continuous in-house ACNP team in addition to two existing in-house resident teams.<sup>12-14</sup> All teams shared a common physical location, staff nurses, equipment, ancillary services, rounding format, and cadre of fellow and attending intensivist physicians. To evaluate the safety and efficacy of this model of care, we compared patient outcomes, including postdischarge survival, of patients admitted over a 3-year period to the ACNP and resident teams. We hypothesized that 90-day survival would be comparable between patients cared for by ACNP and resident teams.

transfers, and discharges) as well as the provisional diagnosis and acuity of the incoming admission.

### Study Population

All patients admitted to a medical ICU team during the 3-year study period were eligible for inclusion in the study. Patients were excluded only if they were not under the care of a medical ICU team or admitted as organ donors after declaration of death (Fig 1). If patients were admitted more than one time during the study period, each admission was included.

### Data Collection

Demographic and administrative data for each patient were entered into a secure, online Research Electronic Data Capture database by the medical receptionist at the time of ICU admission and verified using an independently generated hospital administrative database. The composite database included information on patient characteristics (demographics, marital status, residence), admission data (date, time, and source of admission, provisional admitting diagnosis), severity of illness (use of mechanical ventilation and vasopressors, expected hospital mortality), team assignment (ACNP or resident), and outcomes (ICU and hospital length of stay, ICU and hospital mortality). In January 2015, more than 1 year after the date of the last admission, vital status of all patients was added to the database by study personnel unaware of patients' team assignment by review of the electronic health record. When vital status at 90 days could not be determined by review of the electronic health record, study personnel searched [legacy.com](http://legacy.com) for the patient's obituary or a relative's obituary listing them as a survivor. If vital status remained in question, a search of [ancestry.com](http://ancestry.com), which links to the national death index, was conducted. If a record of death could still not be found, each patient's name and common variants were searched using [google.com](http://google.com) in an attempt to determine vital status.

### Study Outcomes

The primary end point was 90-day survival, defined as the time from ICU admission to death censored at 90 days. Secondary end points included ICU and hospital length of stay and ICU, hospital, and longer term mortality (with median follow-up of 231 days).

### Statistical Analysis

With 6,700 admissions to the resident team and 2,366 admissions to the ACNP team, an accrual interval of 3 years and additional follow-up after the accrual interval of 3 months, and a median survival time on

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