

Outcomes of Care Managed by an Acute Care Nurse Practitioner/Attending Physician Team in a Subacute Medical Intensive Care Unit

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OUTCOMES OF CARE MANAGED BY AN ACUTE CARE NURSE PRACTITIONER/ATTENDING PHYSICIAN TEAM IN A SUBACUTE MEDICAL INTENSIVE CARE UNIT

By Leslie A. Hoffman, RN, PhD, Frederick J. Tasota, RN, MSN, Thomas G. Zullo, PhD, Carmella Scharfenberg, RN, MSN, and Michael P. Donahoe, MD. From Schools of Nursing (LAH, FJT, TGZ, CS) and Medicine, Division of Pulmonary, Allergy and Critical Care Medicine (MPD), University of Pittsburgh, Pittsburgh, Pa.

- **BACKGROUND** Many academic medical centers employ nurse practitioners as substitutes to provide care normally supplied by house staff.
- **OBJECTIVE** To compare outcomes in a subacute medical intensive care unit of patients managed by a team consisting of either an acute care nurse practitioner and an attending physician or an attending physician and critical care/pulmonary fellows.
- **METHODS** During a 31-month period, in 7-month blocks of time, 526 consecutive patients admitted to the unit for more than 24 hours were managed by one or the other of the teams. Patients managed by the 2 teams were compared for a variety of outcomes.
- **RESULTS** Patients managed by the 2 teams did not differ significantly for any workload, demographic, or medical condition variable. The patients also did not differ in readmission to the high acuity unit ($P = .25$) or subacute unit ($P = .44$) within 72 hours of discharge or in mortality with ($P = .25$) or without ($P = .89$) treatment limitations. Among patients who had multiple weaning trials, patients managed by the 2 teams did not differ in length of stay in the subacute unit ($P = .42$), duration of mechanical ventilation ($P = .18$), weaning status at time of discharge from the unit ($P = .80$), or disposition ($P = .28$). Acute Physiology Scores were significantly different over time ($P = .046$). Patients managed by the fellows had more reintubations ($P = .02$).
- **CONCLUSIONS** In a subacute intensive care unit, management by the 2 teams produced equivalent outcomes. (*American Journal of Critical Care*. 2005;14:121-132)

CE**Notice to CE enrollees:**

A closed-book, multiple-choice examination following this article tests your understanding of the following objectives:

1. Explain the role of the acute care nurse practitioner/attending physician team in providing care in a subacute medical intensive care unit
2. Identify the 3 main outcome measures in the study
3. Discuss the limitations of the study

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Provision of intensive care is one of the largest and most costly aspects of healthcare in the United States.¹ National surveys indicate that an estimated 6000 noncoronary intensive care units (ICUs) in the United States provide care for approximately 55 000 patients each day.¹ According to calculated national projections, based on 2001 data, the total cost of ICU care is \$67.5 billion yearly or 23% of hospital costs.² Of concern, the need for critical care services continues to grow, and professional societies are projecting inability to meet future demands.^{3,4}

Intensive care, which accounts for 23% of hospital costs, is one of the largest and most costly aspects of US healthcare.

Within the spectrum of care provided in ICUs, some patients are particularly challenging. These patients, termed the chronically critically ill, experience a prolonged recovery often accompanied by difficulty in weaning from mechanical ventilation.⁵⁻⁷ Patients who require a prolonged ICU stay place an enormous work-force burden on healthcare resources.⁵⁻⁹ These patients tend to be older than other patients, have 1 or more chronic conditions, and be severely debilitated as a consequence of their extended illness.^{10,11} Further, because of their chronic care needs, such patients are not well fitted to an academic model that emphasizes learning new skills and frequent changes in the personnel who provide care.^{5,6,12} Other factors complicating the care of these patients include new restrictions in the number of hours worked by medical trainees and the projected shortage of intensivists.^{3,4,13}

Many academic medical centers employ nurse practitioners as substitutes to provide care normally supplied by house staff. Previous studies¹⁴⁻¹⁹ suggest that acute care nurse practitioners (ACNPs) can provide safe, cost-effective care as part of a collaborative medical management team in acute care settings and that these practitioners are well received by patients, nurses, physicians, and administrators. Although the practice site of ACNPs may include the ICU, little research has been done on the role of ACNPs in adult ICUs. Investigators examined a similar role in the ICU in only 3 studies,²⁰⁻²² and historical controls were used for comparison in all 3.

Care of the chronically critically ill, not well suited to an academic teaching model, may be most appropriate for acute care nurse practitioners.

Russell et al²⁰ examined outcomes before and after introduction of an ACNP team in 2 units, a neuroscience ICU and an acute care neurosurgical unit. Compared with matched controls admitted the preceding year and managed by house staff, patients managed by the ACNP team had a significantly shorter overall ($P = .03$) and ICU ($P < .001$) length of stay. Burns and colleagues^{21,22} tested an intervention in which unit-based advance practice nurses (called outcomes managers) managed and monitored adherence to an evidence-based clinical pathway designed to promote weaning from long-term (>3 days) mechanical ventilation. The intervention was tested for 12 months in 5 ICUs. Compared with patients treated in the units before implementation of the intervention, patients managed by

using the pathway had a reduction in median days of mechanical ventilation ($P < .001$), ICU length of stay ($P < .001$), and hospital length of stay ($P = .001$).²²

At the time of the study, the medical ICU (MICU) existed as 2 units: a high-acuity ICU and a subacute unit that provided transitional care before patients were discharged to a clinical unit or an extended-care facility. Patients were transferred to the subacute MICU when they had recovered from the acute phase of critical illness but could not be weaned from mechanical ventilation, experienced complications that precluded ICU discharge, or were awaiting placement. Historically, medical management of patients admitted to this unit was the responsibility of critical care/pulmonary fellows and an attending physician. However, changes in the educational program and numbers of ICU beds made it difficult to provide such management. We therefore evaluated the potential of assigning collaborative medical management of these patients to an ACNP/attending physician team.

This study was designed to test the hypothesis that the outcomes of critically ill patients whose condition is stable enough to allow admission to a subacute MICU will be equivalent when medical management is provided by an ACNP/attending physician team or a team of critical care/pulmonary fellows and an attending physician.

Methods

Design

A nonrandomized, repeated measures, equivalent time samples design was used in which consecutive patients admitted to the subacute MICU were managed by an ACNP/attending physician team or a team consisting of critical care/pulmonary fellows and an attending physician. Both teams were responsible for all unit admissions during 7-month blocks of time (total 14 months per team) that were alternated and separated by 1-month intervals. During the time patients were managed by the ACNP/attending physician team, no fellows were assigned to the unit. During the time that patients were managed by the fellows/attending physician team, the ACNP was not present in the unit. The total duration of the study was 31 months. No patients were enrolled in the study and no study data were collected during the 1-month intervals between teams. Patients not discharged before the beginning of a 1-month interval between teams were also not included in data analysis.

Both providers (ie, the ACNP and the critical care/pulmonary fellows) received an equivalent intensity of oversight by an attending physician. Both providers were responsible for managing the care of all patients

admitted to the unit 5 days each week (Monday-Friday) in collaboration with the attending physician. This role included assessment, diagnosis, and writing all orders for care, including weaning and extubation. Both providers were responsible for admitting new patients, with subsequent consultation with the attending physician about the diagnosis and plan of care. Daily rounds were held after rounds in the high-acuity MICU. During rounds, the attending physician reviewed the plan of care and suggested revisions, if indicated. The attending physician was also available, as needed, for consultation throughout the day. Both providers worked an 8- to 10-hour day during daylight hours. Evening and night coverage was provided by residents, and weekend care management was provided by the attending physician.

Sample

Between June 2000 and February 2003, all patients admitted to the subacute MICU for more than 24 hours were enrolled in the study and were followed up until discharge from the unit or death. Patients were admitted to the unit if they met the following criteria: stable or decreasing need for mechanical ventilation in the preceding 24 hours, stable hemodynamic status, and no active bleeding. The study protocol was reviewed and approved by the institutional review board.

The ACNP had a master's degree and was a certified (American Nurses Credentialing Center) graduate of an ACNP program. She was employed by the university-affiliated practice plan of the service administratively responsible for the subacute MICU. The ACNP was hired approximately 6 months before the start of the study. She had 15 years of experience as a critical care nurse but no previous experience in the nurse practitioner role. The ACNP program, in existence since 1994, has been previously described.²³

The fellows, who were board certified in internal medicine, were enrolled in a 1- or a 2-year program dedicated solely to critical care (n=14) or in a 3-year program that included training in various aspects of pulmonary medicine, including critical care (n=8). Each critical care fellow completed a 1- or a 2-week rotation in the unit, and the pulmonary fellows completed multiple 4-week rotations.

Setting

The setting was 1 of 10 ICUs located within a tertiary care facility. One attending physician was responsible for the care of patients admitted to the subacute MICU and an adjacent 14-bed high acuity MICU. Six attending physicians, who were board certified in critical care medicine, alternately provided care on a

monthly basis. One respiratory therapist was assigned to the unit on all shifts. The nurse-to-patient ratio varied from 1:2 (7 AM to 3 PM) to 1:3 (3 PM to 7 AM).

Main Outcome Measures

Length of stay was recorded for the number of days in the high-acuity MICU before transfer and for the number of days in the subacute MICU. Duration (in days) of mechanical ventilation was recorded for the same intervals. Reintubations were recorded as the total number of patients reintubated (yes/no) after removal of an endotracheal tube. Weaning discharge status was determined by the need for mechanical ventilation (yes/no) at the time of discharge from the subacute MICU. Disposition was recorded with regard to the discharge site, that is, high-acuity ICU, other unit, or other facility and not receiving mechanical ventilation; other facility and receiving mechanical ventilation; and home. Readmission rates were calculated for patients readmitted to a high-acuity ICU at any time after transfer to the subacute MICU and for patients readmitted to any ICU within 72 hours after discharge from the subacute MICU. In addition, number of deaths of patients who did or did not have treatment limitations were recorded.

Data on demographics and medical conditions included comorbid conditions (Charlson Comorbidity Index) calculated in the standard manner by using data available from the medical record.²⁴ Scores on the Acute Physiology and Chronic Health Evaluation (APACHE) III and the Acute Physiology Score were calculated in the standard manner at 3 points: first 24 hours of ICU admission, first 24 hours of subacute MICU admission, and last 24 hours in the subacute MICU.²⁵ The primary reason for mechanical ventilation was coded by using 5 categories: acute pulmonary problem (eg, acute respiratory distress syndrome, pneumonia), chronic pulmonary problem (eg, chronic obstructive pulmonary disease, idiopathic pulmonary fibrosis), neurological problem (eg, quadriplegia, stroke), cardiac problem (eg, congestive heart failure, after cardiac arrest), and other problem (eg, drug overdose, gastrointestinal bleeding).

Data Collection and Analysis

Data were obtained from an electronic medical records database (Medical Archival System, Inc, Pittsburgh, Pa), the computerized bedside charting system (Eclipsis, formerly Motorola Emtek, Tempe, Ariz), and hard-copy medical records by 2 researchers (FJT, CS) not involved in patients' care. A computer search was done at the end of each 7-month block to verify that all admissions were included. Baseline demo-

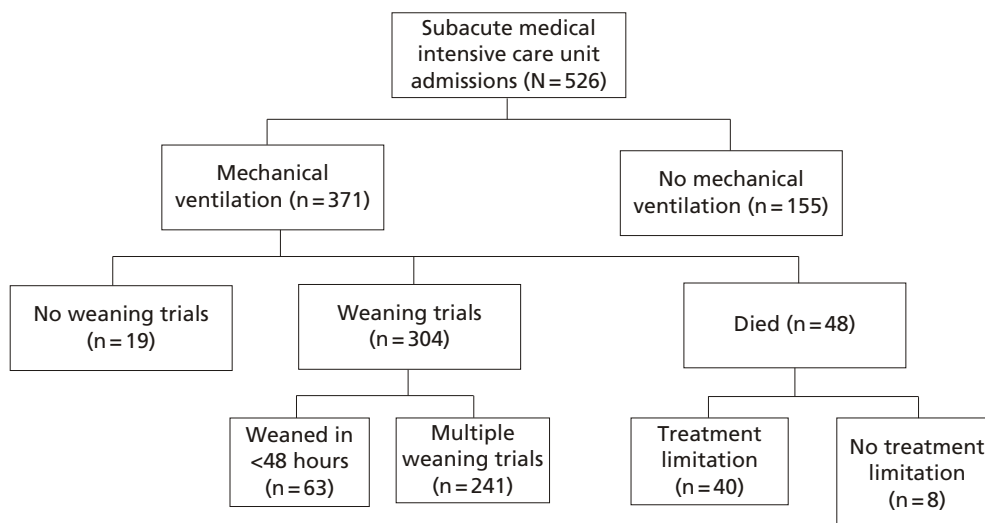


Figure 1 Flow diagram of patients enrolled in the study.

graphic and medical profile data were compared by using χ^2 and t tests, as appropriate. Differences between care managed by the ACNP team or by the fellows team for length of stay and duration of mechanical ventilation were compared by using multivariate analysis of variance. Weaning status and disposition were analyzed by using χ^2 tests. SPSS version 11.0 (SPSS Inc, Chicago, Ill) was used for all analyses.

Results

Total Caseload

During the 28 months of data collection, 526 patients with a mean age of 63.2 years were admitted to the subacute MICU (Figure 1). Of these patients, 276 (52.5%) were collaboratively managed by the fellows team and 250 (47.5%) by the ACNP team. The patients managed by the 2 teams did not differ significantly in age, sex, race, or APACHE III scores (Table 1). They also did not differ significantly in mean daily number of admissions, discharges, or patients undergoing weaning trials. Patients managed by the ACNP team had a greater number of comorbid conditions ($P = .02$), reflected by higher Charlson Comorbidity Scores. The mean daily census was also higher ($P < .001$) during ACNP care.

The patients managed by the 2 teams did not differ significantly in readmissions to the high-acuity MICU ($P = .25$) or to an ICU ($P = .44$) within 72 hours of discharge from the subacute MICU. Mortality of patients who did ($P = .25$) or did not ($P = .89$) have treatment limitations did not differ between the patients managed by the 2 teams.

Patients Being Weaned From Mechanical Ventilation

Of the 526 patients, 371 were receiving mechanical ventilation. A minority ($n = 63$) of these patients began weaning trials before transfer from the MICU and were quickly weaned (in <48 hours) from mechanical ventilation. The majority ($n = 241$) underwent multiple weaning trials and were analyzed as a subgroup.

Patients who underwent multiple weaning trials who were managed by the 2 teams did not differ significantly in age, sex, race, Charlson Comorbidity Scores, scores on the Glasgow Coma Scale, or the primary reason for mechanical ventilation (Table 2). More patients managed by the ACNP team had a history of cardiac disease than did patients managed by the fellows team (47% vs 29%; $P = .004$). Acute Physiology Scores differed over time, resulting in a significant interaction of time and group ($P = .046$). However, significant differences between the groups were detected only for day 1 of ICU admission (Figure 2).

Duration of mechanical ventilation, length of stay, readmission rates, and mortality did not differ for patients cared for by an acute care nurse practitioner versus fellows.

Length of Stay and Duration of Mechanical Ventilation

The patients managed by the 2 teams did not differ significantly (by multivariate analysis, $P = .52$; or

Table 1 Profile of all patients managed by the ACNP or critical care/pulmonary fellows (n = 526)

Variable*	ACNP (n = 250)	Fellows (n = 276)	P
Age, years	63.8 (15.7)	62.6 (16.8)	.15
Men, %	53.2	52.5	.47
Race, %			.32
White	79.6	82.6	
African-American	17.6	15.9	
Other	2.8	1.5	
Charlson Comorbidity score	6.7 (4.1)	5.9 (4.1)	.02
APACHE III score			.67
High-acuity ICU admission	70.7 (26.0)	67.1 (28.1)	
Subacute medical ICU admission	51.5 (22.1)	49.9 (22.0)	
Daily unit workload, No.			
Patients	7.0 (1.0)	6.6 (1.3)	<.001
Admissions	0.9 (1.0)	1.0 (1.1)	.28
Discharges	1.0 (1.0)	1.0 (1.1)	.45
Weaning trials	2.5 (1.4)	2.5 (1.3)	.27
Readmission, No./total discharges (%)			
To high-acuity ICU	26/198 (13.1)	29/225 (12.9)	.25
To ICU within 72 hours of discharge	10/198 (5.1)	15/225 (6.7)	.44
Mortality, No.			
Died without treatment limitation	4	4	.89
Died with treatment limitation	22	18	.25

Abbreviations: ACNP, acute care nurse practitioner; APACHE, Acute Physiology and Chronic Health Evaluation; ICU, intensive care unit.
 *Values are mean (SD) unless otherwise indicated.

by univariate analysis) in ICU length of stay. They also did not differ significantly (by multivariate analysis, $P = .10$, or by univariate analysis) in duration of mechanical ventilation. Median length of stay in the subacute MICU and the interquartile range of stay were similar for both groups of patients.

The acuity of patients in this subacute medical intensive care unit was comparable to the acuity of patients admitted to intensive care units nationwide.

Weaning Status

Of the 241 patients, 129 (53.5%) were successfully weaned from mechanical ventilation. The number of patients successfully weaned by the 2 teams did not differ significantly ($P = .80$). However, more reintubations occurred in patients who were managed by the fellows team ($P = .02$).

Disposition and Mortality

Th patients managed by the 2 teams did not differ significantly in disposition ($P = .28$). One patient who had no treatment limitation died during management by the ACNP team. The patient had congestive heart

failure, chronic obstructive pulmonary disease, and metastatic cancer. Death occurred while the team was awaiting a family decision on comfort measures.

Discussion

The enormous workforce and economic burden associated with long-stay ICU patients mandates testing new approaches for managing this population of patients. One proposed solution involves adding nurse practitioners as members of the critical care healthcare delivery team. Although many academic medical centers now employ nurse practitioners as substitutes to provide care normally supplied by house staff, this model has received limited testing. To our knowledge, we are the first investigators to prospectively compare outcomes in long-stay ICU patients who were managed by different teams of providers.

Our hypothesis that similar outcomes could be achieved when patients admitted to a subacute MICU were collaboratively managed by an attending physician/ACNP team or a team consisting of an attending physician and fellows was supported by our findings. The total caseloads of patients managed by both teams were similar in demographics, medical condition, and workload. Both providers (ie, the ACNP and the fellows) had similar rates for patients readmitted to the high acuity MICU or the subacute unit within 72 hours of discharge from the subacute MICU. Mortal-

Table 2 Profile of patients who had multiple weaning trials (n=241)

Variable	ACNP (n=135)	Fellows (n=106)	P
Age, mean (SD), years	64.6 (14.6)	62.6 (14.6)	.10
Men, %	50	44	.37
Whites, %	84	81	.38
Charlson Comorbidity Score, mean (SD)	7.0 (4.0)	6.2 (3.8)	.10
Comorbid conditions, %			
Cardiac problem	47.4	29.2	
Neurological problem	48.1	48.1	
Chronic pulmonary problem	41.5	41.5	
Diabetes	28.9	24.5	
Gastrointestinal or liver problem	23.7	15.1	
Renal problem	20.7	19.8	
Cancer	11.8	13.2	
Glasgow Coma Scale score, mean (SD)			.32
Subacute MICU admission	11.0 (3.9)	9.9 (5.5)	
Subacute MICU discharge	12.7 (3.2)	12.1 (4.1)	
Primary reason for ventilator dependency, %			.053
Acute pulmonary problem	57.0	45.3	
Chronic pulmonary problem	23.0	30.2	
Neurological problem	8.9	15.1	
Postoperative problem	3.0	6.6	
Other	8.1	2.8	
ICU length of stay, days			MANOVA .52 .35
High-acuity ICU before transfer			
Mean (SD)	10.7 (10.5)	9.5 (9.6)	
Median (interquartile range)	8 (3-16)	6 (3-12.5)	
Subacute MICU			.42
Mean (SD)	12.7 (9.5)	11.7 (9.3)	
Median (interquartile range)	10 (5-19)	9 (5-15.25)	
Mechanical ventilation, days			MANOVA .10 .06
High-acuity ICU before transfer			
Mean (SD)	11.9 (11.9)	8.7 (10.6)	
Median (interquartile range)	8 (3-17)	5.5 (2-11)	
Subacute MICU			.18
Mean (SD)	10.6 (9.4)	9.6 (8.8)	
Median (interquartile range)	7 (4-15)	7 (4-13)	
Reintubation, No./total extubations (%)	2/94 (2.1)	10/99 (10.1)	.02
Disposition at discharge from subacute MICU, %			.28
Transfer to high-acuity ICU	11	15	
Transfer to another unit or another facility without mechanical ventilation	49	54	
Transfer to another facility with mechanical ventilation	39	30	
Discharge to home	0	1	
Death without treatment limitation	1	0	

ity in patients who did or did not have treatment limitations also was similar for patients managed by the 2 teams. For the subgroup of patients who underwent multiple weaning trials, differences between patients managed by the 2 teams did not differ significantly in all but 2 variables. Differences in Acute Physiology Scores were statistically, but not clinically, significant, and patients managed by the fellows were more likely to require reintubation.

Teams that include an acute care nurse practitioner and an attending physician can safely manage care of chronically critically ill patients.

We did not directly analyze reasons for the difference in reintubations, but we speculate that it was the result of a difference in time available to spend in direct

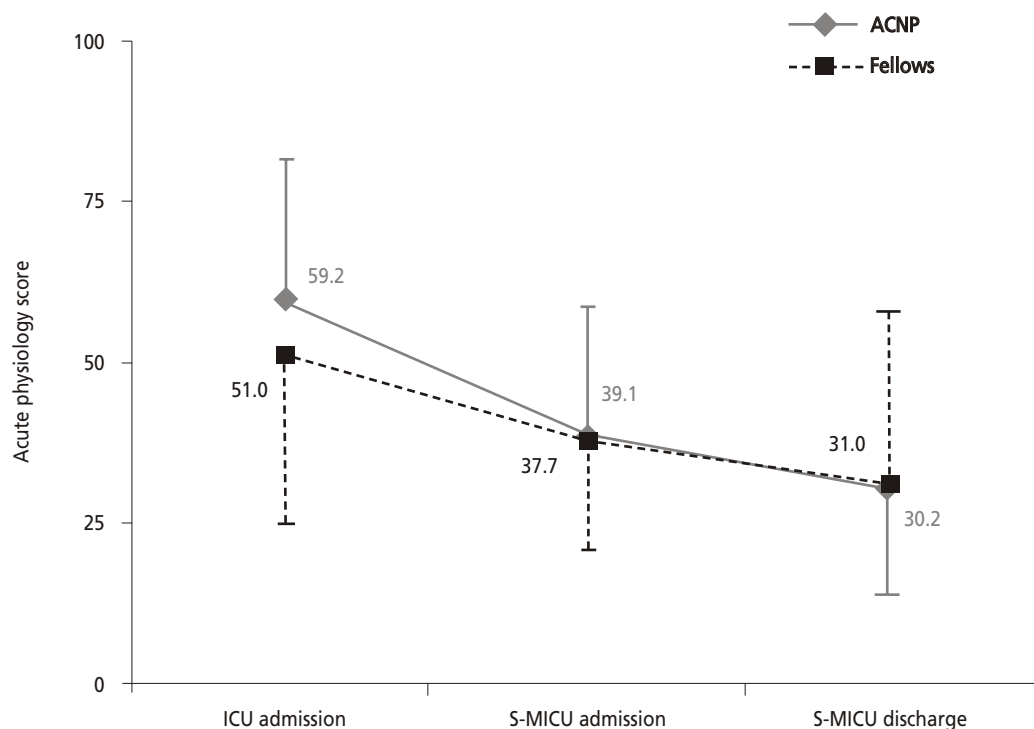


Figure 2 Change in Acute Physiology Scores over time for patients managed by the 2 teams. A significant interaction of time and group ($P = .046$) was detected because scores of patients managed by the acute care nurse practitioner (ACNP) team tended to be higher than scores of patients managed by the fellows team at the times of admission to the intensive care unit (ICU) and the subacute medical ICU (S-MICU) and lower than those of patients managed by the fellows team at the time of discharge from the S-MICU. However, differences between groups were significant only for day 1 of the ICU admission.

supervision of patients. The ACNP was always present on the unit and thus could “see problems coming” and proactively make adjustments in care (eg, start use of bronchodilators). Fellows had off-unit responsibilities and therefore a less constant presence on the unit. In the difficult-to-wean patients in our sample, we think this difference led to fewer reintubations.

In support of our speculation, Krishnan et al²⁶ reported a similar benefit from a study in which they compared protocol-based weaning with usual, physician-directed weaning. In contrast to other investigators,²⁷⁻²⁹ Krishnan et al found no benefit from protocol-based weaning for any study outcome, including patients successfully weaned from mechanical ventilation, duration of mechanical ventilation, and ICU length of stay. The authors²⁶ considered several reasons, including compliance with the protocol and changes over time in weaning methods, but none of the reasons appeared to explain the outcome. Physician ICU staffing was then examined as a possible explanation. Physician staffing was approximately 9.5 hours per bed per day in their study,²⁶ compared with a range of 4.7 to 3.5 physician-hours per bed per day in studies²⁶⁻²⁹ that indicated a benefit with

protocol-based weaning. Krishnan et al attributed their equivalent findings to a higher level of physician staffing and hence more time available to manage patients’ care. We think the design of our study had a similar effect.

To test this potential, we used work-sampling analysis³⁰ to analyze differences in the amount of time the ACNP and the fellows spent in various care activities. Work sampling analysis is a measurement technique that involves gathering data about activities that individuals perform at preset intervals during a work unit (eg, shift, week). The number of observations are summed and used to estimate the proportion of time spent performing these activities.^{31,32} Both providers spent a similar amount of time in activities related to patients’ management (44% for the ACNP vs 40% for the fellows; $P = \text{NS}$), suggesting similar efficiency in performing required tasks. As anticipated, the fellows spent more time in off-unit activities (15% for the ACNP vs 37% for the fellows; $P < .001$). Conversely, the ACNP spent more time in activities related to coordination of care, such as interacting with patients, patients’ families, and other care providers (45% for the ACNP vs 18% for the fellows; $P < .001$).³⁰

An important consideration in interpreting study findings is related to ensuring that both teams were equivalent in the amount of oversight provided by the attending physician. We were careful to ensure that oversight was equivalent. Both providers managed all patients admitted to the unit and made decisions about assessment, diagnosis, and writing all orders for care in consultation with the attending physician, who reviewed the plan of care. The unit had a weaning protocol that each team could follow or override if they thought necessary. Therefore, decisions about weaning trials and extubation reflected the providers' judgment. The attending physician made rounds daily and reviewed and revised the plan of care, as indicated. Although available for consultation, the attending physician did not write the initial orders or do the initial assessments. Both the ACNP and the fellows were responsible for management of patients on the unit for the same length of time and both signed off to the medical intern or resident for evening/night coverage. In order to confirm that intensity of oversight by the attending physicians was equivalent, after the study, interviews were conducted with attending physicians and with respiratory therapists who were present during the study. The results confirmed that the time spent in supervision of both the ACNP and the fellows was equivalent.

Acute care nurse practitioners, with their constant presence on the unit, can provide more proactive care than can fellows, who have greater off-unit responsibilities.

Many options are available for chronically critically ill patients who experience an extended recovery. These options include transfer to a regional facility (eg, long-term acute care hospital) and various types of specialized weaning units that exist within the host hospital and primarily serve that facility.^{6,7,33-37} Care provided in such settings has a number of advantages, including a focus on rehabilitation, documented success in weaning patients from mechanical ventilation, and lower costs.^{6,33-37} However, issues related to the availability of beds, personnel, space, financial resources, and third-party reimbursement limit use of these options, and transfer cannot occur until a patient's condition is stable enough for the patient to be discharged from the subacute ICU.³⁴ Because of these constraints, a substantial part of the care of chronically critically ill patients most likely will continue to be provided in the acute care setting, at least during the initial phase of recovery.

Admission criteria for subacute ICUs vary. Therefore, we compared the acuity of our sample with that of patients in other studies. In our study, mean (SD) APACHE III scores for all unit admissions and for the subgroup being weaned from mechanical ventilation were 50.4 (22.4) and 51.1 (20.2), respectively. In a study³⁸ of 851 patients admitted to a medical or a surgical ICU in an urban teaching hospital, the mean (SD) APACHE III score was 48 (24) on day 1 of admission to the ICU. In another study,³⁹ the mean (SD) APACHE III score on day 1 of admission of 104 487 patients admitted to 38 ICUs in 28 teaching hospitals was nearly identical: 48.5 (20.3). In a study by Junker et al⁴⁰ of 8917 patients admitted to intermediate care units in 32 hospitals, the mean (SD) APACHE III score on day 1 of admission was considerably lower: 28.9 (15.5). Therefore, the acuity of patients admitted to the subacute MICU in our study was high and was comparable to the mean acuity of ICU admissions nationwide.

Our findings suggest that an attending physician/ACNP team can safely manage subgroups of ICU patients, such as those admitted to a subacute unit. In addition to increasing the number of care providers available, this expanded role could have other advantages. The care of high-acuity ICU patients, whose conditions are unstable, demands extensive time from intensivists. When the availability of physicians is a limited factor in weaning, patients who require prolonged mechanical ventilation are at risk for having a lower priority.²⁶ Further, such patients are not well suited to an academic model that emphasizes learning new skills and frequent changes in the personnel who provide care.^{5,6,12} When changes in personnel are frequent, gaps can develop in the caregivers' knowledge of a patient's history (especially if lengthy or complex) and of interventions that have been applied, evaluated, and discarded.¹² Patients who require prolonged ICU stays are therefore ideal candidates for the consistency provided by having a single practitioner manage their care.

Limitations

Our study has several limitations. First, the study was done in a university-affiliated tertiary care center. The ACNP practiced in collaboration with attending physicians who were always available for consultation. Other types of ICUs or other settings may not provide the same level of support. Second, the part of the MICU designated as the subacute MICU was smaller than many ICUs; only 6 to 8 patients were treated in the subacute unit during the study interval. Findings might have been different if the ACNP's workload had involved managing more patients.

Third, on the basis of workload and cost constraints, we judged that the MICU's needs could be met with a single ACNP assigned to the unit Monday through Friday. Consequently, we evaluated the practice of a single ACNP. The findings might have differed if more than a single ACNP had provided care. Although use of a single ACNP is not optimal, other investigators^{41,42} used a single medical professional model to compare outcomes associated with off-pump vs conventional coronary artery bypass grafting⁴¹ and use of an intensivist.⁴² Fourth, the fellows were enrolled in a training program and thus had other off-unit responsibilities and did not provide care exclusively in the MICU. Outcomes might have differed if patients had been managed by a single attending physician; however, our goal was to evaluate outcomes within the constraints imposed by an academic model.

Finally, we did not use a randomized design because doing so would have required that both practitioners be present in the unit at the same time, a situation that could have confounded the intervention. Although a randomized design is the ideal, this choice would have required 2 study units in order to eliminate the potential influence of one care provider on the other providers' outcomes and matching of patients with regard to key study variables. The primary weakness of a nonrandomized design is related to the potential that events other than the intervention (eg, a change in acuity, staffing, or technology) during the study could bias study outcomes. However, to be a serious counter-explanation, such events would have to be confounded with treatment at 2 separate points in time. Accordingly, we think this possibility is unlikely.

Conclusion

This study was designed to compare outcomes in chronically critically ill patients admitted to a subacute MICU who were managed by an ACNP/attending physician team or a team composed of fellows and an attending physician. The hypothesis that outcomes would be similar was supported by the findings of no significant differences in length of stay in the subacute MICU, duration of mechanical ventilation in the subacute MICU, the number of patients who had been weaned at the time of discharge, and disposition. Our findings strongly support the notion that with appropriate training and supervision, an ACNP can competently assume responsibility for the medical management of a caseload of chronically critically ill patients admitted to a subacute MICU.

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CE Test Form

OUTCOMES OF CARE MANAGED BY AN ACUTE CARE NURSE PRACTITIONER/ATTENDING PHYSICIAN TEAM IN A SUBACUTE MEDICAL INTENSIVE CARE UNIT

Objectives

1. Explain the role of the acute care nurse practitioner/attending physician team in providing care in a subacute medical intensive care unit
2. Identify the 3 main outcome measures in the study
3. Discuss the limitations of the study

Mark your answers clearly in the appropriate box. There is only one correct answer. You may photocopy this form.

1. qa	2. qa	3. qa	4. qa	5. qa	6. qa	7. qa	8. qa	9. qa	10. qa	11. qa
qb	qb	qb	qb	qb	qb	qb	qb	qb	qb	qb
qc	qc	qc	qc	qc	qc	qc	qc	qc	qc	qc
								qd	qd	qd

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Objective 3 was met	q	q	q
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CE Test Questions

OUTCOMES OF CARE MANAGED BY AN ACUTE CARE NURSE PRACTITIONER/ ATTENDING PHYSICIAN TEAM IN A SUBACUTE MEDICAL INTENSIVE CARE UNIT

1. How many noncoronary intensive care units (ICUs) are in the United States and how many patients are cared for each day?
 - a. 60 000 noncoronary ICUs provide care for 55 000 patients each day
 - b. 5500 noncoronary ICUs provide care for 60 000 patients each day
 - c. 6000 noncoronary ICUs provide care for 55 000 patients each day
 - d. 600 noncoronary ICUs provide care for 5500 patients each day
2. Based on 2001 data, what is the total yearly cost of ICU care?
 - a. \$23.5 billion
 - b. \$55 billion
 - c. \$67.5 billion
 - d. \$75 billion
3. Which of the following patients meets the criteria for a chronically critically ill patient?
 - a. A 24-year-old with appendicitis
 - b. A 53-year-old with myocardial infarction
 - c. A 43-year-old insulin-dependent patient with HBA1C of 6.2
 - d. A 67-year-old patient with chronic obstructive pulmonary disease who is unable to be weaned from mechanical ventilation
4. This study tested which of the following hypotheses?
 - a. Outcomes of critically ill patients whose conditions are stable enough to allow admission to a subacute medical ICU (MICU) will be significantly worse when medical management is provided by an acute care nurse practitioner (ACNP)/attending physician team compared with a team of critical care/pulmonary fellows and an attending physician.
 - b. Outcomes of critically ill patients whose conditions are stable enough to allow admission to a subacute MICU will be equivalent when medical management is provided by an ACNP/attending physician team or a team of critical care/pulmonary fellows and an attending physician.
 - c. Outcomes of critically ill patients whose conditions are stable enough to allow admission to a subacute MICU will be improved when medical management is provided by an ANCP/attending physician team compared with a team of critical care/pulmonary fellows and an attending physician.
 - d. None of the above
5. When was each team responsible for managing the care of patients admitted to the unit?
 - a. 5 days a week during daylight hours
 - b. 7 days a week, 24 hours a day
 - c. 7 days a week during daylight hours
 - d. 5 days a week, 24 hours a day
6. What were the criteria for admission to the subacute unit?
 - a. Stable or decreasing need for mechanical ventilation in the preceding 24 hours, unstable hemodynamic status, and active bleeding
 - b. Stable or decreasing need for mechanical ventilation in the preceding 24 hours, stable hemodynamic status, and active bleeding
 - c. Stable or decreasing need for mechanical ventilation in the preceding 24 hours, unstable hemodynamic status, and no active bleeding
 - d. Stable or decreasing need for mechanical ventilation in the preceding 24 hours, stable hemodynamic status, and no active bleeding
7. What were 3 of the main outcome measures?
 - a. Length of stay in MICU and subacute unit, duration of mechanical ventilation, and reintubations
 - b. Length of stay in MICU only, patients not receiving mechanical ventilation, and number of patients with gastrointestinal bleeding
 - c. Length of stay in subacute unit only, reintubations, and weaning discharge status
 - d. Length of stay in MICU and subacute unit, weaning discharge status, and number of patients with gastrointestinal bleeding
8. How many patients were admitted to the subacute unit?
 - a. 356
 - b. 478
 - c. 526
 - d. 625
9. What did the authors believe the reason was for the differences in numbers of reintubation between the groups studied?
 - a. The fellows had off-unit responsibilities and therefore were a less constant presence on the unit.
 - b. The ACNP had more available time to spend in the direct supervision of patients.
 - c. The fellows spent more time in the direct supervision of patients.
 - d. Both A and B
10. Who spent more time in activities related to the coordination of care, and who spent less time in the coordination of care?
 - a. 45% for the ACNP vs 18% for the fellows
 - b. 45% for the fellows vs 18% for the ACNP
 - c. 45% for the ACNP vs 15% for the fellows
 - d. 25% for the ACNP vs 75% for the fellows
11. What were 2 limitations of this study?
 - a. Large subacute unit and evaluation of only 1 ACNP
 - b. Small subacute unit and evaluation of several ACNPs
 - c. Small subacute unit and evaluation of only 1 ACNP
 - d. Large subacute unit and evaluation of several ACNPs