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14. ABSTRACT

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Design: Repeated measures, descriptive design.

Methods: Monthly, for six months, registered and licensed vocational nurses completed a 50-item, paper survey. Administrative data related to nursing staff supply and working conditions also were collected monthly from local nurse leaders.

Sample: In total, 599 surveys were handed out to 118 nurses; 269 useable surveys were returned (overall response rate of 44.9%, range = 37.9%-51.0%). A total of 95 unique participants were identified, indicating that 80.5% of all eligible nurses participated at least once. Sixty-five (55.1%) participated more than once; 55 (46.6%) participated three or more times.

Analysis: Descriptive statistics and multilevel modeling were used in the analysis.

Findings: Monthly, 85.7%-100% of nurses reported leaving at least one element of care unfinished. On average, nurses rationed 52.3%-77.7% of the 31 elements of care. Most frequently left unfinished were: documentation of care, emotional support, reviewing interdisciplinary documentation, and changing intravenous catheters (in one unit). Least frequently left unfinished were: the provision of enteral/parenteral nutrition, monitoring patient safety, and important conversations. Only nursing care hours provided by float staff significantly predicted nurse estimates of UNC, $\beta = .008$, $p < .05$, $R^2 = .021$.

Implications for Military Nursing: UNC increases the risk of patient adverse events; burn patients may be at greater risk due to hospitalization length. Nursing leaders should: work to identify causes of UNC; develop interventions to give bedside nurses more time to complete care. Policy leaders should: monitor UNC as an additional indicator of nursing care supply/demand balance; develop a surge capacity to mobilize nursing staff when nursing care demand exceeds supply; consider mechanisms to reduce time scarcity for nurses. Future studies should expand the study of UNC across the Military Health System.

15. SUBJECT TERMS

unfinished nursing care (UNC), Army Burn Center

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TSNRP Research Priorities that Study Addresses

Primary Priority

Force Health Protection:	☐ Fit and ready force ☐ Deploy with and care for the warrior ☐ Care for all entrusted to our care
Nursing Competencies and Practice:	☐ Patient outcomes ☒ Quality and safety ☐ Translate research into practice/evidence-based practice ☐ Clinical excellence ☐ Knowledge management ☐ Education and training
Leadership, Ethics, and Mentoring:	☐ Health policy ☐ Recruitment and retention ☐ Preparing tomorrow's leaders ☐ Care of the caregiver
Other:	☐

Secondary Priority

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Other:	☐

Progress Towards Achievement of Specific Aims of the Study

Findings related to each research question:

The purpose of this study was to examine the variability in the prevalence and patterns of unfinished nursing care (UNC) in the US Army Burn Center (USABC) over time. The following research questions were examined in the current study:

1. What is the monthly variation in the prevalence and patterns of UNC in the USABC?
2. What is the relationship between nursing staff supply and UNC in the USABC?
3. What is the relationship between working conditions and UNC in the USABC?

Study design. A repeated measures survey design was used to identify differences in the prevalence and patterns of UNC over time and to examine the influence of *nursing staff supply* and *management of working conditions* on variations in individual nurse estimates of UNC. Earlier cross-sectional studies established associations between UNC and various indicators of *nursing staff supply* and *management of working conditions*. However, cross-sectional studies are insufficient to assess for the presumed sequential relationships among these variables in the highly dynamic hospital environment. Additionally, it is logical that demands on nursing time change as *nursing staff supply* and the *management of working conditions* change. *Nursing staff supply* is known to vary over time due to staff turnover, as well as shift-by-shift variations in skill mix and types of staff members available to provide care (Aiken et al., 2014; Bae et al., 2010b; Ball et al., 2014; Duffield et al., 2011; Duffield et al., 2015; O'Brien-Pallas et al., 2006). Additionally, nursing employment conditions change over time due to daily variations in patient turnover, the number of hours of care provided by staff members temporarily assigned to the unit (float staff), and the amount of overtime needed to provide care to patients (Duffield, Diers, Aisbett, & Roche, 2009; Garrett & McDaniel, 2001; Jennings et al., 2013; Needleman et al., 2011; Orique et al., 2015; Park et al., 2012; Salyer, 1995; Shindul-Rothschild & Gregas, 2013). Therefore, this repeated measures design was appropriate to detect temporal relationships and to determine whether or not variations in *nursing staff supply* and *management of working conditions* were associated with variations in UNC (Peters & Mengersen, 2008; Powers & Knapp, 2011).

Study measures. Twelve nurse-level and unit-level measures were included in the current study (see Table 1). All study variables were measured on a monthly basis for six months. Measures from both levels were present in the variable category *management of working conditions*. *Nursing staff supply* and *nursing processes* data were nurse-level only. Because the instrument to assess the prevalence of UNC refers the respondent to the last seven shifts worked, unit-level measures from a 14-day window of time preceding the last day of survey packet administration were collected to provide a reasonable estimate of the work environment during the respondent's most recent shifts. Matching unit-level measures to participant shifts was not possible due to the anonymity of the participants in the current study.

Table 1: ***Summary of Measures***

Measure Name	Source	Survey Question	Reliability
Dependent Variable (Nursing Processes)			
Unfinished nursing care	Survey	PIRNCA (20-50)	α = .97[a]
Independent Variables			
Nursing Staff Supply			
Nurse education	Survey	15	
Experience in nursing	Survey	13	
Experience in burn care	Survey	14	
Nurse licensure	Survey	10	
Management of Working Conditions			
Supply/demand ratio	WMSNi		
Patient turnover	WMSNi		
Unit type	Survey	9	
Shift worked	Survey	12	
Overtime paid	Admin data		
Employment category	Survey	11	
Nursing care hours provided by float staff	Admin data		

Note. PIRNCA = Perceived Implicit Rationing of Nursing Care; WMSNi = Workload Management System for Nursing-Internet.
[a](Jones, 2014).

Data collection. After institutional review board approval, for one week per month for six months, all bedside registered nurses (RNs) and licensed vocational nurses (LVNs) were asked to complete an anonymous paper survey to estimate the prevalence of UNC on their unit during that month. The survey packet included demographic questions, the Perceived Implicit Rationing of Nursing Care (PIRNCA), and questions used to establish a participant-generated identification code. This code was used to maintain the anonymity of participants and still link the responses of those nurses who participated more than once (Damrosch, 1984). At their convenience, participants were asked to deposit completed surveys in a locked drop box located centrally on each nursing unit. Unit administrative data were collected from the unit nursing leaders each month.

Inclusion/Exclusion criteria. Participant eligibility criteria included burn center RNs and LVNs who provided at least one entire shift of direct patient care on either burn nursing unit within their previous seven shifts. Temporarily assigned nurses (such as nurses floated to the burn center from another nursing unit) were excluded because the care they provided over their preceding seven shifts would not have occurred in the burn center. Nurses in a student role (e.g., LVN students or critical care nursing students) were excluded because they did not have full responsibility for the care of their assigned patients. Additionally, participants were asked not to consider any care they provided to patients outside of the burn center inpatient setting (e.g., in the clinic, in the operating room, or on a nursing unit outside of the burn center) during the data collection period.

Data cleaning and preparation for analysis. Data collected from two sources (nurse self-report surveys and administrative data) were hand-entered into an electronic data file for analysis. The data file was examined for accuracy, subject eligibility, and missing values. Data were accepted as accurate if values fell within the range of possible values appropriate for each variable. Values outside this range were compared to the original data source (e.g., the paper survey or the administrative reports) and data entry errors were corrected as indicated. Similarly, values for demographic variables that were inconsistent with eligibility criteria were compared to the original source documents for validation. Accurate values inconsistent with eligibility criteria resulted in exclusion of the entire survey from further analysis. This resulted in the exclusion of four surveys.

Thresholds for missing survey data were established *a priori* and varied by study variable. The threshold for missing data on demographic variables designated as predictor variables in the planned model analysis was set at zero. In repeated measures studies, multilevel modeling is useful for dealing with panel dropout and missing values for the time-variant measures at Level-1. However, missing values among the time-invariant measures above Level-1 require exclusion of the entire case (Hox, 2010). Therefore, surveys with any missing data related to education, licensure, experience, employment category, shift worked, and unit worked were excluded from further analysis. This resulted in the exclusion of two surveys. The threshold for missing data on the PIRNCA instrument used to estimate the primary outcome variable, UNC, was set at 10%. Therefore, surveys with missing data on greater than or equal to four of the 31 items on the PIRNCA were excluded from further analysis. Two surveys were excluded due to missing PIRNCA data (5 and 18 items missing, respectively).

In total, eight surveys were excluded from the final sample. Survey distribution and response rates across all six months are summarized in Table 2. A total of 599 surveys were distributed to 118 nurses over the data collection period with a return of 269 useable surveys (overall response rate = 44.9%). Monthly response rates ranged from 37.9% to 51.0%. A total of 95 unique identification codes were identified, indicating that 80.5% of the 118 eligible nurses participated in the study during at least one of the six months. Sixty-five nurses (55.1% of all nurses) participated during more than one month and 55 nurses (46.6% of all nurses) participated during three or more months.

Across the retained surveys, the incidences of missing data were low, 0% to 5.2%. At the item level, the incidence of missing data ranged from 0% to 3%. The distribution of missing values was as follows: ethnicity (n = 8; 3%); PIRNCA item #46 (review documentation; n = 2; .7%); PIRNCA item #47 (initiation/review plan of care; n = 6; 2.2%); PIRNCA item #48 (document assessment and monitoring; n = 2; .7%); and, PIRNCA item #49 (documentation of care; n = 3; 1.1%). No methods for imputation of data were applied.

Table 2. ***Survey Completion Data***

	Month					
	Jul	Aug	Sep	Oct	Nov	Dec
Nurses scheduled						
USABC	108	98	102	109	110	110
BPCU						
RNs	21	21	23	25	23	23
LVNs	18	18	17	16	18	18
BICU						
RNs	62	55	57	63	63	63
LVNs	7	4	5	5	6	6
Surveys						
Distributed	108	98	99	104	95	95
Returned	49	51	49	45	37	46
Excluded	2	1	2	0	1	2
Retained	47	50	47	45	36	44
Response rate (%)	43.5	51.0	47.5	43.3	37.9	46.3
Unique participants						
USABC	47	22	15	5	3	3
BPCU	18	7	9	0	3	3
BICU	29	15	6	5	0	0

Note. The count of unique participants represents the number of nurses participating for the first time. The response rate is the percent of returned surveys after subtracting the number of surveys excluded. BICU = burn intensive care unit; BPCU = burn progressive care unit; LVN = licensed vocational nurse; RN = registered nurse; USABC = US Army Burn Center.

The threshold for missing data on the administrative data reports also was set at zero. Missing values were identified for the following items on seven days in the burn intensive care unit (BICU): census, admissions, discharges, transfers, nursing care hours (NCHs) provided by float staff, NCHs (available), and NCHs (required). These items were necessary for the computation of daily values for key predictor variables [supply/demand ratio (SDR) and patient turnover]. Consequently, the data from these seven days were excluded from further analysis. These seven days occurred during two separate months (August and September). As a result, the mean values computed for the month of August were based on 10 days and mean values computed for the month of September were based on 11 days rather than 14 days as planned.

Description of time invariant predictor variables. The demographic characteristics of the nurse sample reflect time invariant predictor variables in the current study. In cases where a nurse participated during more than one month of data collection, demographic values that were recorded on the survey associated with the first month of participation were carried forward to subsequent months. Characteristics for the 95 unique participants are summarized in Table 3. Across the USABC, most participants were female, 66% (n = 63), and RNs, 81% (n = 77). The majority of the participants identified their race as Caucasian, 51% (n = 48). A large portion of the participants reported working in the BICU, 58% (n = 55), consistent with the distribution of

Table 3. Time Invariant Characteristics of the Nurse Sample

	BPCU		BICU		Total	
	n	%	n	%	n	%
N	40	42	55	58	95	100
Gender						
Male	13	33	19	35	32	34
Female	27	67	36	65	63	66
Race						
Caucasian	16	40	32	58	48	51
African American	4	10	7	13	11	11
Hispanic	17	42	10	18	27	28
Other	3	8	2	4	5	6
Missing response	0	0	4	7	4	4
Education						
AIT only	1	3	0	0	1	1
Some college	13	32	2	4	15	16
Associate's degree	13	32	14	25	27	28
Bachelor's degree	10	25	37	67	47	49
Master's degree	3	8	2	4	5	6
Licensure						
LVNs	15	37	3	6	18	19
RNs	25	63	52	94	77	81
Employment category						
Military	2	5	11	20	13	14
Government civilian	24	35	29	53	53	56
Contracted civilian	14	60	15	27	29	30
Shift worked						
Days	23	58	33	60	56	59
Nights	17	42	22	40	39	41
Nursing experience						
≤ 3 years	2	5	2	4	4	4
> 3 to ≤ 10 years	12	30	21	38	33	35
> 10 years	26	65	32	58	58	61
Burn experience						
≤ 3 years	9	22	23	42	32	34
> 3 to ≤ 10 years	19	48	20	36	39	41
> 10 years	12	30	12	22	24	25

Note. AIT = advanced individual training; BPCU = burn progressive care unit; BICU = burn intensive care unit; LVN = licensed vocational nurse; RN = registered nurse.

all nurses at the USABC. Also consistent with the distribution of nurses at the USABC, most participants were civilian employees of the US federal government, 56% (n = 53), and military nurses participated in the current study least frequently, 14% (n = 13). More than half of all participants reported working on the day shift, 59% (n = 56). No nurses reported working swing shift. As such, the swing shift was not considered in further analysis in the current study. Additionally, most participants reported having achieved at least a bachelor's degree, 55% (n = 52).

One military LVN reported that high school was their highest level of formal education. This level of education was re-coded to "Advanced Individual Training (AIT) only" because a participant could not be a LVN without undergoing some sort of professional training beyond high school. However, the LVN training received in the military is not directly affiliated with a college or university. To obtain college credit, AIT graduates must apply to a college in order to receive credit for their training. Therefore, it was likely that the designation of "AIT only" more accurately reflected the true highest level of education achieved by the military LVNs.

In the current study, participants were asked to report their nursing and burn experience in years and months. An individual's professional experience has been shown to be an important factor in nursing competence and the quality of care delivered by the nurse (Anzai, Douglas, & Bonner, 2014; Blegen, Vaughn, & Goode, 2001; McHugh & Lake, 2010). For greater precision, experience values were converted to months for analysis. However, for ease of understanding, experience is reported in years in Table 4. The categories of experience used in Table 4 (less than or equal to three years, between three and ten years, and greater than ten years) were arbitrary thresholds meant to represent low, moderate, and high levels of experience, respectively. The mean years of nursing experience was nearly equal in the two units, burn progressive care unit (BPCU) = 14.67, *Mdn* = 12.25, *SD* = 8.4 and BICU = 14.63, *Mdn* = 12.0, *SD* = 9.2. However, nurses in the BPCU reported more mean burn experience (7.69 years, *Mdn* = 8.0, *SD* = 5.3) than the BICU (5.78 years, *Mdn* = 4.3, *SD* = 4.7).

Description of time variant predictor variables. Data collected from the Workload Management System for Nursing-Internet (WMSNi) were transformed into time variant predictor variables. Due to missing values during months August and September, mean values were based on the number of days with complete data rather than the planned 14 days. The time variant predictor variables generated from the WMSNi data included SDR and patient turnover. The time variant predictor variables generated from unit administrative records included NCHs provided by float staff and overtime paid (OTp). The monthly mean values for these variables are presented in Tables 4 and 5 for the BPCU and BICU, respectively.

Supply/demand ratio. The SDR was a reflection of the balance between the number of nurses available and the number of nurses needed for a given timeframe. Thus, a SDR of 1.0 reflected an ideal balance between nursing care supply and nursing care demand. A SDR value greater than 1.0 reflected a higher number of nurses available relative to the number of nurses actually needed for a given timeframe. This reflected a state of imbalance characterized as overstaffed. A SDR value less than 1.0 reflected a lower number of nurses available relative to the number of nurses needed for a given timeframe. This reflected a state of imbalance characterized as understaffed.

Table 4. ***Time Variant Characteristics of Burn Progressive Care Unit***

	Month					
	Jul	Aug	Sep	Oct	Nov	Dec
Days of data	14	14	14	14	14	14
Supply/demand ratio	1.07	1.08	1.39	1.10	.77	.74
NCH (available)	208.50	228.71	187.29	220.14	248.57	200.96
NCH (required)	197.29	216.93	136.07	203.57	325.57	282.14
Patient turnover	1.30	1.43	1.38	1.42	1.31	1.36
Census	11.93	11.50	7.21	11.86	15.86	13.43
Admissions	1.07	1.29	1.14	1.64	1.36	1.50
Discharges	1.79	1.79	1.21	2.29	2.14	2.29
Transfers (in/out)	.71	1.36	.50	1.07	1.5	.79
NCH provided by float staff	7.07	19.43	1.71	7.43	24.57	22.00
Overtime paid (hours)	4.29	2.29	0	1.43	2.43	.29

Note. Except for days of data, all values represent the mean of the data collection period each month. NCH = nursing care hours.

Table 5. ***Time Variant Characteristics of Burn Intensive Care Unit***

	Month					
	Jul	Aug	Sep	Oct	Nov	Dec
Days of data	14	10	11	14	14	14
Supply/demand ratio	.81	1.06	1.31	.85	.86	1.20
NCH (available)	309.14	317.60	264.83	295.23	331.79	287.32
NCH (required)	399.93	297.23	199.79	346.71	399.21	252.50
Patient turnover	1.21	1.24	1.27	1.29	1.22	1.29
Census	8.50	6.90	3.42	7.77	9.79	6.29
Admissions	.86	.50	.42	1.08	.64	.64
Discharges	.21	0	.08	0	.14	.21
Transfers (in/out)	.64	1.80	.50	1.08	1.29	1.00
NCH provided by float staff	4.57	0	.50	2.77	5.14	0
Overtime paid (hours)	2.39	1.80	.43	2.34	1.57	0

Note. Except for days of data, all values represent the mean of the data collection period each month. NCH = nursing care hours.

The SDRs reported across the six months reflected both types of staffing imbalances within the BPCU and the BICU. The SDR for the BPCU ranged from .74 to 1.39. The BPCU was the most understaffed during November (SDR = .77) and December (SDR = .74). These values occurred during the months with the highest mean census, 15.86 and 13.43, respectively. The BPCU was the most overstaffed during September (SDR = 1.39). This value occurred during the month with the lowest mean census, 7.21. The SDRs for the BICU ranged from .81 to 1.31. The BICU was the most understaffed during July (SDR = .81), October (SDR = .85), and November (SDR = .86). These values occurred during the months with the highest mean census, 8.50, 7.77, and 9.79, respectively. The BICU was the most overstaffed during September (SDR = 1.31) and December (SDR = 1.20). These values occurred during the months with the lowest mean census, 3.42 and 6.29 respectively.

Patient turnover. Patient turnover was a reflection of a proportional increase in nursing care demand related to the permanent movement of patients in or out of a nursing unit during a given timeframe. A patient turnover value of 1.0 reflected no patient movement in or out of the nursing unit for a given timeframe and therefore no change in nursing care demand. A patient turnover value greater than 1.0 reflected permanent movement of patients in or out of the nursing unit for a given timeframe, which resulted in a proportional increase in nursing care demand. Mean patient turnover in both units was moderate during the current study (see Tables 4 and 5). Patient turnover for the BPCU ranged from 1.30 to 1.43. The BPCU experienced the most patient movement during August (patient turnover = 1.43) and October (patient turnover = 1.42). Patient turnover for the BICU ranged from 1.21 to 1.42. The BICU experienced the most patient movement during October and December (patient turnover = 1.29 during both months).

Nursing care hours provided by float staff. Nursing care hours provided by float staff was a reflection of the need to temporarily increase the number of nurses available (or, surge) to provide patient care due to an imbalance between nursing care supply and nursing care demand. These values reflected the number of hours of nursing care temporarily provided by nurses not assigned to the USABC in order to meet the demand for nursing care. Tables 4 and 5 depict these data. The BPCU required more NCHs from float staff than the BICU. The mean NCHs provided by float staff in the BPCU ranged from 1.71 to 24.57. The largest mean value of NCH provided by float staff occurred during November (NCH by float staff = 24.57) and December (NCH by float staff = 22.0). These values occurred during the months with the highest mean census, 15.86 and 13.43 respectively. Despite the use of float staff to meet the nursing care demand during these months, the BPCU remained understaffed. The lowest mean value of NCH provided by float staff occurred during September (NCH by float staff = 1.71), the month with the lowest mean census (7.21) and the highest SDR (1.39). The mean NCHs provided by float staff in the BICU ranged from 0 to 5.14. The largest mean value of NCH provided by float staff occurred during July (NCH by float staff = 4.57) and November (NCH by float staff = 5.14). These values occurred during the months with the highest mean census, 8.50 and 9.79 respectively. Despite the use of float staff to meet the nursing care demand during these months, the BICU remained understaffed. There was no NCH provided by float staff during August and December. September had the lowest mean census (3.42) and float staff provided .5 hours of nursing care.

Overtime paid. Overtime paid also was a reflection of the need to surge due to a low SDR (understaffing). These values reflect the number of hours over and above their normally scheduled hours provided by nurses assigned to the USABC in order to meet the demand for nursing care. Tables 4 and 5 on page 11 depict these data. The BPCU required more hours of OTp than the BICU. The mean number of hours of OTp in the BPCU ranged from 0 to 4.29. The highest mean hours of OTp occurred during July. This coincided with a mean of 7.07 NCHs provided by float staff and a mean SDR of 1.07. The lowest mean hours of OTp occurred during September, a month with the lowest mean census and the highest SDR (1.39). The second lowest mean hours of OTp (.29) occurred during December, coinciding with a high use of NCHs by float staff (NCH by float staff = 22.00) and understaffing in the BPCU (SDR = .74). The mean number of hours of OTp in the BICU ranged from 0 to 2.39. The highest mean hours of OTp occurred during July (2.39), which coincided with a mean census of 8.5, 4.57 NCHs provided by float staff, and understaffing in the BICU (SDR = .81). The lowest mean hours of OTp occurred during September (OTp = .43) and December (OTp = 0), which coincided with the lowest mean census (3.42 and 6.29, respectively) and the best staffing (SDR = 1.31 and 1.20, respectively).

Prevalence and patterns of UNC. The prevalence and patterns of UNC were examined using nurse self-report data from the PIRNCA instrument. However, the PIRNCA was first examined for acceptability, utility, and reliability in the current study sample. Acceptability was assessed based on the percentage of item-level missing data. Consistent with previous reports (Jones, 2014, 2015), there was a low percentage of item-level missing data on the PIRNCA (0% to 2.2%) in the current study. These findings suggest high acceptability of the PIRNCA among nurses at the USABC. Utility of the PIRNCA in the military and burn care environments was assessed through analysis of item-level response options, particularly the frequency and pattern of response option "not needed." Frequencies and percentages of this response option were computed at the survey- and item-level. The results for the BPCU and BICU are depicted in Tables 6 (page 14) and 7 (pages 15 and 16), respectively.

At the survey level, participants in the BPCU selected "not needed" response option infrequently (.7% to 2.8% of monthly item responses). Participants in the BICU also selected "not needed" response option infrequently (3.4% to 6.9% of monthly item responses). This low frequency reflects the mean proportion of items on the PIRNCA that was not needed for patients in the USABC per each month. At the item level, some elements of care were marked as "not needed" more frequently than others. In the BPCU, the items with the highest frequency of "not needed" responses included administering enteral/parenteral nutrition (10.8% of surveys) and having important conversations with external team members (12.5% of surveys). In the BICU, the items with the highest frequency of "not needed" responses included ambulation (24.8% of surveys), having important conversations with the patient or family (24.8% of surveys), and having important conversations with external team members (30.2% of surveys). Of note, in the BPCU, more nurses rated elements of care as not needed toward the end of the study period. Conversely, in the BICU, more nurses rated elements of care as not needed toward the beginning of the study period. Reliability of the PIRNCA was assessed using Cronbach's alpha; results indicated high reliability (.96 to .98) across all months. These findings demonstrated that the PIRNCA was an acceptable, useful, and reliable instrument for estimating UNC in the current study sample.

Table 6. *Frequency of Elements of Care Marked as 'Not Needed' in the Burn Progressive Care Unit (n = 120 surveys)*

Element of Care	Month						Surveys (n)	% of surveys
	Jul	Aug	Sep	Oct	Nov	Dec		
Routine hygiene		1			1		2	1.7
Ambulation					1		1	.8
Mobilization/position change		1			1	1	3	2.5
Eating/drinking	1	1	1		1	1	5	4.2
Physical comfort						1	1	.8
Medication administration						2	2	1.7
Enteral/parenteral nutrition	1	1	1	3	3	4	13	10.8
Wound care						1	1	.8
Change intravenous catheter						1	1	.8
Safe patient handling		1			1	1	3	2.5
Follow-up					1		1	.8
Important conversations (internal)				1			1	.8
Important conversations (external)	2	3	2	3	2	3	15	12.5
Important conversations (patient/family)			1	2	1		4	3.3
Plan of care initiation/revision						1	1	.8
Total	4	8	5	9	12	16		
Surveys (n)	18	21	21	23	14	23		
% of all elements	.7	1.2	.8	1.3	2.8	2.2		

Note. Values in far right column reflect proportion of surveys with the item marked as "not needed." Values in bottom row reflect proportion of total items marked as "not needed." Elements of care never marked as "not needed" were not included in this table. Blank spaces indicate that the element of care was always needed for care during that month.

Table 7. *Frequency of Elements of Care Marked as 'Not Needed' in the Burn Intensive Care Unit (n = 149 surveys)*

Element of Care	Month						Surveys	% of
	Jul	Aug	Sep	Oct	Nov	Dec	(n)	surveys
Routine hygiene	1						1	.7
Routine skin care	1			1			2	1.3
Change linen	2						2	1.3
Ambulation	9	7	5	4	7	5	37	24.8
Mobilization/position change	1	1					2	1.3
Elimination	2	2	4	2	1	2	13	8.7
Eating/drinking	4	3	4	4	2	1	18	12.1
Physical comfort	1			1			2	1.3
Medication administration	1						1	.7
Enteral/parenteral nutrition	1		1				2	1.3
Wound care	1	1	1			1	4	2.7
Change intravenous catheter	1	1	2				4	2.7
Safe patient handling			1				1	.7
Infection control adherence			1				1	.7
Teaching			1	1			2	1.3
Patient preparation	2		1	1			4	2.7
Emotional support	1		1				2	1.3
Monitoring behavior	1	2	1		1		5	3.4
Monitoring safety	1			1			2	1.3
Follow-up			1				1	.7
Patient/family kept waiting	2	2	5				9	6.0
Important conversations (internal)	2						2	1.3
Important conversations (external)	11	8	6	8	5	7	45	30.2

(continued)

Table 7. *Frequency of Elements of Care Marked as 'Not Needed' in the Burn Intensive Care Unit* (continued)

Elements of Care	Month						Surveys (n)	% of surveys
	Jul	Aug	Sep	Oct	Nov	Dec		
Important conversations (patient/family)	9	9	1	4	6	8	37	24.8
Review documentation	1						1	.7
Plan of care initiation/revision	2						2	1.3
Document assessment & monitoring	1						1	.7
Document care	1						1	.7
Plan of care evaluation	1						1	.7
Total	62	37	36	27	23	25		
Surveys (n)	29	29	26	22	22	21		
% of all elements	6.9	4.1	4.5	4.0	3.4	3.8		

Note. Values in far right column reflect proportion of surveys with the item marked as "not needed." Values in bottom row reflect proportion of total items marked as "not needed." Elements of care never marked as "not needed" were not included in this table. Blank spaces indicate that the element of care was always needed for care during that month.

Prior to conducting any statistical analysis, certain assumptions must be met in order to properly interpret the findings from the analysis. In other analyses, these assumptions are generally met before analysis begins. However, in multilevel modeling, these assumptions can be demonstrated after the final models are built because the assumptions require knowledge about the values of the residuals identified during the modeling process (Singer & Willet, 2003). Therefore, the testing of statistical assumptions is described after the modeling process is described.

<u>*Research Question 1*</u>. Research Question 1 was "what is the monthly variation in the prevalence and patterns of UNC in the USABC?" To answer this question, four scoring procedures were applied to generate prevalence estimates for UNC at the USABC, consistent with recommendations by the author of the PIRNCA (Jones et al., 2016). These procedures included one composite score (the mean scale score) and three scores based on dichotomized responses (percentage of nurses rationing one or more elements of care; mean number of elements of care rationed per nurse; mean percentage of elements of care rationed per nurse). For each participant, the composite score was calculated as the arithmetic mean of responses to the 4-point Likert-type scale across the 31 items in the PIRNCA. The mean of composite scores for each unit at each month was calculated. In addition, the distribution of composite scores for each unit was examined. To obtain the three dichotomized instrument scores, each of the 31 items was recorded to reduce the responses from the 4-point scale to a 2-point scale. The cut point used to

dichotomize the response was 2.0 (equal to "rarely"). The recoded responses were scored as follows: 0 = no (never or not needed) and 1 = yes (rarely, sometimes, or often).

The survey-level prevalence estimates of UNC at the USABC are depicted in Table 8. The mean composite score reflects the average frequency with which the 31 items in the PIRNCA were left unfinished. In the BPCU, mean composite scores ranged from 1.76 to 2.27, which reflected mean frequencies of "less than rarely" to "more than rarely," respectively. In the BICU, mean composite scores ranged from 1.69 to 1.93, which reflected mean frequencies of "less than rarely." Across the entire study period, 49.8% of individual mean composite scores fell in the range of 0 to 1.97 (less than "rarely"); 45.7% of individual mean composite scores fell in the range of 2.0 to 3.0 ("rarely" to "sometimes"); and 4.5% of individual mean composite scores fell in the range of 3.03 to 3.94 (less than "often"). In the BPCU, the lowest mean composite score (1.76) occurred during September, when the mean census was the lowest (7.21) and the unit was most overstaffed (SDR = 1.39; see Table 4 on page 11). The highest mean composite scores occurred during July (2.27) and August (2.14), when the unit was appropriately staffed (based on the SDR), SDR = 1.07 and 1.08, respectively. The second highest mean composite score occurred in August when the BPCU experienced the highest patient turnover (1.43) and required the third highest number of NCH provided by float staff (19.43) to maintain appropriate staffing. In the BICU, the lowest mean composite score (1.69) also occurred during September, when the mean census was the lowest (3.42) and the unit was most overstaffed (SDR = 1.31; see Table 5 on page 11). The highest mean composite score occurred during October, when the unit was understaffed (SDR = .86). This also coincided with the third highest mean census (7.77) and the highest patient turnover value (1.29).

Table 8. *Prevalence Estimates of Unfinished Nursing Care*

	Month					
	Jul	Aug	Sep	Oct	Nov	Dec
Mean Composite Scores						
Burn Progressive Care Unit	2.27	2.14	1.76	2.00	2.07	2.01
Burn Intensive Care Unit	1.88	1.85	1.69	1.93	1.87	1.71
% Nurses Leaving One or More Elements of Care Unfinished						
Burn Progressive Care Unit	100	100	85.7	91.3	92.9	95.7
Burn Intensive Care Unit	100	100	92.3	95.5	95.5	95.2
Number of Elements of Care Left Unfinished per Nurse						
Burn Progressive Care Unit	24.1	22.3	16.2	20.0	20.7	20.6
Burn Intensive Care Unit	18.2	18.9	16.4	21.5	18.1	16.8
% of Elements of Care Left Unfinished per Nurse						
Burn Progressive Care Unit	77.7	71.9	52.3	64.5	66.8	66.5
Burn Intensive Care Unit	58.7	61.0	52.9	69.4	58.4	54.2

Note. All values represent the unit mean for the month.

In the current study, dichotomized scoring revealed that a high percentage of nurses left one or more elements of care unfinished in both nursing units. In the BPCU, between 85.7% and 100% of nurses rationed at least one element of necessary care during the study period; 80.9% to 100% rationed more than one element of necessary care. In the BICU, between 92.3% and 100% of nurses rationed at least one element of necessary care during the study period; 88.5% to 100% rationed more than one element of necessary care. On both units, the lowest percentage of nurses rationing care occurred during September, the month with the lowest mean census and the highest staffing levels. Despite being overstaffed during September, a high percentage of nurses (85.7% in the BPCU and 92.3% in the BICU) rationed at least one element of nursing care. Additionally, on both units, 100% of nurses rationed at least one element of nursing care in July and August.

Additionally, a high number of elements of care were left unfinished per nurse throughout the study period. In the BPCU, nurses reported leaving an average of 16 to 24 elements of care (52.3% to 77.7% of all elements of care) unfinished each month. The highest number of elements of care left unfinished occurred in July and August. The highest amount of patient turnover (1.43) and the third highest amount of NCH provided by float staff (19.43) also occurred in August. In the BICU, nurses reported leaving 16 to 22 elements of care (52.9% to 69.4% of all elements of care) unfinished during each month. The highest number of elements of care left unfinished occurred in October, which also was the month in which the BICU was the most understaffed (SDR = .85). In both units, the lowest number of elements of care left unfinished per nurse occurred in September, also coinciding with the lowest mean census and the highest staffing levels.

In total, according to three methods of estimation, the prevalence of UNC was higher in the BPCU. Another estimate (the percent of nurses rationing any element of care) suggested that a higher proportion of nurses in the BICU rationed care. Regardless of the method used to estimate the prevalence of UNC, the lowest prevalence of UNC occurred in September for both units. Interestingly, in September (as depicted in Tables 4 and 5, page 11), the BPCU and BICU experienced the lowest census, the lowest OTp, the lowest NCHs provided by float staff for both units, and were the most overstaffed.

The item-level prevalence estimates of UNC for each element of care in the PIRNCA are depicted in Tables 9, 10, 11, and 12. By considering UNC using item-level analysis of the PIRNCA, more specific patterns of care rationing can be described and potential areas for intervention can be identified (Jones et al., 2016). The data in Tables 9 and 10 (pages 19 to 22) represent the mean frequency (represented as the mean item score) with which individual nurses rationed an element of care. However, this information provided no understanding about how many nurses prioritized care in this manner. The data in Tables 11 and 12 (pages 23 to 26) represent the percent of nurses who reported rationing each element of care, which provided no understanding about how often individual nurses rationed the individual elements. By cross-referencing these item-level data, the most and least frequently rationed elements of care were identified.

Table 9. *Mean Item Scores in the Burn Progressive Care Unit*

Element of Care	Month					
	Jul	Aug	Sep	Oct	Nov	Dec
Routine hygiene	2.06	1.95	1.75	2.09	2.08	2.09
Routine skin care	1.94	1.90	1.70	1.91	2.00	2.05
Change linen	1.88	1.85	1.55	1.96	1.85	1.77
Ambulation	2.35	2.30	1.80	2.30	2.38	2.00
Mobilization/ position change	2.06	2.15	1.80	2.22	2.08	2.05
Elimination	1.82	2.10	1.65	2.04	1.92	2.05
Eating/drinking	1.76	1.95	1.70	2.09	2.00	1.91
Physical comfort	2.35	2.15	1.90	1.96	1.85	1.91
Medication administration	1.88	1.85	1.80	1.70	1.54	1.55
Enteral/parenteral nutrition	1.41	1.25	1.35	1.48	1.15	1.36
Wound care	2.12	1.70	1.70	1.78	1.69	1.86
Change intravenous catheters	2.65	2.35	2.15	2.09	2.38	2.18
Safe patient handling	2.29	1.95	1.50	1.96	1.92	1.86
Infection control adherence	2.12	1.55	1.45	1.74	1.77	1.68
Teaching	2.53	2.40	2.05	2.35	2.62	2.27
Patient preparation	2.41	2.05	1.85	2.17	2.54	1.95
Emotional support	2.76	2.55	2.05	2.22	2.69	2.45
Monitoring physiology	2.35	2.10	1.70	1.87	2.15	2.05
Monitoring behavior	2.53	2.25	1.80	1.96	2.23	2.05
Monitoring safety	2.00	1.90	1.65	1.83	1.85	1.68
Follow-up	2.41	1.90	1.75	1.87	2.08	2.09
Patient/family kept waiting	2.71	2.60	2.25	2.48	2.69	2.55
Important conversations (internal)	2.47	2.45	1.95	2.13	2.15	2.36
Important conversations (external)	2.00	2.00	1.75	1.78	1.92	1.82
Important conversations (patient/family)	2.53	2.25	1.75	2.48	2.00	2.09

(continued)

Table 9. *Mean Item Scores in the Burn Progressive Care Unit* (continued)

Element of Care	Month Jul	Aug	Sep	Oct	Nov	Dec
Supervision	2.35	2.40	1.90	2.09	2.08	2.05
Review documentation	2.76	2.35	1.90	2.09	2.46	2.14
Plan of care initiation/revision	2.47	2.25	1.75	2.09	1.92	1.86
Document assessment & monitoring	2.29	2.35	1.75	1.87	1.92	2.09
Document care	2.94	2.85	2.00	2.22	2.54	2.41
Plan of care evaluation	2.18	2.35	1.75	1.91	2.08	2.05

Note. A mean score of: 1 = never; 2 = rarely; 3 = occasionally; 4 = often.

Across both units, each of the 31 elements of care was left unfinished by at least 31.0% of nurses. No single element was completed 100% of the time by 100% of the nurses; every element was rationed by at least one nurse during each measurement period. Specifically, in the BPCU, 20 of 31 elements of care were left unfinished at least once by at least 50% of the nurses. If September were excluded from the analysis, this number would increase to 28 of 31 elements of care. Additionally, across all months, the elements of care most frequently left unfinished (based on mean scale responses) were: patient/family kept waiting; documenting care; changing intravenous catheters; emotional support; and teaching. The mean item score for these elements ranged from 2.28 to 2.54 (more than "rarely"). The mean proportion of nurses rationing these elements ranged from 75.0% to 85.6%. Two elements of care [routine hygiene and important conversations (internal)] also were reported as being left unfinished by a relatively high percentage of nurses [M = 72.6% for routine hygiene; M = 73.7% for important conversations (internal)] but were rationed less frequently [M = 2.00 for routine hygiene; M = 2.25 for important conversations (internal)]. The elements of care least frequently left unfinished were consistent based on both estimates: enteral nutrition; medication administration; changing linens; infection control adherence; wound care; and monitoring safety. The mean item score for these elements ranged from 1.33 to 1.79. The mean proportion of nurses rationing these elements ranged from 39.3% to 57.6%.

In the BICU, 14 of 31 elements of care were left unfinished at least once by at least 50% of the nurses. If September were excluded from the analysis, this number would increase to 17 of 31 elements of care. Additionally, across all months, the elements of care most frequently left unfinished (based on mean scale responses) were: teaching; reviewing documentation; documenting care; plan of care initiation/revision; and emotional support. The mean item score for these elements ranged from 2.19 to 2.46 (more than "rarely"). The mean proportion of nurses rationing these elements ranged from 71.3% to 78.5%. One element of care [important conversations (internal)] also was reported left unfinished by a high percentage of nurses (M = 73.9%) but was rationed slightly less frequently (M = 2.09). Another element of care (patient/family kept waiting) was reported as being frequently left unfinished (M = 2.29) but was reported as rationed by slightly fewer nurses (M = 67.7%). The elements of care least frequently

Table 10. *Mean Item Scores in the Burn Intensive Care Unit*

Element of Care	Month					
	Jul	Aug	Sep	Oct	Nov	Dec
Routine hygiene	1.96	2.11	1.78	1.95	1.58	2.05
Routine skin care	1.67	1.78	1.52	1.68	1.58	1.75
Change linen	1.85	1.85	1.78	1.84	1.58	1.75
Ambulation	1.33	1.26	1.43	1.53	1.11	1.20
Mobilization/ position change	2.00	1.67	1.83	1.89	1.79	1.75
Elimination	1.63	1.37	1.39	1.47	1.42	1.55
Eating/drinking	1.44	1.44	1.35	1.42	1.42	1.40
Physical comfort	1.93	1.81	1.65	1.89	1.58	1.65
Medication administration	1.96	1.78	1.52	1.63	1.74	1.70
Enteral/parenteral nutrition	1.63	1.48	1.52	1.74	1.47	1.40
Wound care	1.67	1.48	1.39	1.63	1.63	1.30
Change intravenous catheters	2.07	2.00	1.65	2.00	1.84	1.60
Safe patient handling	1.85	1.89	1.65	2.21	2.16	1.60
Infection control adherence	2.04	1.70	1.61	1.95	2.00	1.55
Teaching	2.22	2.41	2.13	2.63	2.37	2.15
Patient preparation	1.70	2.00	1.61	1.89	1.89	1.75
Emotional support	2.22	2.22	2.00	2.58	2.32	2.20
Monitoring physiology	1.96	1.52	1.43	2.05	1.74	1.40
Monitoring behavior	1.78	1.56	1.43	2.00	1.79	1.65
Monitoring safety	1.48	1.44	1.35	1.68	1.58	1.30
Follow-up	2.07	1.74	1.65	2.11	1.95	1.65
Patient/family kept waiting	2.52	2.15	1.91	2.47	2.26	2.35
Important conversations (internal)	2.22	2.11	1.96	2.16	2.11	2.00
Important conversations (external)	1.22	1.33	1.48	1.05	1.58	1.15
Important conversations (patient/family)	1.33	1.07	1.13	1.63	1.42	1.10

(continued)

Table 10. *Mean Item Scores in the Burn Intensive Care Unit* (continued)

Element of Care	Month					
	Jul	Aug	Sep	Oct	Nov	Dec
Supervision	1.85	1.78	1.70	2.16	1.68	1.70
Review documentation	2.11	2.52	2.17	2.58	2.32	2.15
Plan of care initiation/revision	2.04	2.44	2.09	2.16	2.11	2.10
Document assessment & monitoring	2.15	2.00	1.78	2.21	1.95	1.65
Document care	2.48	2.56	2.22	2.68	2.32	2.20
Plan of care evaluation	2.07	2.15	1.83	2.16	1.84	1.75

Note. A mean score of: 1 = never; 2 = rarely; 3 = occasionally; 4 = often.

left unfinished were: important conversations (patient/family); important conversations (external); eating/drinking; and monitoring safety. The mean item score for these elements ranged from 1.32 to 1.49 (less than "rarely"). The mean proportion of nurses rationing these elements ranged from 42.1% to 45.5%. Two elements of care (ambulation and elimination) were rationed less frequently (*M* = 1.36 for ambulation; *M* = 1.47 for elimination) but were reported left unfinished by a slightly higher percentage of nurses (*M* = 46.5% for ambulation; *M* = 48.3% for elimination). Another element of care (enteral/parenteral nutrition) was rationed by fewer nurses (*M* = 45.0%) but was reported left unfinished more frequently (*M* = 1.56).

Influence of Predictors of UNC. The influence of the proposed predictors on nurse reports of UNC were examined using nurse self-report data from the PIRNCA instrument, indicators of *nursing staff supply* (time-invariant) from the demographic portion of the self-report survey, and indicators of *management of working conditions* (time-variant and time-invariant) from self-report surveys and the administrative records of the nursing leaders at the USABC. Because of the natural clustering of repeated measures within the individual participants, multilevel modeling was used to identify the influence of the predictors on nurse estimates of UNC. Generalized linear modeling was used due to the continuous nature of the dependent variable (UNC). Prior to building the multilevel model, for ease of interpretation, the following variables were recoded: employment category (a nominal measure) was dummy coded to separate the categories government civilian and contract employee (military category was the reference); SDR was centered on 1.0, representing an ideal balance between nursing care supply and nursing care demand; and patient turnover was centered on 1.0, representing no patient turnover. The other nominal and ordinal measures (nurse licensure, shift worked, and unit type) were dummy coded from the beginning because they each consisted of only two categories.

The parameter estimation methods used in multilevel modeling (maximum likelihood or restricted maximum likelihood) operate on an assumption of large sample sizes. Maximum likelihood estimation is a common, robust and efficient method of estimation. Restricted maximum likelihood provides a less biased estimate and is better for smaller sample sizes (Hox, 2010; Luke, 2004; Raudenbush & Bryk, 2002). To achieve at least 80% power, Huta (2014)

Table 11. *Percentage of Nurses Leaving Elements of Care Unfinished in the Burn Progressive Care Unit (> Never)*

Element of Care	Month					
	Jul	Aug	Sep	Oct	Nov	Dec
Routine hygiene	88.9	71.4	61.9	69.6	78.6	65.2
Routine skin care	77.8	66.7	52.4	65.2	71.4	73.9
Change linen	55.6	61.9	42.9	65.2	57.1	56.5
Ambulation	77.8	81.0	47.6	82.6	71.4	69.6
Mobilization/ position change	66.7	76.2	52.4	78.3	71.4	69.6
Elimination	55.6	76.2	42.9	65.2	71.4	69.6
Eating/drinking	55.6	61.9	52.4	69.6	64.3	60.9
Physical comfort	72.2	71.4	57.1	60.9	57.1	73.9
Medication administration	61.1	57.1	52.4	47.8	35.7	47.8
Enteral/parenteral nutrition	38.9	38.1	42.9	43.5	28.6	43.5
Wound care	83.3	47.6	42.9	47.8	50	65.2
Change intravenous catheters	83.3	85.7	61.9	69.6	85.7	73.9
Safe patient handling	77.8	66.7	42.9	56.5	57.1	60.9
Infection control adherence	72.2	42.9	38.1	52.2	57.1	52.2
Teaching	83.3	85.7	61.9	69.6	71.4	78.3
Patient preparation	83.3	71.4	52.4	69.6	78.6	69.6
Emotional support	94.4	90.5	57.1	69.6	78.6	69.6
Monitoring physiology	88.9	71.4	47.6	60.9	64.3	73.9
Monitoring behavior	88.9	71.4	52.4	65.2	78.6	69.6
Monitoring safety	72.2	66.7	52.4	52.2	50	52.2
Follow-up	88.9	71.4	52.4	56.5	71.4	73.9
Patient/family kept waiting	88.9	85.7	76.2	82.6	92.9	87.0
Important conversations (internal)	88.9	81.0	57.1	69.6	71.4	73.9

(continued)

Table 11. *Percentage of Nurses Leaving Elements of Care Unfinished in the Burn Progressive Care Unit (> Never)* (continued)

Element of Care	Month					
	Jul	Aug	Sep	Oct	Nov	Dec
Important conversations (external)	61.1	71.4	57.1	65.2	64.3	56.5
Important conversations (patient/family)	83.3	76.2	52.4	65.2	71.4	65.2
Supervision	83.3	81.0	52.4	73.9	71.4	60.9
Review documentation	83.3	81.0	61.9	60.9	78.6	65.2
Plan of care initiation/revision	88.9	76.2	47.6	73.9	64.3	65.2
Document assessment & monitoring	88.9	71.4	47.6	56.5	50	69.6
Document care	94.4	95.2	52.4	78.3	85.7	78.3
Plan of care evaluation	77.8	81.0	47.6	60.9	71.4	65.2

suggested that a sample of at least 60 individuals was required in a study that measured participants at least twice. The current study resulted in 95 unique participants; 65 participated at least twice, exceeding Huta's assertion. However, Singer and Willet (2003) suggested that at least three months were appropriate for longitudinal study. In the current study, 55 nurses participated at least three times. Therefore, to reduce the risk of bias related to the relatively small sample size, restricted maximum likelihood estimation was used.

The sequential building of the multilevel model progressed using the SAS procedure (PROC) MIXED sample code provided by Singer (1998) as a template. A three-level unconditional means model with an unstructured covariance matrix was initially evaluated to determine the appropriate model structure for the data. An unconditional means model contains no specific predictor variables within levels. Therefore, the resulting variance estimates for the outcome variable (UNC) were aggregated by level and did not reveal the effects of any specific conditions (i.e., nursing staff supply or management of working conditions). The intercept and standard error for this model were 1.938 and .10, respectively. The resulting variance estimates for each level were: Level 1 (within-nurse) = .1254, SE = .01; Level 2 (between-nurse) = .3230, SE = .06; Level 3 (between-unit) = .0123, SE = .03. The between-unit variance estimate was insignificant, suggesting that a two-level model structure was most appropriate for the data. Therefore, a two-level unconditional means model (Model 1) was evaluated to examine within- and between-nurse variation.

Model 1 produced an intercept (β_{00}) of 1.93, SE = .064, p < .0001. The intercept value represented a predicted PIRNCA mean composite score of slightly less than "rarely" (scored as "2" on the PIRNCA) in the first month, without the influence of any predictor variables. The variance in UNC estimated by Model 1 was portioned for levels 1 and 2 based on intraclass

Table 12. *Percentage of Nurses Leaving Elements of Care Unfinished in the Burn Intensive Care Unit (> Never)*

Element of Care	Month					
	Jul	Aug	Sep	Oct	Nov	Dec
Routine hygiene	65.5	75.9	57.7	77.3	54.5	71.4
Routine skin care	55.2	62.1	46.2	68.2	50	61.9
Change linen	55.2	69.0	61.5	63.6	54.5	61.9
Ambulation	44.8	41.4	50.0	59.1	40.9	42.9
Mobilization/ position change	69.0	62.1	65.4	63.6	68.2	61.9
Elimination	44.8	41.4	42.3	59.1	50	52.4
Eating/drinking	37.9	41.4	46.2	40.9	45.5	42.9
Physical comfort	58.6	55.2	42.3	72.7	59.1	57.1
Medication administration	58.6	55.2	38.5	50	50	52.4
Enteral/parenteral nutrition	44.8	44.8	42.3	54.5	45.5	38.1
Wound care	48.3	44.8	42.3	54.5	50	33.3
Change intravenous catheters	58.6	72.4	53.8	72.7	63.6	52.4
Safe patient handling	41.4	62.1	38.5	77.3	72.7	57.1
Infection control adherence	62.1	58.6	50.0	81.8	68.2	42.9
Teaching	72.4	82.8	80.8	77.3	86.4	71.4
Patient preparation	51.7	69.0	50.0	72.7	54.5	61.9
Emotional support	72.4	79.3	65.4	81.8	72.7	71.4
Monitoring physiology	62.1	48.3	42.3	77.3	54.5	38.1
Monitoring behavior	55.2	51.7	42.3	68.2	45.5	47.6
Monitoring safety	34.5	41.4	38.5	63.6	45.5	33.3
Follow-up	65.5	55.2	46.2	77.3	59.1	52.4
Patient/family kept waiting	75.9	65.5	61.5	72.7	63.6	66.7
Important conversations (internal)	75.9	72.4	73.1	68.2	72.7	76.2

(continued)

Table 12. *Percentage of Nurses Leaving Elements of Care Unfinished in the Burn Intensive Care Unit (> Never)* (continued)

Element of Care	Month					
	Jul	Aug	Sep	Oct	Nov	Dec
Important conversations (external)	37.9	48.3	57.7	36.4	54.5	38.1
Important conversations (patient/family)	44.8	31.0	38.5	54.5	45.5	38.1
Supervision	58.6	65.5	50.0	72.7	50	57.1
Review documentation	69.0	82.8	73.1	86.4	81.8	66.7
Plan of care initiation/revision	75.9	79.3	65.4	86.4	59.1	61.9
Document assessment & monitoring	72.4	65.5	57.7	81.8	59.1	47.6
Document care	82.8	86.2	65.4	90.9	68.2	66.7
Plan of care evaluation	72.4	75.9	57.7	86.4	63.6	57.1

correlations (ICCs). The ICCs for Level 1 (within-nurse) and Level 2 (between-nurse) were .1255 and .3288, respectively. Therefore, in the current study sample, most of the variance in UNC was explained by Level 2 (between-nurse) factors. The two-level unconditional means model (Model 1) served as the baseline against which subsequent models that include specific predictor variables were compared to establish a model of best fit.

Table 13. *Model of Best Fit Scores for Covariance Matrices*

	Unstructured	Compound Symmetry	Heterogeneous Compound Symmetry
-2LL	363.8	396.7	390.9
AIC	405.8	400.7	404.9
BIC	459.4	405.8	422.8

Note. -2LL = -2 log likelihood.

To achieve the best estimates of residual variance, three covariance matrices (unstructured, compound symmetry, heterogeneous compound symmetry) were considered. The matrices were assessed using the -2LL, Akaike's, and Bayesian information criteria scores (Littell et al., 2006; Singer, 1998; Singer & Willet, 2003). The results can be found in Table 13. Although the unstructured matrix provided the lowest -2LL, use of this matrix was not feasible because it provided no estimates of residual covariance. Additionally, this matrix tends to produce the most complex models (Littell et al., 2006). Instead, the BIC was used to identify the model of best fit (Littell et al., 2006; Singer & Willet, 2003). The compound symmetry matrix resulted in the lowest BIC score and provided estimates of residual variance. Therefore, compound symmetry was selected as the covariance matrix for subsequent modeling.

Research Question 2. Research Question 2 was "what is the relationship between *nursing staff supply* and UNC in the USABC?" To determine which indicators to include in the model of the effects of *nursing staff supply* on nurse estimates of UNC, each variable was modeled. These indicators represented Level 2, time invariant predictors and included: experience in nursing, experience in burn care, education, and licensure. The results are presented in Table 14. None of the individual predictors explained a significant portion of the variance in UNC. Therefore, to answer Research Question 2, a second model with all four indicators of *nursing staff supply* was considered (Model 2). In Model 2, the intercept was 2.07, $p < .001$ and the resulting R^2 was -.075, which represented an increase in prediction error. Model fit was determined by comparing the difference in BIC of Model 1 and Model 2 to a χ^2 distribution, where the degrees of freedom equaled the difference in the number of parameters added to the model (Singer & Willett, 2003). A significantly lower BIC indicated a better model fit. The BIC for Model 2 was significantly higher than Model 1, $\Delta = 26.8$, $df = 3$, $p < .005$, indicating a worse model fit. None of the indicators of *nursing staff supply* explained a significant portion of the variance in UNC. The results of all modeling processes are depicted in Table 16 (on page 29).

Table 14. *Effects of Predictors of Nursing staff supply on Nurse Estimates of Unfinished Nursing Care*

Predictor	Parameter Estimate	*SE*	*p*	*CS (PGID)*	*Var(r)*	R^2
Level-2, time invariant predictors						
Experience (nursing)	-.0005	.0007	.4974	.3313	.1254	-.007
Experience (burn)	-.0002	.0010	.8736	.3329	.1255	-.011
Education	-.0371	.0715	.6049	.3321	.1254	-.009
Licensure	-.2068	.1639	.2104	.3273	.1253	.004

Note. The individual predictors were modeled separately. Each parameter estimate is the raw value and represents the relationship between the individual predictor and instrument mean scores. *CS(PGID)* = between-nurse variance; NCH = nursing care hours; *Var(r)* = residual variance.

Research Question 3. Research Question 3 was "what are the relationships between working conditions and UNC in the USABC?" To determine which indicators to include in the model of the effects of *management of working conditions* on nurse estimates of UNC, each variable was modeled separately. Four indicators (SDR, patient turnover, OTp, and NCH provided by float staff) represented Level 1, time varying predictors. Four indicators [employment category (government civilian), employment category (contract), shift worked and unit worked] represented Level 2, time invariant predictors. Nursing care hours by float staff was the only predictor to explain a statistically significant portion of the variance in nurse estimates of UNC, $R^2 = .021$, $p = .048$. Because no Level-2 predictors were significant (to include indicators of *nursing staff supply*), no interaction effects were tested. The results are presented in Table 15.

Model 3 considered the predicted PIRNCA mean composite score while controlling for the mean NCH provided by float staff. This was the only statistically significant predictor identified in previous models; it remained statistically significant, $\beta_{40} = .008$, $p < .05$ and resulted in a R^2 of .021. The BIC for Model 3 was significantly higher than Model 1, $\Delta = 5.40$, $df = 1$, $p < .025$, indicating a worse model fit.

Table 15. *Effects of Predictors of Management of Working Conditions on Nurse Estimates of Unfinished Nursing Care*

Predictor	Parameter Estimate	*SE*	*p*	*CS (PGID)*	*Var(r)*	R^2
Level-1, time variant predictors						
Supply/demand ratio	-.1843	.1188	.1226	.3250	.1251	.009
Patient turnover	-.0392	.5142	.9393	.3302	.1259	-.004
Overtime paid	.0267	.0207	.1999	.3215	.1262	.015
NCH provided by float staff *	.0078	.0039	.0484	.3197	.1250	.021
Level-2, time invariant predictors						
Employment category (contract)	.0117	.1212	.9234	.3314	.1257	-.007
Employment category (government civilian)	.0835	.1237	.5004	.3314	.1254	-.007
Shift (night)	-.0564	.0983	.5671	.3309	.1256	-.006
Unit	-.2031	.1290	.1187	.3323	.1254	-.009

Note. The individual predictors were modeled separately. Each parameter estimate is the raw value and represents the relationship between the individual predictor and instrument mean scores. *CS(PGID)* = between-nurse variance; NCH = nursing care hours; *Var(r)* = residual variance.
* $p < .05$.

Model 4 predicted the PIRNCA mean composite score while controlling for all of the indicators representing *management of working conditions*: SDR, patient turnover, OTp, NCHs provided by float staff, employment category (government civilian), employment category (contract), shift worked, and unit worked. The addition of these predictors resulted in a R^2 of .027. However, no predictors explained a statistically significant portion of the variance in UNC; the significant influence of NCHs provided by float staff was reduced in the model. The BIC for Model 4 was significantly higher than Model 1, $\Delta = 16.3$, $df = 7$, $p < .025$, indicating a worse model fit. Model 5 contained all of the major predictors considered in the current study. Again, none of the predictors explained a statistically significant portion of the variance in UNC. The addition of these predictors resulted in a R^2 of -.001. The BIC for Model 5 was significantly higher than Model 1, $\Delta = 42.4$, $df = 11$, $p < .005$, indicating a worse model fit.

Table 16. *Effects of Predictors on Participant Composite Scores (n = 269)*

	Model 1	Model 2	Model 3	Model 4	Model 5
Solution for Fixed Effects					
Intercept	1.93** (.06)	2.07** (.22)	1.87** (.07)	1.84** (.35)	1.87** (.40)
Supply/demand ratio				-.035 (.22)	-.027 (.22)
Patient turnover				-.088 (.71)	-.095 (.72)
Overtime paid				.022 (.03)	.022 (.03)
NCH provided by float staff			.008* (.00)	.005 (.01)	.006 (.01)
Employment category (government civilian)				.201 (.18)	.289 (.20)
Employment category (contract)				.143 (.18)	.155 (.18)
Shift (night)				-.092 (.10)	-.086 (.11)
Unit				-.136 (.17)	-.116 (.19)
Experience (nursing)		-.000 (.00)			-.000 (.00)
Experience (burn)		-.001 (.00)			-.001 (.00)
Education		.049 (.10)			.091 (.10)
Licensure		-.269 (.24)			-.280 (.25)
Solutions for Random Effects					
CS(PGID)	.329** (.08)	.337** (.06)	.320** (.06)	.314** (.06)	.320** (.06)
Var(r)	.126** (.01)	.126** (.01)	.125** (.01)	.128** (.01)	.128** (.01)
R^2		-.075	.021	.027	-.001
Measure of Model Fit					
-2LL	396.7	423.4	402.0	413.0	439.1
BIC	405.8	432.6	411.2	422.1	448.2

Note. Values in parentheses are standard errors. -2LL = -2 log likelihood; *CS(PGID)* = between-nurse variance; NCH = nursing care hours; *Var(r)* = residual variance.
* p < .05; ** p < .001

After assessing the measures of model fit, the unconditional means model (Model 1) was determined to be the model of best fit. However, Model 3 was the second-best fitting model and the only model to explain a significant portion of the variance in UNC. Therefore, for the purpose of answering Research Question 3, Model 3 was deemed the best fitting model. The equation representing the final model was:

$$UNC_{ij} = \beta_{00} + \beta_{40}(Float)_{ij} + u_{0j} + r_{ij}$$

where UNC_{ij} represented the predicted PIRNCA mean composite score reported on the *i*-th month by the *j*-th nurse, after controlling for the effect of mean NCHs provided by float staff. In the final model (Model 3), the PIRNCA composite mean score for a nurse at the USABC was predicted to be 1.87 (less than "rarely") and was predicted to increase by .008 for every hour of nursing care provided by float staff. The significant variation in nurse estimates of UNC at the USABC (represented by the PIRNCA mean composite score) was not significantly accounted for by any indicators of *nursing staff supply* or by the indicators of *management of working conditions.* The remaining variance indicated that between-nurse and within-nurse variations influenced nurse estimates of UNC due to factors not accounted for in the current study.

Post hoc analysis. Prior to accepting the findings of multilevel modeling, assumptions of linearity, normality, and homoscedasticity must be met (Hox, 2010; Singer & Willett, 2003). To test the assumptions of linearity and normality, quantile (Q-Q) plots of the residuals were inspected (Field, 2013; Hox, 2010; Singer & Willet, 2003). In Q-Q plots, residuals that have a linear relationship and are normally distributed residuals will fall on the diagonal (Field, 2013). Plots of the residuals were constructed and assessed using the RESIDUAL command in PROC MIXED (Littell et al., 2006; SAS, 2015). For all models considered in the current study, the Q-Q plots of the residuals approximated normality. Therefore, the assumptions of linearity and normality were met.

The assumption of homoscedasticity holds that residual variability was approximately equal at every predictor value (Singer & Willett, 2003). Plots of standardized residuals were used to assess this assumption. In these plots, the distribution of the standardized residual values should be approximately even on either side of the mid-point (often zero) on the graph (Field, 2013; Singer & Willett, 2003). For all models considered in the current study, the distribution of the standardized residuals occurred evenly on either side of the zero line. To support these findings, an assessment of heteroscedasticity was conducted for each of the models in the current study using the PROC AUTOREG procedure in SAS/ETS (2016a, 2016b). The Q statistic (Engle, 1982) and the Lagrange multiplier (McLeod & Li, 1983) tests were used to determine whether significant changes in variance occurred across time; statistically significant values indicated the presence of heteroscedasticity (SAS, 2016b). No values could be determined for the unconditional means models since the model contained no predictors. For the remaining models, no Q statistic or Lagrange multiplier tests were significant, $p < .05$, indicating that there was no significant heteroscedasticity. Therefore, the assumption of homoscedasticity was met.

Researchers also have expressed concern about autocorrelation, which is the unexplained portion of the variance in the dependent variable that is correlated across the repeated measures (Schonfeld & Rindskopf, 2010; Singer & Willett, 2003). Autocorrelation was assessed using the Durbin-Watson test. In this test, a value of 2.0 indicates zero autocorrelation. A value significantly less than 2.0 indicates positive correlations and a value significantly more than 2.0 indicates negative correlations (Field, 2013). Durbin-Watson tests also were conducted using the PROC AUTOREG procedure in SAS/ETS (SAS, 2016a). No values could be determined for the unconditional means models since the model contained no predictors. The Durbin-Watson values were 1.92-2.03, $p > .05$ for the remaining models. Therefore, autocorrelation did not appear to influence the findings of the current study.

Littell et al. (2006) also suggested identifying individual participants who might influence the multilevel model more than others. In doing so, the researcher may identify outlying participants whose responses may introduce bias into the analysis. The presence of undue influence may require a re-examination of the data for data entry errors. Researchers also might consider excluding surveys or participants that exert undue influence on study findings (Field, 2013). Cook's distance (Cook's D) is an indicator of the overall influence a participant had on a model; values greater than 1.0 may need further assessment and consideration (Field, 2013). Cook's D was measured for each participant, for each model using the INFLUENCE command in PROC MIXED (Littell et al., 2006; SAS, 2015). The maximum value for Cook's D, across all participants and all models, was .14 in Model 4. Because no value approached 1.0, it was determined that no participant exerted undue influence on the findings of the current study.

Relationship of current findings to previous findings:

Utility of the instrument. The PIRNCA was shown to be a reliable instrument for estimating UNC in the military burn environment. As previously noted, the Cronbach's alpha values ranged from .96 to .98 across both units and across all months, indicating a high level of internal consistency for the PIRNCA. These values were in keeping with values reported in previous studies of UNC using the PIRNCA (Jones, 2014, 2015; Jones et al., 2016). The PIRNCA was deemed acceptable for use at the USABC because of the low occurrence of missing data (0% to 2.2%), also consistent with previous studies using the PIRNCA in other populations (Jones, 2014, 2015). The utility of the PIRNCA for this environment was supported by the low occurrence of "not needed" ratings across all surveys. For any month, less than 1.5% of the items contained in the PIRNCA were categorized as "not needed" on either nursing unit. This value was less than the 2.8% found in a previous study using the PIRNCA in other populations (Jones et al., 2016). Additionally, 100% of the individual items were reported as necessary and rationed on at least 69% of the completed surveys across all months. This finding indicated that the items contained in the PIRNCA represented necessary elements of care appropriate for patient care on the BPCU and the BICU. Therefore, the PIRNCA was a reliable, acceptable and useful instrument for estimating UNC in military and burn environments.

Prevalence of unfinished nursing care. Disruptions in nursing processes (as represented by UNC) were highly prevalent at the USABC during the current study. When UNC was assessed using the dichotomized PIRNCA scores, at least 85.7% of nurses reported rationing care due to time scarcity. Additionally, nurses left an average of at least 16.2 elements of care unfinished (52.3% of the elements in the PIRNCA) each month. When assessed according to PIRNCA mean composite scores, the prevalence of UNC was approximately "rarely" (1.71 to 2.27). This generally low reported prevalence of UNC (according to the mean composite score) must be considered within the context of the hospitalized patient because patients receive care from multiple nurses during a hospitalization (Jones, 2015). Each item may be rationed with a low frequency as indicated by the mean composite score. However, if a high percentage of nurses rationed care or a high mean number of items were rationed per nurse, this would indicate that patients were at a higher risk of experiencing UNC than the mean composite score alone might indicate. In the current study, the collective frequency with which nurses rationed across all elements of care reflected a high overall prevalence of UNC. Given these findings, it was evident that the USABC nursing care system did not reliably translate nursing resources into nursing care.

The prevalence of UNC at the USABC must be considered within the context of previous research about UNC. To do so, one also must consider the instruments used to measure UNC and the methods used to score the instruments (Jones et al., 2016). The high prevalence of UNC identified in the current study (when the PIRNCA was scored using the dichotomized methods) may be related to the number of elements of care included in the instrument inventory. For example, in the current study, 85.7% to 100% of nurses reported leaving one or more elements of care unfinished. Similarly, four previous studies that also followed the implicit rationing approach used instruments with larger inventories [the PIRNCA or Basel Extent of Rationing of Nursing Care (BERNCA)] and reported results that were similar (82% to 98%) to the current study (Cho et al., 2016; Jones, 2015; Schubert et al., 2009, 2013). In contrast, four studies using smaller inventories (from the tasks undone and MISSCARE approaches) found that fewer nurses (52% to 74%) reported leaving at least one element of care unfinished (Al-Kandari & Thomas, 2009; Ball et al., 2016; Lake et al., 2015; Tubbs-Cooley et al., 2015). Similarly, Jones and colleagues (2016) found that when estimates of UNC were based on the sum of dichotomized scores, prevalence estimates from the PIRNCA were higher (by six elements of care) than estimates from the MISSCARE instrument. The PIRNCA inventory included seven more elements of care than the MISSCARE inventory (Jones et al., 2016).

The prevalence of UNC at the USABC, when reported as the mean composite score (less than "rarely"), also was consistent with other studies that used the PIRNCA or the BERNCA instruments to assess UNC (Jones et al., 2016; Schubert et al., 2008, 2013). However, the prevalence of UNC in the current study was lower than reported in studies that derived the mean composite score (more than "rarely") from the MISSCARE instrument (Kalisch, 2009; Kalisch & Lee, 2012a, 2012b; Kalisch, Tschannen, & Lee, 2011a, 2012; Kalisch, Tschannen, Lee et al., 2011). These inconsistencies may be attributable to the presence of time references (e.g., "answering a call light within five minutes") in the descriptions of the necessary elements of care. The MISSCARE instrument contains eight items with a time reference, compared to three in the PIRNCA. In a study that compared the instruments, the presence of a time reference resulted in consistently higher estimates of UNC for each item and, because the MISSCARE instrument contained more items with a time reference, it may have resulted in higher estimates (Jones et al., 2016).

In general, the most frequently rationed elements of care at the USABC were consistent with the findings from previous studies of UNC. Jones and colleagues (2015) identified that the elements of care most frequently left unfinished fell into five categories: emotional support; education; care coordination/discharge planning; care planning; and timeliness of care. Four more recent studies also reported UNC frequencies that were consistent with this list (Ball et al., 2016; Papastavrou et al., 2016; Roche et al., 2016; Winsett et al., 2016). In the BPCU, the following elements of care were the most frequently left unfinished and were consistent with the previous literature (Jones et al., 2015): patient/family kept waiting; emotional support; teaching; and important conversations (internal). In the BICU, the following elements of care also were consistent with the previous literature (Jones et al., 2015): teaching; reviewing documentation; plan of care initiation/revision; important conversations; patient/family kept waiting; and emotional support.

The frequent rationing of changing intravenous catheters (in the BPCU) was consistent with one previous study of UNC (Winsett et al., 2016). This finding at the USABC may be due to the time required to complete the element of care. The elements of care most frequently left unfinished tend to require more time (or, an unpredictable amount of time) to complete (Jones et al., 2015). In the burn environment, intravenous catheter changes require more time than in other care environments due to the frequent need to place the catheters through burned skin. For example, peripherally placed intravenous catheters are at times inserted through scarred burn wounds that make locating and cannulating veins by palpation difficult. At other times, because peripheral placement may not be an option due to a lack of skin in the surrounding area, providers (physicians, physicians assistants or advanced practice nurses) are required to place intravenous catheters more centrally under sterile conditions. This requires time to coordinate with care team members outside of the bedside nursing team and flexibility to assist with central placement when the provider is available. Once placed, the intravenous catheter must be secured carefully to prevent damage to the healing tissues around the site. This may include specialized dressings or wrapping techniques that require more time than in other care environments. And finally, nurses invest time to carefully remove the old catheter in order to prevent tearing of fragile, healed burn wounds that might surround the old catheter site.

Jones and colleagues (2015) identified that the elements of care least frequently left unfinished fell into the following categories: infection control; nutrition; elimination; and treatments, tests, and procedures. In the BPCU, the following elements of care were the least frequently left unfinished and were consistent with the previous literature (Jones et al., 2015): enteral nutrition; medication administration; changing linens; infection control adherence; and wound care. In the BICU, the following elements of care also were consistent with the previous literature (Jones et al., 2015): eating/drinking; enteral/parenteral nutrition; and elimination.

Across the USABC, four elements of care were left unfinished less frequently than previously identified in the UNC literature: monitoring safety; ambulation; important conversations (external); and important conversations (patient/family). It is likely that these elements of care were among the least frequently left unfinished because of the emphasis placed on them by the USABC leadership team and the processes in place to facilitate their completion. For example, the USABC employs a large number of dedicated physical therapy technicians to assist with patient ambulation (Renz et al., 2012). Additionally, burn patients are at high risk for injury from falls due to the need for high dose opiate medications and other sedation-inducing medications. As such, frequent rounding and frequent use of monitoring devices (such as bed alarms) facilitate patient safety monitoring. Finally, to facilitate the prolonged wound care required for the burn patient after discharge, USABC nurses must have frequent important conversations with external agencies (such as home health or skilled nursing facilities) and with the patient’s family members (Price & Milner, 2012; Renz et al., 2012). These conversations may include topics such as care coordination, providing wound care instruction, or (in the case of external agencies) nursing report prior to transferring the patient to the agency. This is particularly important at the USABC (a regional burn center) because many of the patients are transported to the USABC from far away and cannot return to the burn center for post-discharge follow-up care. Additionally, because of the military status of the USABC, civilian patients (some of whom are undocumented immigrants) may be restricted from returning for follow-up care. Thus, the inclusion of these items among the least frequently unfinished elements of care was not surprising.

In the BICU, wound care was not among the elements of care least frequently left unfinished. In the current study, rationing of wound care was reported by 33.3-54.5% of BICU nurses, with item scores of 1.30-1.63 (less than “rarely”). This finding was surprising given that care of the burn patient was centered on wound care. In an attempt to identify the cause of this anomaly, the data were explored further. No causes were identified in the data. Wound care is the cornerstone of patient care at the USABC; it is one of the major reasons patients are brought to a burn center. At the USABC, wound care is a time consuming, labor intensive process that is generally accomplished in multiple steps: removal of old dressings; gross debridement (shower); fine debridement (scalpel or scissors); reapplication of dressings; and repeated wetting of the dressings with antimicrobial solutions. For many patients, this process occurs twice daily. If the wound is colonized with an invasive fungus, this process occurs more frequently (such as every four hours). Given the extreme importance of wound care in this environment, it seems unlikely that this entire process was frequently left unfinished. Rather, it seems more likely that the nurses were reporting that only a portion of the multi-step process was rationed. This is not surprising because wound care can occur multiple times per day, and some aspects of the process (such as wetting of the dressing) occur multiple times after the rest of the process is complete, introducing numerous opportunities to ration any portion of this multi-step process. A reexamination of the individual surveys revealed no indications (such as hand written notes in the margins of the survey) that only particular aspects of wound care were being reported as unfinished. Without a more in-depth investigation, the cause of this finding remains unclear.

Influence of nursing staff supply and management of working conditions. Nursing care hours provided by float staff, an indicator of *management of working conditions*, was the only significant predictor of UNC identified in the current study. The model containing NCH provided by float staff (Model 3) accounted for 2.1% of the total variance in nurse reports of UNC. This finding indicated that the USABC nursing care system needed to increase nursing care supply (using float nurses) to meet the demand for nursing care but was unable to effectively do so, resulting in UNC.

This was the first study of UNC to demonstrate a significant relationship between float nurse usage (in hours) and nurse estimates of UNC. Six previous studies of UNC considered the influence of temporary nurses (as an employment category or status) on nurse estimates of UNC (Ausserhofer et al., 2014; Kalisch et al., 2013; Kalisch & Lee, 2010, 2012a; Kalisch et al., 2011a; Tschannen et al., 2010). None found a significant relationship between temporary nurses and nurse reports of UNC. In the larger context of nursing care quality, the use of temporary nurses has been inconsistently linked to nursing care quality. Previously, the use of temporary nurses was shown to increase the likelihood of medication errors (Roseman & Booker, 1995), central venous-associated blood stream infections (Alonso-Echanove et al., 2003), and 30-day patient mortality (Estabrooks et al., 2005). Conversely, one study found that the use of temporary nurses did not significantly influence rates of central-line associated blood stream infections or ventilator-associated pneumonia (Bae et al., 2015). Another study by Bae and colleagues (2010b) found that nursing units that used temporary nurses for 5-15% of all nursing care experienced fewer medication errors than nursing units that used no temporary nurses. Finally, in a single study, researchers found opposing results about Army Reserve nurses used in US Army hospitals to temporarily replace active duty Army nurses deployed overseas. Fewer Army Reserve nurses was predictive of higher medication administration error rates, $\beta = -2.907$ to -4.080, $p < .05$. At the same time, a higher proportion of Army Reserve nurses was predictive of patient falls, $\beta =$

4.921, $p < .05$ (Breckenridge-Sproat et al., 2012). The findings from the current study lend support to the idea that the need to use temporary nurses to meet nursing care demand influences nursing care quality.

The use of temporary nurses (such as float nurses) to meet nursing care demand may have influenced nurse estimates of UNC because the temporary nurses, although competent to provide care consistent with their normal clinical environment (i.e., a medical or surgical unit), required supervision or assistance from experienced USABC nurses to provide burn-specific care to their assigned patients. Being a competent nurse involves the following attributes: integrating knowledge into practice, experience, critical thinking, skill proficiency, caring, communication, environment, motivation, and professionalism (Smith, 2012). Developing these attributes in a nurse requires an investment of time, education, and collegial relationships among nursing peers (Benner, 1982; Smith, 2012). To achieve a minimum level of unit-specific nurse competence at the USABC, newly assigned nurses participate in an evidence-based precepting program (Robbins, 2014). Nurses from San Antonio Military Medical Center (SAMMC) who float to the USABC during periods of increased nursing care demand do not participate in this precepting program and therefore may lack the burn-specific competencies to independently meet the nursing care demand of their assigned burn patients. Consequently, the USABC nurses may have been required to assist the float nurses with burn-specific competencies, which in turn resulted in increased time scarcity for the USABC nurse.

Across all of the models tested, no significant relationships were identified between the indicators of *nursing staff supply* and nurse estimates of UNC. This was consistent with previous studies of UNC. In four previous studies of UNC, researchers identified no significant relationships between nurse estimates of UNC and nurse education (Al-Kandari & Thomas, 2009; Castner et al., 2014; Schubert et al., 2013; Tschannen et al., 2010). Similarly, researchers found no significant differences in nurse reports of UNC between registered nurses (RNs) and licensed vocational nurses (LVNs; Jones, 2014; Orique et al., 2015). Furthermore, five studies found no significant relationship between nurse experience and nurse estimates of UNC (Al-Kandari & Thomas, 2009; Bragadottir et al., 2016; Kalisch, 2009; Kalisch & Lee, 2012a; Schubert et al., 2013).

In contrast to previous studies of UNC, the current study revealed no significant relationships between six indicators of *management of working conditions* (SDR, patient turnover, OTp, shift worked, unit worked, and employment category) and nurse estimates of UNC. In particular, the relationship between the SDR and nurse estimates of UNC was not significant. Previously, measures that represented the balance between nursing care supply and nursing care demand (such as nurse-to-patient ratio or NCHs per patient day) were shown to have significant relationships with nurse estimates of UNC. Six studies of UNC reported that the nurse-to-patient ratio was significantly related to nurse estimates of UNC (Al-Kandari & Thomas, 2009; Ausserhofer et al., 2014; Cho et al., 2016; Orique et al., 2015; Schubert et al., 2008; Sochalski, 2004). Three other studies of UNC reported that NCHs per patient day were significantly related to nurse estimates of UNC (Dabney & Kalisch, 2015; Kalisch, Tschannen et al., 2012; Tschannen et al., 2010).

Only two previous studies of UNC considered patient turnover as a predictor of nurse estimates of UNC. The findings were mixed. Both studies operationalized patient turnover in a manner that was similar to the operationalization used in the current study (based on counts of admissions, discharges, transfers and deaths). One represented patient turnover as a series of whole numbers and found that discharges, transfers, and deaths were significantly related to nurse reports of UNC, $r = .07$ to .12, $p < .05$ (Al-Kandari & Thomas, 2009). The other study represented patient turnover as a ratio, similar to the current study, and found no significant relationship between patient turnover and nurse reports of UNC (Orique et al., 2015).

Overtime was considered in five previous studies of UNC. No study operationalized overtime as OTp, as was done in the current study. Instead, all previous studies of UNC operationalized overtime as overtime worked. Overtime worked represents the hours nurses worked beyond their scheduled shift. Overtime worked could represent time that nurses stayed at work past their scheduled shift to complete some aspects of care but was not authorized as overtime by nursing leaders (therefore, unpaid). Overtime worked also could represent time beyond a scheduled shift to meet nursing care demand that was authorized by a nursing leader and for which the nurse was compensated. Overtime paid refers only those hours worked by nurses beyond the 80 hours normally worked in a pay period, for which the nurse is compensated in some manner (in the form of payment or compensatory time). At the USABC, nursing care system leaders must authorize the overtime before the nurse works the additional time. Two studies found that working overtime resulted in increased odds of reporting UNC, $OR = 1.29$ to 1.86 (Cho et al., 2016; Griffiths et al., 2014). However, consistent with the findings of the current study, three studies found no significant relationship between overtime and nurse estimates of UNC (Bragadottir et al., 2016; Kalisch et al., 2013; Kalisch & Lee, 2010).

The relationship between OTp and nurse estimates of UNC may have been confounded by nurse competence, which was not measured in the current study. As a member of the USABC nursing staff, the nurse who worked overtime would have an established level of unit- and burn-specific nurse competence. Unlike nurses floated from SAMMC who may have required assistance with unit and burn-specific elements of care, USABC nurses working overtime may have required less (if any) assistance providing the necessary elements of care for their assigned USABC patients. Consequently, the nurse working overtime may have relieved some of the time scarcity experienced by other nurses on the nursing unit rather than imposing more time scarcity, as may have occurred with float nurses.

Shift worked, an indicator of *management of working conditions* modeled at Level-2, was considered in six previous studies of UNC. In two studies, nurses who worked day or evening shifts reported higher levels of UNC, $\beta = .721$ to 1.776, $p < .001$ (Ball et al., 2014, 2016). In two of these studies, working night shift was predictive of lower reported levels of UNC, $\beta = -.052$ to -.08, $p < .05$ (Kalisch et al., 2011a, 2013). However, consistent with the current study, two studies found no significant relationships between shift worked and nurse estimates of UNC (Kalisch & Lee, 2010; Tschannen et al., 2010).

Unit worked, also an indicator of *management of working conditions* modeled at Level-2, was considered in eight previous studies of UNC. Of particular interest to the current study, two studies found that nurses who worked on critical care units reported less UNC than other units, $p \leq .01$ (Bradagottir et al., 2016; Castner et al., 2014) and one study found that rehabilitation units reported more UNC than critical care units, $\beta = .17$, $p = .019$ (Kalisch et al., 2013). Two more studies also found that nursing units were significantly related to nurse estimates of UNC (Friese et al., 2013; Kalisch, Landstrom, & Williams, 2009). Conversely, but consistent with the current study, three studies found no significant relationship between the unit worked and nurse estimates of UNC (Kalisch, 2009; Kalisch & Lee, 2012b; Kalisch, Tschannen, Lee et al., 2011).

Employment category was modeled at Level-2 as two separate variables (government civilian and contract). Five previous studies considered the influence of full-time, part-time, or temporary employment on nurse estimates of UNC. Those studies reported no significant relationship between employment category and nurse estimates of UNC (Kalisch et al., 2013; Kalisch & Lee, 2010, 2012a; Kalisch et al., 2011a; Tschannen et al., 2010).

Given the inconsistent findings in the previous literature about UNC and these indicators of *management of working conditions*, those findings were not entirely unexpected. It is possible that a significant relationship does not exist. It is also possible that a significant relationship went undetected. This may be the result of an underpowered statistical test or a lack of measure sensitivity (Cohen, 1988; Field, 2013). Both of these potential limitations are discussed later.

Patterns over time. The patterns identified in the current study highlighted the complex nature of the USABC nursing care system. Nurse leaders at the USABC distribute the nursing resources to meet the demand for nursing care. However, across the entire study, the nursing care supply [reflected in the NCH (available)] remained relatively consistent from month to month, regardless of the demand. During months of understaffing, the USABC nursing care system did not increase the supply of nursing resources to meet the demand for nursing care. In fact, when nurse leaders increased nursing care supply (using overtime or NCHs provided by float staff) the nursing care supply did not always meet the nursing care demand.

The inability to meet the demand for nursing care at the USABC may be the result of a limited capacity to surge. Surge capacity is the ability of the nursing care system to rapidly increase nursing care supply to meet a sudden increase in nursing care demand. The term “surge capacity” was previously used in the context of hospital responses to disasters and sudden surges in emergency department admissions (Hick, Barbera, & Kelen, 2009; Kaji, Koenig, & Bey, 2006). The term can easily be applied to non-emergency inpatient settings as well. The difference between the surge capacity in disaster situations and surge capacity related to daily changes in health care demand, however, lies in the notion that individual care can be compromised during a disaster for the good of the larger population (Kaji et al., 2006). Such a compromise is not acceptable in day-to-day patient care operations. Interestingly, the same effect seen in disaster management is also seen in nursing care systems that experience time scarcity; nurses prioritize the elements of care to achieve the best results for the population of patients assigned. Based on the current study findings, there is a limited surge capacity in USABC nursing care system and the care of the individual may be compromised for the good of the larger population of patients.

When nursing care demand surpasses nursing care supply at the USABC, nurse leaders have two options to temporarily increase the supply of nursing staff: overtime or float staff from SAMMC. Overtime is not ideal because the amount of overtime allowed is limited by Military Health System (MHS) budgeting restrictions. Military personnel can be on overtime without additional cost to the MHS. However, military personnel make up a small portion of the USABC work force. Given their small numbers and their sporadic unavailability due to other military requirements (such as training), relying on military overtime to meet increased nursing care demand is not an optimal solution. Furthermore, overtime has been linked to negative patient outcomes that make overtime an undesirable surge option (Kunaviktukul et al., 2015; Rogers et al., 2004; Stimpfel & Aiken, 2013; Trinkoff et al., 2011; Wu et al., 2013).

The use of float staff from SAMMC also limits the surge capacity at the USABC. First, because SAMMC is a large trauma center that is administratively separate from the USABC, nurse leaders at SAMMC must meet their own nursing care demands before providing nursing resources to the USABC. Additionally, the administrative separation dictates (through regulatory mechanisms) that nursing personnel cannot be freely floated between the organizations to support temporary increases in nursing care demand. Furthermore, the use of temporary nurses (such as float nurses) was shown to increase rates of UNC (Ausserhofer et al., 2014) and has been associated with increased rates of adverse patient events (Alonso-Echanove et al., 2003; Dunton et al., 2004; Estabrooks et al., 2005; Pham et al., 2011; Roseman & Booker, 1995). Therefore, reliance on float staff from SAMMC also limits the surge capacity at the USABC.

Effect of problems or obstacles on the results:

No problems or obstacles that might have affected the results were noted throughout the course of this study.

Limitations:

There were limitations in the current study that may prevent generalizations outside of the USABC. These limitations include concerns about statistical power, measure sensitivity, the use of nursing experience as an indicator of *nursing staff supply*, survey fatigue and survey burden, the potential for common source bias, and the possibility that other potential influencing factors of the nursing care system (confounding variables) were not captured in the current study.

The absence of significant relationships among indicators of *nursing staff supply* and *management of working conditions* must be viewed with caution because the current study did not achieve the desired sample size (60 participants for 3 months). As such, it is possible that the analytic test was underpowered. Underpowered tests are not sensitive to small effects that some predictors have on the dependent variable (Cohen, 1992; Field, 2013). And, in the science about UNC, the effect sizes for indicators of *nursing staff supply* and *management of working conditions* were generally small (Jones et al., 2015). Given the probable effect size of these insignificant indicators, a larger sample may have been needed to improve the power of the statistical test used in the current study.

The absence of significant relationships between UNC and the other time varying indicators of *management of working conditions* (SDR, patient turnover, and overtime) also may be due to the measures used. Measurement of these indicators occurred at the unit level. As such, the measures were not sensitive to the individual nurse's experience of time scarcity. Conceptually, the nurse's decision to ration care in periods of time scarcity was dependent upon the individual nurse's experience within the context of a given nursing unit (Jones, 2016). Nurses work to meet nursing care demand within their available time (a nursing shift) while balancing other demands placed on them within the nursing unit context. In the current study, although nursing care at the USABC was provided as a team, it was likely that individual nurses experienced time scarcity differently depending on a multitude of work-related, time varying factors. For example, the overall patient turnover value for the nursing unit may have been low, giving the impression of stable working conditions on the unit. However, if one nurse experienced all of the patient turnover events, this individual may have experienced a great deal of time scarcity and reported a high prevalence of UNC. Conversely, the other nurses on the unit may have experienced little time scarcity and reported a much lower prevalence of UNC.

In the current study, when the nurses estimated their rationing of care (and the resulting UNC), they did so within the context of their individual experience of working conditions on the nursing unit. However, because the *management of working conditions* was measured as the unit level mean, variations experienced by the individual nurse were not detected. Consequently, the time varying indicators of *management of working conditions* (measured at the unit level) were scored the same for every nurse on a given unit during a given month, regardless of their individual experience. This resulted in an indication of *management of working conditions* that did not reflect the variety of individual nurse experiences in the nursing unit.

Additionally, measuring *management of working conditions* at the unit level resulted in a loss of sensitivity during statistical analyses. Sensitivity is the ability of a measure to identify small variations in the concept being measured (Powers & Knapp, 2011). In this case, when the indicators of *management of working conditions* were coded into the statistical software programs, the same values were entered for every nurse participant from the same nursing unit. This resulted in no between-nurse variations on that unit for that month. Regression analysis of a linear model (to include multilevel modeling) requires variation among the predictors in order to detect significant changes in the dependent variable in relation to the predictor (Field, 2013; Littell et al., 2006). Because only two units were considered in the current study, there was little between-unit variation per month for each indicator of *management of working conditions*. There were only two nursing units in the USABC and so increasing between-unit variability was not possible. Therefore, measuring these indicators at the individual level may have increased variability among the participants and improved the sensitivity of the measures.

The use of nurse experience as an indicator of *nursing staff supply* also may have limited the current study. Nurse experience is one of the attributes of nurse competence (Smith, 2012) and may have been used as a proxy indicator for the phenomenon in other studies of UNC (Al-Kandari & Thomas, 2009; Ausserhofer et al., 2014; Bragadottir et al., 2016; Castner et al., 2014; Kalisch, 2009; Kalisch et al., 2013; Kalisch & Lee, 2010, 2012a, 2012b; Kalisch, Tschannen et al., 2011a; Lucero et al., 2009; Schubert et al., 2013; Tschannen et al., 2010). However, a nurse with many years of experience may not possess one or more of the other attributes of a competent nurse. Therefore, using nurse experience as a proxy indicator of nurse competence was not ideal. Data derived from the evidence-based precepting program in place at the USABC (Robbins, 2014) may have been a more complete indicator of nurse competence. This was not possible, however, because obtaining individual-level competency data would have required knowing the identity of each participant, compromising the anonymity of the participant. Therefore, nurse experience was the most feasible indicator of nurse competence for the current study.

The current study also may have been limited by survey fatigue and the burden of the survey on the population of interest (Olson, 2014). Survey fatigue is the number of survey contacts (Porter, 2004). Nurses at the USABC previously participated in survey-based studies and have a history of high participation (Robbins, 2014). However, just prior to data collection for the current study, the USABC nurses were asked to participate in at least one other survey-based study. This fact, coupled with the multiple participation points in the current study, may have resulted in survey fatigue that reduced participation rates over the entire study period. Survey burden is related to the length of the survey, the difficulty answering the questions, and respondent's perception of the importance of the survey topic (Kramer et al., 2009; McCarthy, Beckler, & Qualey, 2006; Olson, 2014; Sharp & Frankel, 1983). In the current study, the 50-item survey was expected to take 15-30 minutes to complete. At the USABC, this represents a significant time cost that may have prevented some nurses from participating. When coupled with the survey fatigue that may have been exacerbated by the repeated nature of the current study, the repeated investment of 30 minutes may have overburdened the USABC nurses. Therefore, participation in the current study may have been limited by survey fatigue and survey burden that resulted in monthly response rates that may have been lower than if the survey had been administered only once.

Furthermore, given the amount of unexplained variance in the multilevel model, it is likely that there were other significant factors within the nursing care system related to UNC that were not captured in the current study. For example, at least three time-and-motion studies identified that nurses spend time on non-patient care tasks (such as clerical needs, attending meetings, or searching for equipment) that were not captured in the current study (Abbey et al., 2012; Cornell et al., 2010; Webster et al., 2011). The amount of time spent on these types of non-patient care tasks would vary by nurse and so these items could have been included as time-varying, within-nurse indicators of *management of working conditions*. Additionally, other between-nurse factors that may have influenced nurse estimates of UNC (such as specialty certification) were not captured in the current study (Boyle, Cramer, Potter, & Staggs, 2015). Assuming that the limitations related to power and measurement were corrected, inclusion of measures such as these may have reduced the amount of unexplained variance in the multilevel model and resulted in a more complete understanding about the influence of *nursing staff supply* and *management of working conditions* on nurse estimates of UNC.

The current study also may be limited by the use of instruments relying on nurse-self report for indicators of independent and dependent variables; estimates of NCHs (required) and UNC were derived from nurse self-report. The use of the same source to acquire data about independent and dependent variables has been criticized (Favero & Bullock, 2014; Meier & O'Toole, 2012), indicating that use of such instruments introduces the potential for common source bias. This bias is believed to artificially inflate the relationship between the variables, potentially leading to Type I errors (Conway & Lance, 2010). In the current study, nurses who completed the PIRNCA also were responsible for estimating the number of NCHs (required) for all of their assigned patients. However, the estimates of NCHs (required) were entered into WMSNi before estimates of UNC were acquired, limiting the possibility that the nurses might have artificially changed the estimates of NCHs (required) to coincide with their reported levels of UNC. Therefore, it was anticipated that the influence of common source bias was limited in the current study.

The current study also may be limited because the study conceptual model did not include all of the dimensions of the nursing care system identified in the NCPF that could influence UNC. These missing elements represent potential confounding variables that may have influenced UNC. Specifically, nursing staff maintenance, economic sustainability, and the nurse practice environment also were conceptualized in the NCPF to influence *nursing processes* (Dubois et al., 2013). In order to focus on the research questions, items related to these dimensions were omitted from the conceptual model for the current study. Studies that directly consider the influence of these dimensions of the nursing care system are underrepresented in the nursing literature (Dubois et al., 2013). However, previous studies of UNC have used instruments that assess organizations across these dimensions. For example, nurse perceptions of their work environment were assessed by the Essentials of Magnetism II (Schmalenberg & Kramer, 2008) and the Nursing Work Index-Revised (Aiken & Patrician, 2000) and were moderately correlated with estimates of UNC, r = -.28 to -.53, $p < .001$ and r = -.26 to -.67, $p \leq .01$, respectively (Jones, 2014; Schubert et al., 2008; Schubert et al., 2007). In the current study, the dimensions of nursing staff maintenance, economic sustainability, and the nursing practice environment may account for a portion of any unexplained variance in the reported levels of UNC. Therefore, the influence of these dimensions of the nursing care system on UNC cannot be discounted.

Another potential confounding variable was the presence of precepting dyads in the sample. Precepting dyads (made up of a new burn nurse undergoing approximately six weeks of evidence-based precepting with an experienced burn nurse) were included in the sample because individual participants could not be eliminated from the sample without breaching participant anonymity. Inclusion of the precepting dyads may have confounded these findings because during the precepting period, the dyad is assigned fewer patients than other nurses working on the shift in order to facilitate training the new burn nurse. This may have resulted in an overestimation of nursing care hours (available) and a higher SDR. Additionally, the effects of being in a precepting dyad on nurse estimates of UNC are unknown. The smaller patient load may have facilitated completion of the necessary elements of care for their assigned patients. However, the educational needs of the orienting nurse may have resulted in increased time scarcity for the dyad. Based on the number of precepting dyads that existed during the study period (12; obtained from USABC nursing leaders), it is estimated that not more than 8.9% (24) of the retained surveys contained data from a precepting dyad.

Finally, the effects of nursing leader judgment on decisions about the *management of working conditions* also may have confounded these findings. Specifically, nurse leader decisions about when and how to surge were not based solely on the SDR. Using their professional experience, knowledge of the available nursing staff, and knowledge of the USABC nursing care system, nursing leaders may have decided to surge (or not) based on triggers or inputs that were not captured in this study. In turn, the individual nurse's decision to ration care was based on their experience working in the setting and conditions managed by the nurse leader. Consequently, it must be acknowledged that nursing leader judgment may have indirectly influenced nurse reports of UNC in a manner that was not captured in the current study.

Conclusion:

This repeated measures, descriptive study examined the monthly variation in UNC at the USABC as indicators of *nursing staff supply* and *management of working conditions* changed over time. In doing so, the prevalence and patterns of UNC on each nursing unit were identified by month before assessing the relationships between UNC and the indicators of *nursing staff supply* and *management of working conditions*.

Analysis of nurse responses to the PIRNCA revealed that the mean composite score ranged from 1.71 (less than “rarely”) to 2.27 (more than “rarely”) across all months on both nursing units. Additionally, 85.7% to 100% of participating nurses reported leaving at least one necessary element of care unfinished. The mean number of elements of care left unfinished per nurse ranged from 16.2 to 24.1 (52.3% to 77.7% of all elements) across all six months on both nursing units. In the BPCU, the most frequently unfinished elements of care were: patient/family kept waiting; documenting care; changing intravenous catheters; emotional support; and teaching. The least frequently unfinished elements of care were: enteral nutrition; medication administration; changing linens; infection control adherence; wound care; and monitoring safety. In the BICU, the most frequently unfinished elements of care were: teaching; reviewing documentation; documenting care; plan of care initiation/revision; and emotional support. The least frequently unfinished elements of care were: important conversations (patient/family); important conversations (external); eating/drinking; and monitoring safety.

Multilevel modeling revealed that only the mean NCHs provided by float staff significantly predicted nurse estimates of UNC. This may indicate that when float nurses were used to meet increased nursing care demand, USABC nurses were required to assist the float nurses with burn-specific competencies. Consequently, the USABC experienced time scarcity and had to ration care for their assigned patients.

Nurses at the USABC experienced time scarcity that resulted in disruptions of their nursing processes (represented by nurse estimates of UNC). The presence of UNC at the USABC indicated that the nursing care system was unable to effectively transform nursing resources into beneficial nursing care. In general, these findings were consistent with other studies of UNC. This is the first study to identify the prevalence and patterns of UNC at the USABC and the first study to identify the prevalence and patterns of UNC at any burn center in the US or in any US military hospital. Additionally, this is the first study to identify the monthly variation of nurse estimates of UNC in any setting. Furthermore, this is the first study to demonstrate the utility of the PIRNCA in the burn or military environments.

Significance of Study Results to Military Nursing

The findings from the current study have implications for nursing practice at the USABC and broader implications for the healthcare policy in the MHS. Additionally, these findings provide direction for future research about UNC across the MHS, burn environments, and the broader science of UNC.

Practice. It is imperative that efforts are taken to minimize UNC at the USABC because the occurrence of UNC may negatively influence patient outcomes. These findings revealed that UNC at the USABC occurred frequently. Based on previous studies, the presence of UNC could lead to increased occurrence of adverse patient events, such as increased rates of infection, patient falls, or 30-day readmissions (Brooks-Carthon et al., 2015; El-Jardali & Lagace, 2005; Sochalski, 2004). Furthermore, the risk of experiencing UNC may be higher at the USABC because burn patients remain hospitalized longer than other patient populations, thereby increasing their potential to experience UNC. Presumably, by reducing time scarcity, one reduces the potential for UNC. However, this study did not identify potential causes of time scarcity at the USABC. Therefore, nurse leaders at the USABC also should work with bedside nurses to identify potential causes of time scarcity and develop potential interventions to give bedside nurses more time to provide care.

Additionally, nurses and nurse leaders at the USABC need to be aware of the elements of care most and least frequently left unfinished on each nursing unit. This information could help determine if the elements of care were prioritized in manner that was in keeping with the needs of the USABC patient population and focus any potential intervention efforts on processes that maximize the completion of elements of care most important to the USABC patient population.

Policy. Monitoring UNC represents an effort to continuously improve patient care in the MHS journey toward high reliability; the presence of UNC may indicate an undetected imbalance between nursing care supply and nursing care demand. Policy makers in the MHS should consider using UNC as an additional indicator of supply/demand balance. Current methods of analyzing the balance between nursing care supply and nursing care demand at the USABC are based on aggregated unit-level measures. This level of analysis limits the sensitivity of these measures and may provide policy makers a false sense that nursing care supply and nursing care demand are balanced.

Policy makers also should consider developing a surge capacity to rapidly mobilize nursing staff when the demand for nursing care exceeds the supply of nurses available (i.e., when understaffing occurs). Ideally, rapid mobilization should occur as soon as the increased demand is recognized and last for the duration of the increased demand. If float nurses are to remain a primary means of surging at the USABC, increased familiarity with the environment and a minimum level of burn competence may minimize the level of UNC when surging is necessary. The potential pool of float nurses should be cross trained an evidence-based precepting program to ensure they are familiar with the USABC environment and have achieved the minimum level of burn competence to provide care to the patient population (Robbins, 2014).

Finally, policy makers at the USABC and the MHS should identify potential system-level causes of time scarcity (e.g., the documentation system) and develop system-level interventions aimed at reducing the overall time burden for the individual nurse.

Education. Nurses and nurse leaders across the MHS should be educated about the phenomenon of UNC. Given the prevalence of UNC, every nurse and nurse leader will be exposed to the effects of UNC on their patients, staff, and organization. Educating nurses and nurse leaders about these effects may potentiate proactive monitoring for periods of time scarcity and might limit the potential for the negative patient and nurse outcomes previously associated with UNC.

Research. This study advanced the science of UNC by demonstrating the prevalence and patterns of UNC in a previously undocumented environment. However, given the unique patient care requirements at the USABC, it is inappropriate to assume that these findings are consistent with other inpatient environments across the MHS. To expand the knowledge about UNC, future research should consider the prevalence and patterns of UNC across a broader sample of MHS inpatient environments.

The PIRNCA was useful for estimating UNC in the military environment. The instrument was previously demonstrated to be valid and reliable in the medical/surgical and critical care environments (Jones, 2014; Jones et al., 2016). Therefore, future research about UNC in other MHS medical/surgical and critical care environments can be completed using the PIRNCA.

Additionally, future studies should consider the influence of nurse competence on nurse estimates of UNC. Previous studies of UNC (including the current study) have considered only the influence of specific aspects of nurse competence (such as nurse experience or education) on UNC (Smith, 2012). However, because of the complex nature of nurse competence, a nurse's experience and education do not adequately represent the phenomenon (Smith, 2012). Benner (1982) posited that a nurse moves through five phases of clinical skill development: novice, advanced beginner, competent, proficient, and expert. As the nurse moves through these phases, they gain perspective and concrete experiences on which to base their nursing judgment. Consequently, nurses of increasing competence are likely to approach patient care with different care priorities (Benner, 1982). Within the context of UNC, the competent nurse may experience time scarcity differently than the proficient or expert nurse, which may result in varying reports of UNC under similar nurse working conditions. Therefore, future studies of UNC should consider the influence of the larger phenomenon of nurse competence on nurse estimates of UNC. This could be accomplished using data derived from competency assessment tools such as those used in the evidence-based precepting program at the USABC (Robbins, 2014).

Finally, future studies of UNC should seek to describe the relationships between UNC and patient, nurse, and organization outcomes at the USABC. The current study did not seek to identify these relationships. However, previous research demonstrated that UNC increased a patient's risk of experiencing an adverse event (El-Jardali & Lagace, 2005; Sochalski, 2004) or readmission within 30 days of discharge (Brooks-Carthon et al., 2015). Previous research also indicated that UNC negatively influenced nurse job satisfaction (Jones, 2014; Kalisch et al., 2011b), decreased nurse occupation satisfaction (Jones, 2014), increased intent to leave, and increased nursing turnover (Tschannen et al., 2010). Therefore, future studies of UNC at the USABC should consider these outcomes in relation to the prevalence of UNC.

Changes in Clinical Practice, Leadership, Management, Education, Policy, and/or Military Doctrine that Resulted from Study

At this time, the Clinical Nurse Officers in Charge on each nursing unit at the USABC have begun efforts to identify the potential causes of nurse time scarcity in their respective units. Through conversations with the bedside nurses, the nurse leaders expect to identify USABC processes that prevent nurses from completing the necessary elements of care for their assigned patients. After analyzing this information, the nurse leaders expect to identify potential changes to the nursing care system that might reduce time scarcity on their respective units.

The Clinical Nurse Officers in Charge on each USABC nursing unit also have begun efforts to educate the bedside nurses on the elements of care most and least frequently left unfinished. Through this education, the nurse leaders expect to begin an open dialogue about UNC on their respective units. These dialogues will include discussions about priorities of care on each unit and methods of ensuring the highest priority elements of care are among the least frequently rationed.

Immediately prior to the release of the results from this study, the leaders at the US Army Institute of Surgical Research began efforts to improve nurse staffing at the USABC. A part of these efforts included the long-term loan (one year) of float nurses from SAMMC to supplement the USABC bedside nurses. Prior to caring for burn patients independently, these float nurses were oriented to the USABC using an evidence-based preceptorship program (Robbins, 2014). At the conclusion of the one-year loan of float nurses, the SAMMC float nurses can act as a pool of burn competent float nurses available when the USABC needs to surge, which may result in decreased time scarcity. The results of this study informed these processes.

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Summary of Dissemination

Type of Dissemination	**Citation**	**Date and Source of Approval for Public Release**
Publications	VanFosson, C. A., Jones, T. L., & Yoder, L. H. (submitted). Monthly variation of unfinished nursing care at the US Army Burn Center. *Burns.*	Approved 11/4/2017, US Army Institute of Surgical Research
	VanFosson, C. A., Yoder, L. H., & Jones, T. L. (2017). Patient turnover: A concept analysis. *Advances in Nursing Science*, *40*(3), 300-312. doi:10.1097/ANS.0000000000000171	Not submitted for approval.
	VanFosson, C. A., Jones, T. L., & Yoder, L. H. (2016). Unfinished nursing care: An important performance measure for nursing care systems. *Nursing Outlook*, *64*(2), 124-136. doi:10.1016/j.outlook.2015.12.010	Not submitted for approval.
Podium Presentations	VanFosson, C. A., Yoder, L. H., Jones, T. L., & Mann-Salinas, E. A. (2017, 22 March). *The longitudinal prevalence of unfinished nursing care.* Podium presentation at the 49th Annual Meeting of the American Burn Association in Boston, MA.	Abstract approved 9/29/2016, US Army Institute of Surgical Research Presentation approved 3/15/2017, US Army Institute of Surgical Research
Poster Presentations	VanFosson, C. A., Yoder, L. H., Jones, T. L., & Mann-Salinas, E. A. (submitted). *A longitudinal approach to the study of unfinished nursing care at the US Army Burn Center*. Poster presentation at the 2017 Tri-Service Nursing Research and Evidence-Based Practice Dissemination Course in Elliot City, MD.	Abstract approved 1/18/2017, US Army Institute of Surgical Research

Reportable Outcomes

Reportable Outcome	**Detailed Description**
Applied for Patent	None.
Issued a Patent	None.
Developed a cell line	None.
Developed a tissue or serum repository	None.
Developed a data registry	None.

Recruitment and Retention Table

Recruitment and Retention Aspect	# Cases (Jul 2016)	# Cases (Aug 2016)	# Cases (Sep 2016)	# Cases (Oct 2016)	# Cases (Nov 2016)	# Cases (Dec 2016)	Total Cases
# Subjects Projected in Grant Application				60 unique participants			
Subjects Available	108	98	102	109	110	110	637
Subjects Contacted by Approved Recruitment Method	108	98	99	104	95	95	599
Subjects Screened							
Subjects Ineligible	0	0	0	0	1	2	3
Subjects Refused	59	47	50	59	58	49	322
Human Subjects Consented	49	51	49	45	37	46	277
Subjects Who Withdrew	0	0	0	0	0	0	0
Surveys Returned	49	51	49	45	37	46	277
Surveys With Complete Data	47	51	47	45	37	46	269
Surveys with Incomplete Data	2	1	2	0	0	0	5

Summary regarding recruitment and retention:

The preceding table represents the recruitment and retention data for the entire study. Over the course of the study, 599 surveys were distributed to approximately 118 different bedside nurses; 277 were returned. Eight surveys were excluded, resulting in 269 surveys included for analysis. This study resulted in 96 unique participants; 55 participated three or more times. The mean monthly response rate was 44.9%. Over the course of the entire study, 81.4% of all USABC nurses participated and completed at least one survey.

Demographic Characteristics of the Sample

Characteristic	
Women, n (%)	63 (66)
Race	
White, n (%)	48 (51)
Black, n (%)	11 (11)
Hispanic or Latino, n (%)	27 (28)
Other, n (%)	5 (6)
No response, n (%)	4 (4)
Military Service or Civilian	
Army, n (%)	13 (14)
Civilian, n (%)	53 (56)
Contract, n (%)	29 (30)
Service Component	
Active Duty, n (%)	13 (14)
Civilian, n (%)	53 (56)
Licensure	
LVNs	18 (19)
RNs	77 (81)
Education	
AIT only	1 (1)
Some college	15 (16)
Associate’s degree	27 (28)
Bachelor’s degree	47 (49)
Master’s degree	5 (6)
Shift worked	
Days	56 (59)
Nights	39 (41)