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THE WEEKEND EFFECT IN SEPTIC SHOCK PATIENTS USING THE NATIONWIDE EMERGENCY DEPARTMENT SAMPLE DATABASE

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ABSTRACT—**Background:** The weekend effect is the increased mortality in hospitalized patients admitted on the weekend. The aim of this study was to examine the effect of weekend admissions on septic shock patients. **Methods:** This This is a retrospective observational study of the 2014 Nationwide Emergency Department Sample Database. Septic shock patients were included in this study using ICD-9-CM codes. Descriptive analysis was done, in addition to bivariate analysis to compare variables based on admission day. Multivariate analysis was conducted to examine the association between admission day and mortality in septic shock patients after adjusting for potential confounding factors. **Results:** A total of 364,604 septic shock patients were included in this study. The average age was 67.19 years, and 51.1% were males. 73.0% of patients presented on weekdays. 32.3% of septic shock patients died during their hospital stay. After adjusting for confounders, there was no significant difference in the emergency department or in-hospital mortality of septic shock patients admitted on the weekend compared with those admitted during weekdays, (OR = 1.00 [95% CI: 0.97–1.03], *P* value = 0.985). **Conclusion:** There was no statistically significant difference in overall mortality between septic shock patients admitted on the weekend or weekday. Our results are contradictory to previous studies showing an increased mortality with the weekend effect. The previous observations that have been made may not stand up with current treatment protocols.

KEYWORDS—Mortality, outcome, sepsis, septic shock, United States epidemiology, weekday, weekend

INTRODUCTION

Septic shock is a global public health burden. In Europe and North America, septic shock is responsible for 10.4% of intensive care unit admission and it has a 28-day mortality rate of 36.7% (1). Some of the predictors of mortality in septic shock include an older age, comorbid medical conditions, and an Acute Physiological Assessment and Chronic Health Evaluation score greater than 25 (2–5). Recent research has shown that early recognition and early antibiotic administration have been associated with an improved outcome in septic shock (6–8).

The weekend effect is defined as the increased mortality in hospitalized patients admitted on the weekend (9). In a cross-sectional study of 114,611 emergency department (ED) patients from the HCUP-US 2008 Nationwide Inpatient Sample, sepsis patients admitted over the weekend were found to have a higher likelihood of early mortality (10). In another study of 398,043 sepsis patients in Taiwan, weekend admission was found to be associated with higher 7-day and 28-day mortality rates (11). Weekend admission was also found to be associated with an increase in the in-hospital mortality in a 21,904-person sample of older adults presenting with urosepsis to a Florida hospital (12). There are however no studies looking solely at the weekend effect on septic-shock-related mortality.

The aim of this study was to examine the effect of a weekend admission on mortality in septic shock patients in the United States.

METHODS

This is a retrospective observational study of the 2014 Nationwide Emergency Department Sample Database (NEDS) (released in 2016). Developed for the Agency for Healthcare Research and Quality (AHRQ), Healthcare Cost and Utilization Project (HCUP), NEDS is the largest database of national United States emergency department visits compiling over 30 million annual ED visits (13). The NEDS 2014 version included 137,807,901 weighted ED visits to 945 hospitals in 33 states and the District of Columbia (14). All research team members completed the on-line HCUP Data Use Agreement training course and signed the agreement. The institutional review board has granted an exemption for research using this de-identified database. All patients who were diagnosed with septic shock were included in this study. They were identified using the ICD9-CM code 78552. All diagnoses were taken into consideration while selecting the study sample and not strictly the first diagnosis, yielding a total number of 364,604 weighted ED visits for septic shock. The exclusion criteria were patients who were less than 18 years of age, who had an unknown day of admission, or who had an ED disposition other than: admitted, died, or transferred (n = 4,535). The selection bias is unlikely to occur because all septic shock patients present in NEDS 2014 were included in the study sample.

The Chronic Condition Indicator (CCI) tool from AHRQ was utilized to identify chronic conditions using ICD-9CM coding, according to body system categories affected. The CCI defines a chronic condition as medical condition that persists for at least 1 year with at least one of the following requirements: the medical condition affects activities of daily living and social interaction, the medical condition requires continuous medical intervention (15).

Variables that were included in the analysis were: patient demographics, chronic conditions, day and season of admission, length of stay, as well as ED and hospital: procedures, disposition, outcomes, and charges. Mondays through Fridays were identified as weekdays, while weekends referred to Saturdays and Sundays. The primary outcome was hospital mortality.

Statistical analysis

The statistical analyses were done using the Statistical Package for the Social Sciences (SPSS; version 24.0; Inc, IBM Corp, Chicago, Ill). The study sample was pulled out from the NEDS database and such as it is not feasible to calculate the required sample size since all eligible patients who met the inclusion criteria were selected. Descriptive analyses of the socio-demographic, administrative, and clinical characteristics were carried out by reporting the mean and associated 95% confidence interval (CI) for the continuous variables and the frequencies, percentages, and 95% CI for the categorical variables. Some analyses were verified and confirmed by using a free online query system based on data from HCUPnet. The standard statistical analyses were

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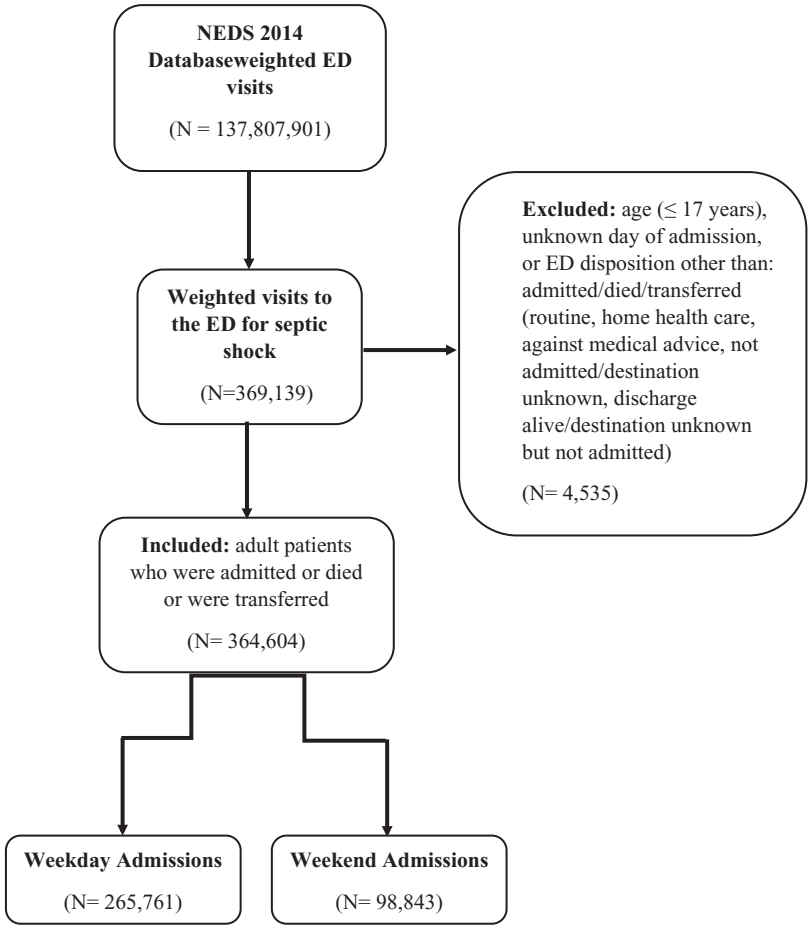

FIG. 1. **Inclusion and exclusion flowchart.**

inappropriate for an extracted data from the NEDS database because a type I error would have occurred and biased estimates would be generated causing overly-narrow confidence intervals and misleading significant *P* values. The Rao-Scott chi-square test, a modified version of the Pearson chi-square test, and a general linear model for complex samples were used to compare the proportion of the categorical variables and the mean age respectively between the two groups of the admission day (weekday vs. weekend). All variables found to be statistically associated with the admission day in addition to those deemed to be clinically meaningful were included in a multivariate analysis to determine the effect of the day of admission on patients' survival. A *P* value of ≤ 0.05 was used to indicate statistical significance. Missing data were not handled through multiple imputations because the percent of unknown/not recorded of almost all variables was found to be less than 5%, except for the season of admission (missing = 14.4%) which was not included in the multivariate analysis. Furthermore, national estimates can be generated from the NEDS database as it was weighted based on HCUP specifications (US census region, trauma center designation, urban–rural location of the hospital, ownership, and teaching status).

RESULTS

A total of 364,604 septic shock patients were included in this study (Fig. 1). The average age was 67.19 [95% CI: 67.09–67.28] years, and 51.1% were males. The majority (72.9%) of patients presented on weekdays, with the most common disposition (98.7%) being an admission to the hospital (Table 1). The most common comorbid conditions were disorders of the endocrine, nutritional, and immune systems (92.4%), followed by diseases of the genitourinary system (83.6%) and diseases of the respiratory system (79.5%) (Table 1). The average length of hospital stay was 12.02 days [95% CI: 11.94–12.11], and the average total charges were 148361.30 USD per patient [95% CI: 147133.06–149589.54]. 32.3% of septic shock patients (n = 117,833) died during their hospital stay (Table 1). 50.7% of patients underwent intubation and mechanical ventilation during the ED or inpatient hospital stay (Table 2). There were no significant differences in age, gender, medical comorbidities, or socioeconomic status between both cohorts (Table 3). There was no statistically significant difference in the ED or hospital mortality between both groups (32.3% [95% CI: 31.9–32.6] for weekdays and 32.4 [95% CI: 31.9–33.0] for weekends, *P* value = 0.62) (Table 3). There was also no difference in ED mortality between both groups (0.4% in each group with a *p* value of 0.75) (Table 3). Finally, there was no significant between both groups in terms of ED and hospital procedures except for arterial blood gas analysis (0.5% during the weekend vs. 0.3% during the weekday, with a *P* value <0.001) (Table 4).

After adjusting for confounders, there was no significant difference in the ED/in-hospital mortality of septic shock patients admitted on the weekend compared with those admitted during weekdays, (OR = 0.99 [95% CI: 0.97–1.03], *P* value = 0.95) (Table 5).

Table 1. **The characteristics and disposition of the septic shock patients presenting to the emergency department**

	Frequency/mean (n = 364,604)	Percentage/ l95% CI)
Sex		
Male	186,389	51.1 (50.8–51.4)
Female	178,190	48.9 (48.6–49.2)
Missing = 24 (0%)		
Mean age (years)	67.19	(67.09–67.28)
Median household income national quartile for patient ZIP code		
$1–$39,999	107,723	30.4 (30.1–30.6)
$40,000–$50,999	99,845	28.1 (27.9–28.4)
$51,000–$65,999	77,346	21.8 (21.5–22.1)
$66,000 or more	69,860	19.7 (19.5–19.9)
Missing = 9,830 (2.7%)		
Season of admission		
Winter	83,023	26.6 (26.3–26.9)
Spring	76,627	24.5 (24.2–24.8)
Summer	75,215	24.1 (23.8–24.4)
Autumn	77,408	24.8 (24.5–25.1)
Missing = 52,331 (14.4%)		
Admission day is a weekend		
Admission on Monday–Friday	265,761	72.9 (72.6–73.2)
Admission on Saturday–Sunday	98,843	27.1 (26.8–27.4)
Chronic condition indicator	362,000	100 (100–100)
Neoplasms	63,159	17.3 (17.1–17.6)
Endocrine, nutritional, and metabolic diseases and immunity disorders	336,923	92.4 (92.2–92.6)
Diseases of blood and blood-forming organs	220,846	60.6 (60.3–60.9)
Diseases of the nervous system and sense organs	192,136	52.7 (52.4–53.0)
Diseases of the circulatory system	311,559	85.5 (85.2–85.7)
Diseases of the respiratory system	289,696	79.5 (79.2–79.7)
Diseases of the digestive system	200,804	55.1 (54.8–55.4)
Diseases of the genitourinary system	304,723	83.6 (83.3–83.8)
Complications of pregnancy, childbirth, and the puerperium	714	0.2 (0.2–0.2)
Diseases of the skin and subcutaneous tissue	85,462	23.4 (23.2–23.7)
Diseases of the musculoskeletal system	101,896	27.9 (27.7–28.2)
Congenital anomalies	8,624	2.4 (2.3–2.5)
Died visit		
Did not die	246,771	67.7 (67.4–68.0)
Died in the ED/hospital	117,833	32.3 (32.0–32.6)
Disposition of patient (uniform) from ED		
Transfer to short-term hospital	2,548	0.7 (0.6–0.8)
Other transfers, including skilled nursing facility, intermediate care, and another type of facility	644	0.2 (0.2–0.2)
Admitted as an inpatient to this hospital	359,847	98.7 (98.6–98.8)
Died in ED	1,565	0.4 (0.4–0.5)
Disposition of patient (uniform) from hospital		
Routine	58,450	16.2 (16.0–16.5)
Transfer to short-term hospital	17,112	4.8 (4.6–4.9)
Other transfers, including skilled nursing facility, intermediate care, and another type of facility	123,460	34.3 (34.0–34.6)
Home health care	41,698	11.6 (11.4–11.8)
Against medical advice	1,923	0.5 (0.5–0.6)
Died in hospital	116,269	32.3 (32.0–32.6)
Discharge alive, destination unknown	804	0.2 (0.2–0.3)
Missing = 4,888 (1.3%)		
Mean total charge for ED services ($)	3174.76	(3148.43–3201.09)
Mean total charge for ED and inpatient services ($)	148361.30	(147133.06–149589.54)
Length of stay	12.02	(11.94–12.11)

Table 2. **Procedures undergone by the septic shock patients**

	Frequency (n = 364,604)	Percentage (95% CI)
Procedure class for ED procedure		
Minor diagnostic	246	(0.1–0.1)
Minor therapeutic	1,114	0.3 (0.3–0.3)
Major therapeutic	19	0 (0–0)
Procedure class for inpatient procedure		
Minor diagnostic	115,123	31.6 (31.3–31.9)
Minor therapeutic	307,245	84.3 (84.0–84.5)
Major diagnostic	5,857	1.6 (1.5–1.7)
Major therapeutic	71,034	19.5 (19.2–19.7)
ED procedures		
Arterial blood gases	73	0 (0–0)
CT scan abdomen	19	0 (0–0)
Diagnostic spinal tap	23	0 (0–0)
Indwelling catheter	294	(0.1–0.1)
Respiratory intubation and mechanical ventilation	480	(0.1–0.2)
Routine chest X-ray	96	0 (0–0)
Hospital procedures		
Abdominal paracentesis	13,292	3.6 (3.5–3.8)
Arterial blood gases	1,252	0.3 (0.3–0.4)
CT scan abdomen	6,213	1.7 (1.6–1.8)
CT scan chest	4,306	1.2 (1.1–1.2)
Debridement of wound; infection or burn	8,937	2.5 (2.4–2.6)
Diagnostic spinal tap	7,519	2.1 (2.0–2.2)
Diagnostic ultrasound of abdomen or retroperitoneum	1,864	0.5 (0.5–0.6)
Diagnostic ultrasound of gastrointestinal tract	390	0.1 (0.1–0.1)
Respiratory intubation and mechanical ventilation	184,297	50.5 (50.2–50.9)
Routine chest X-ray	285	0.1 (0.1–0.1)
Appendectomy	1,821	0.5 (0.5–0.5)
Cholecystectomy and common duct exploration	4,415	1.2 (1.1–1.3)
Exploratory laparotomy	2,046	0.6 (0.5–0.6)
Fluoroscopy of the biliary and pancreatic ducts (ERCP, ERC, and ERP)	870	0.2 (0.2–0.3)
Intraoperative cholangiogram	956	0.3 (0.2–0.3)
Small bowel resection	6,133	1.7 (1.6–1.8)
ED and hospital procedures		
Abdominal paracentesis	13,296	3.6 (3.5–3.8)
Arterial blood gases	1,325	0.4 (0.3–0.4)
CT scan abdomen	6,232	1.7 (1.6–1.8)
CT scan chest	4,311	1.2 (1.1–1.3)
Debridement of wound; infection or burn	8,937	2.5 (2.4–2.6)
Diagnostic spinal tap	7,542	2.1 (2.0–2.2)
Respiratory intubation and mechanical ventilation	184,777	50.7 (50.4–51.0)
Routine chest X-ray	382	0.1 (0.1–0.1)

DISCUSSION

This study examined the association between weekend admissions and mortality in septic shock patients using the largest database of national United States emergency department visits. There was no statistically significant difference in the ED or in-hospital mortality between both groups (32.3% for weekdays and 32.4% for weekends). After adjusting for confounders, there was no significant difference in the ED or in-hospital mortality of patients admitted with septic shock over the weekend compared with those admitted during weekdays, (OR = 1.00 [95% CI: 0.97–1.03], P value = 0.985).

Hospitals can experience a decrease in staffing on weekends which can affect patient care and contribute to worse outcomes. This reduction in staffing can lead to delays in procedures that are needed for patient care. Specialists are also less likely to be in the hospital on weekends (16, 17). This has been shown across different pathologies. El Asmar et al. (16) found that cardiac arrest patients admitted on the weekend had a lower ED/hospital survival (5.2% and 5.9% with a P value of 0.004). Similarly, Kwok et al. found that acute coronary syndrome patients admitted on the weekend had a slightly higher increased risk of early mortality with an OR of 1.06 that was statistically significant. This trend has also been demonstrated in upper GI bleed cases (18), emergency surgery cases (19), and in strokes (20).

TABLE 3. **The characteristics and disposition of the septic shock patients presenting to the emergency department on weekends versus weekdays**

	Weekdays		Weekend		
	n	Percentage/mean (95% CI)	n	Percentage/mean (95% CI)	*P* value
Sex					
Male	135,866	51.1 (50.8–51.5)	50,523	51.1 (50.5–51.7)	0.97
Female	129,871	48.9 (48.5–49.2)	48,319	48.9 (48.3–49.5)	
Mean age	265,761	67.17 (67.06–67.28)	98,843	67.23 (67.05–67.42)	0.59
Season of admission					
Winter	61,440	26.9 (26.6–27.3)	21,583	25.6 (25.0–26.2)	<0.001
Spring	55,812	24.5 (24.1–24.8)	20,814	24.7 (24.1–25.3)	
Summer	54,164	23.8 (23.4–24.1)	21,051	25.0 (24.4–25.6)	
Autumn	56,598	24.8 (24.5–25.2)	20,810	24.7 (24.1–25.3)	
Chronic condition indicator	263,921	100 (100–100)	98,079	100 (100–100)	0.46
Neoplasms	45,833	17.2 (17.0–17.5)	17,326	17.5 (17.1–18.0)	0.29
Endocrine, nutritional, and metabolic diseases and immunity disorders	245,643	92.4 (92.2–92.6)	91,279	92.3 (92.0–92.7)	0.67
Diseases of blood and blood-forming organs	161,380	60.7 (60.4–61.1)	59,466	60.2 (59.6–60.7)	0.11
Diseases of the nervous system and sense organs	140,224	52.8 (52.4–53.1)	51,912	52.5 (51.9–53.1)	0.49
Diseases of the circulatory system	227,161	85.5 (85.2–85.7)	84,397	85.4 (85.0–85.8)	0.72
Diseases of the respiratory system	210,779	79.3 (79.0–79.6)	78,917	79.8 (79.4–80.3)	0.07
Diseases of the digestive system	146,544	55.1 (54.8–55.5)	54,260	54.9 (54.3–55.5)	0.49
Diseases of the genitourinary system	222,406	83.7 (83.4–84.0)	82,317	83.3 (82.8–83.7)	0.13
Complications of pregnancy, childbirth, and the puerperium	508	0.2 (0.2–0.2)	206	0.2 (0.2–0.3)	0.61
Diseases of the skin and subcutaneous tissue	63,159	23.8 (23.5–24.1)	22,303	22.6 (22.1–23.1)	<0.001
Diseases of the musculoskeletal system	74,340	28.0 (27.6–28.3)	27,556	27.9 (27.3–28.4)	0.77
Congenital anomalies	6,160	2.3 (2.2–2.4)	2,464	2.5 (2.3–2.7)	0.11
Median household income national quartile for patient ZIP code					
$1–$39,999	78,388	30.3 (30.0–30.6)	29,335	30.5 (30.0–31.1)	0.26
$40,000–$50,999	72,570	28.0 (27.7–28.4)	27,274	28.4 (27.9–28.9)	
$51,000–$65,999	56,437	21.8 (21.5–22.1)	20,910	21.8 (21.3–22.3)	
$66,000 or more	51,324	19.8 (19.6–20.1)	18,536	19.3 (18.8–19.8)	
Died visit					
Did not die	179,991	67.7 (67.4–68.1)	66,779	67.6 (67.0–68.1)	0.62
Died in the ED/hospital	85,770	32.3 (31.9–32.6)	32,063	32.4 (31.9–33.0)	
Disposition of patient (uniform) from ED					
Transfer to short-term hospital	1,800	0.7 (0.6–0.7)	749	0.8 (0.7–0.9)	0.19
Other transfers, including skilled nursing facility, intermediate care, and another type of facility	452	0.2 (0.1–0.2)	192	0.2 (0.1–0.3)	0.42
Admitted as an inpatient to this hospital	262,379	98.7 (98.6–98.8)	97,467	98.6 (98.5–98.7)	0.15
Died in ED	1,130	0.4 (0.4–0.4)	435	0.4 (0.4–0.5)	0.75
Disposition of patient (uniform) from hospital					
Routine	42,553	16.2 (16.0–16.5)	15,897	16.3 (15.9–16.8)	0.85
Transfer to short-term hospital	12,415	4.7 (4.6–4.9)	4,696	4.8 (4.6–5.1)	
Other transfers, including skilled nursing facility, intermediate care, and another type of facility	90,052	34.3 (34.0–34.7)	33,408	34.3 (33.7–34.9)	
Home health care	30,632	11.7 (11.4–11.9)	11,066	11.4 (11.0–11.7)	
Against medical advice	1,397	0.5 (0.5–0.6)	526	0.5 (0.5–0.6)	
Died in hospital	84,640	32.3 (31.9–32.6)	31,628	32.5 (31.9–33.0)	
Discharge alive, destination unknown	600	0.2 (0.2–0.3)	205	0.2 (0.2–0.3)	

Table 4. **Procedures undergone by the septic shock patients on weekends versus weekdays**

	Weekdays		Weekend		
	n	Percentage (95% CI)	n	Percentage (95% CI)	*P* value
ED and Hospital Procedures					
Abdominal paracentesis	9,832	3.7 (3.6–3.8)	3,464	3.5 (3.3–3.7)	0.15
Arterial blood gases	859	0.3 (0.3–0.4)	466	0.5 (0.4–0.6)	<0.001
CT scan abdomen	4,514	1.7 (1.6–1.8)	1,718	1.7 (1.6–1.9)	0.67
CT scan chest	3,119	1.2 (1.1–1.3)	1,192	1.2 (1.1–1.3)	0.68
Debridement of wound; infection or burn	6,642	2.5 (2.4–2.6)	2,294	2.3 (2.1–2.5)	0.11
Diagnostic spinal tap	5,443	2.0 (1.9–2.2)	2,099	2.1 (2.0–2.3)	0.46
Respiratory intubation and mechanical ventilation	134,398	50.6 (50.2–50.9)	50,380	51.0 (50.4–51.6)	0.26
Routine chest X-ray	259	0.1 (0.1–0.1)	123	0.1 (0.1–0.2)	0.23
Appendectomy	1,390	0.5 (0.5–0.6)	431	0.4 (0.4–0.5)	0.08
Cholecystectomy and common duct exploration	3,245	1.2 (1.1–1.3)	1,170	1.2 (1.1–1.3)	0.64
Colorectal resection	8,841	3.3 (3.2–3.5)	3,199	3.2 (3.0–3.5)	0.49
Exploratory laparotomy	1,503	0.6 (0.5–0.6)	542	0.5 (0.5–0.6)	0.75
Fluoroscopy of the biliary and pancreatic ducts (ERCP, ERC, and ERP)	662	0.2 (0.2–0.3)	208	0.2 (0.2–0.3)	0.28
Intraoperative cholangiogram	702	0.3 (0.2–0.3)	254	0.3 (0.2–0.3)	0.86
Laparoscopy (GI only)	655	0.2 (0.2–0.3)	230	0.2 (0.2–0.3)	0.71
Small bowel resection	4,497	1.7 (1.6–1.8)	1,635	1.7 (1.5–1.8)	0.68

Shih et al. (11) looked at 398,043 sepsis patients and showed that weekday admissions were associated with significantly lower 7-day (OR = 0.89), 14-day (OR = 0.92), and 28-day (OR = 0.97) mortality rates compared with weekend admissions. They attributed this difference in mortality to the lower availability of resources such as lower staffing during weekends and the excess workload the staff must deal with during weekends (11). On the other hand, Fahel et al. (21) looked at 831 septic patients and showed similar mortality rates between patients admitted on weekdays and weekends (10.3% vs. 9.8% respectively, with a *P* value of 0.821). They attributed the absence of the weekend effect to an effective sepsis protocol that ensured early antibiotic treatment (21). However, both studies looked at sepsis patients and to the best of our knowledge, no studies have looked at the weekend effect on septic shock patients only.

The mainstay of septic shock treatment revolved around early goal-directed therapy (EGDT) which was an invasive and resource-dependent protocol that required placement of a specialized central venous catheter, an arterial line, and blood transfusions (22, 23). Over the last few years, the EGDT protocol was challenged by three randomized clinical trials advocating for standard care, which revolved around early recognition of sepsis and early antibiotics (6–8). All three trials failed to show that EGDT was better than usual care (6–8). This was later also confirmed by the PRISM meta-analysis. Furthermore, several studies have advocated for starting vasopressor early through a peripheral vein, therefore reducing the need for central venous catheter insertion (24–27). This shift in sepsis care to a less invasive, less resource-heavy sepsis care is most likely why there is no difference in mortality between the weekday and weekend in our study.

Some studies have shown that patients presenting on the weekend tend to be sicker than those presenting on weekdays (11, 16). In our study, however, there were no differences in the medical comorbidities between patients admitted on weekends or weekdays. Our patients were also matched in terms of procedures except for arterial blood gazes, which were more likely to be drawn on the weekend. The increase in arterial blood gas testing over the weekend could be due to an anticipation of staff shortage or to a limited availability of staff performing this procedure during the weekend.

Table 5. **Crude and adjusted odds ratio of deceased septic shock patients**

	Crude			Adjusted*		
	OR	95% CI	*P* value	OR	95% CI	*P* value
Admission day is a weekend (Admission on Monday–Friday)						
Admission on Saturday– Sunday	1.008	0.98–1.04	0.62	0.99	0.97–1.03	0.95

*Adjusted for: Admission day is a weekend; age; indicator of sex; infectious and parasitic disease; neoplasms; endocrine, nutritional, and metabolic diseases and immunity disorders; diseases of blood and blood-forming organs; mental disorders; diseases of the nervous system and sense organs; diseases of the circulatory system; diseases of the respiratory system; diseases of the digestive system; diseases of the genitourinary system; diseases of the skin and subcutaneous tissue; diseases of the musculoskeletal system; injury and poisoning; factors influencing health status and contact with health services; primary expected payer; patient location: NCHS urban-rural code; region of hospital; ED and Hospital procedures (abdominal paracentesis; arterial blood gases; CT scan abdomen; CT scan chest; debridement of wound, infection, or burn; diagnostic spinal tap; respiratory intubation and mechanical ventilation; routine chest X-ray); additional Hospital procedures (appendectomy; cholecystectomy; and common duct exploration; fluoroscopy of the biliary and pancreatic ducts (ERCP, ERC, and ERP); intraoperative cholangiogram; laparoscopy (GI only); other non-OR gastrointestinal therapeutic procedures; other OR gastrointestinal therapeutic procedures).

As previously mentioned, the standard of care in septic shock has shifted to a less invasive approach. It consists of early recognition of sepsis, source control, resuscitation with fluid, vasopressors, and early antibiotic therapy (24). These interventions are readily available in the ED setting with no delay. This can explain the absence of the weekend effect in septic shock, unlike other medical/surgical conditions that require a more invasive and resource-dependent approach, such as cardiac arrest (16) and emergency general surgery (28).

LIMITATIONS

The retrospective design of the study is one of its main limitations. While trying to select the data from the NEDS database, we used ICD-9 CM for septic shock. Coding can vary from one ED to another which can affect the process of selection by not including all eligible septic shock patients. We excluded patients whose disposition from the ED was missing which could have led to non-differential selection bias. Some potential confounders were missing in the database, such as severity of the clinical presentation, initial lab parameters, and therapeutic measures taken in the ED. The database only includes emergency departments in the United States which limits the generalizability of the study to other populations. Furthermore, even though the most likely reason for the lack of a weekend effect on septic shock mortality is the shift to a less aggressive and less resource demanding treatment strategy emphasizing on early recognition and early antibiotics and our data does not support these conclusions. Finally, another limitation to this study is the lack of information on the cause of sepsis (source of infection) in the NEDS database.

CONCLUSION

There was no statistically significant difference in ED or in-hospital mortality between septic shock patients admitted on the weekend or weekday. Our results are contradictory to previous studies showing an increased mortality with the weekend effect. The previous observations that have been made may not stand up with current treatment protocols.

REFERENCES

1. Vincent JL, Jones G, David S, Olariu E, Cadwell KK: Frequency and mortality of septic shock in Europe and North America: a systematic review and meta-analysis. *Crit Care* 23(1):196, 2019.
2. Mohamed AK, Mehta AA, James P: Predictors of mortality of severe sepsis among adult patients in the medical Intensive Care Unit. *Lung India* 34(4):330–335, 2017.
3. Khwannimit B, Bhurayanontachai R: The epidemiology of, and risk factors for, mortality from severe sepsis and septic shock in a tertiary-care university hospital setting. *Epidemiol Infect* 137(9):1333–1341, 2009.
4. Artero A, Zaragoza R, Camarena JJ, Sancho S, González R, Nogueira JM: Prognostic factors of mortality in patients with community-acquired bloodstream infection with severe sepsis and septic shock. *J Crit Care* 25(2):276–281, 2010.
5. López-Mestanza C, Andaluz-Ojeda D, Gómez-López JR, Bermejo-Martín JF: Clinical factors influencing mortality risk in hospital-acquired sepsis. *J Hosp Infect* 98(2):194–201, 2018.
6. ARISE Investigators and the ANZICS Clinical Trials Group, Peake SL, Delaney A, Bailey M, Bellomo R, Cameron PA, Cooper DJ, Higgins AM, Holdgate A, Howe BD, Webb SA, et al.: Goal-directed resuscitation for patients with early septic shock. *N Engl J Med* 371(16):1496–1506, 2014.
7. Mouncey PR, Osborn TM, Power GS, Harrison DA, Sadique MZ, Grieve RD, Jahan R, Harvey SE, Bell D, Bion JF, et al.: Trial of early, goal-directed resuscitation for septic shock. *N Engl J Med* 372(14):1301–1311, 2015.
8. ProCESS Investigators, Yealy DM, Kellum JA, Huang DT, Barnato AE, Weissfeld LA, Pike F, Terndrup T, Wang HE, Hou PC, LoVecchio F, et al.: A randomized trial of protocol-based care for early septic shock. *N Engl J Med* 370(18):1683–1693, 2014.
9. Pauls LA, Johnson-Paben R, McGready J, Murphy JD, Pronovost PJ, Wu CL: The weekend effect in hospitalized patients: a meta-analysis. *J Hosp Med* 12(9):760–766, 2017.
10. Powell ES, Khare RK, Courtney DM, Feinglass J: The weekend effect for patients with sepsis presenting to the emergency department. *J Emerg Med* 45(5):641–648, 2013.
11. Shih YN, Chen YT, Shih CJ, Ou SM, Hsu YT, Chen RC, Aisiku IP, Seethala RR, Frendl G, Hou PC: Association of weekend effect with early mortality in severe sepsis patients over time. *J Infect* 74(4):345–351, 2017.
12. Peach BC, Li Y, Cimiotti JP: The weekend effect in older adult urosepsis admissions. *Med Care* 58(1):65–69, 2020.
13. Nationwide Emergency Department Sample (NEDS). Overview of the Nationwide Emergency Department Sample (NEDS). 2020 April 27, 2020 July 1, 2020]; Available from: www.hcup-us.ahrq.gov/nedsoverview.jsp.
14. Healthcare Cost and Utilization Project. Introduction to the HCUP Nationwide Emergency Department Sample (NEDS). 2016 July 1, 2020]; Available from: https://hcup-us.ahrq.gov/db/nation/neds/NEDS_Introduction_2014.jsp.
15. El Sibai R, Bachir R, El Sayed M: ECMO use and mortality in adult patients with cardiogenic shock: a retrospective observational study in US hospitals. *BMC Emerg Med* 18(1):20, 2018.
16. El Asmar A, Dakessian A, Bachir R, El Sayed M: Out of hospital cardiac arrest outcomes: impact of weekdays vs weekends admission on survival to hospital discharge. *Resuscitation* 143:29–34, 2019.
17. Kwok CS, Al-Dokheal M, Aldaham S, Rushton C, Butler R, Kinnaird T, Zaman A, Zaman MJ, Timmis A, Mamas MA: Weekend effect in acute coronary syndrome: a meta-analysis of observational studies. *Eur Heart J Acute Cardiovasc Care* 8(5):432–442, 2019.
18. Shih PC, Liu SJ, Li ST, Chiu AC, Wang PC, Liu LY: Weekend effect in upper gastrointestinal bleeding: a systematic review and meta-analysis. *PeerJ* 6:e4248, 2018.
19. Hoehn RS, Go DE, Dhar VK, Kim Y, Hanseman DJ, Wima K, Shah SA: Understanding the ''weekend effect'' for emergency general surgery. *J Gastrointest Surg* 22(2):321–328, 2018.
20. Hsieh CY, Lin HJ, Chen CH, Li CY, Chiu MJ, Sung SF: ''Weekend effect'' on stroke mortality revisited: application of a claims-based stroke severity index in a population-based cohort study. *Medicine (Baltimore)* 95(25):e4046, 2016.
21. Fahel BV, Manciola M, Lima G, Barbosa MH, Starteri C, Ramos JG, Caldas JR, da Hora Passos R: There is no association between weekend admissions and delays in antibiotic administration for patients admitted to the emergency department with suspicion of sepsis: a retrospective cohort study. *Medicine (Baltimore)* 99(47):e23256, 2020.
22. Rivers E, Nguyen B, Havstad S, Ressler J, Muzzin A, Knoblich B, Peterson E, Tomlanovich M: Early goal-directed therapy in the treatment of severe sepsis and septic shock. *N Engl J Med* 345(19):1368–1377, 2001.
23. Rowan KM, Angus DC, Bailey M, Barnato AE, Bellomo R, Canter RR, Coats TJ, Delaney A, Gimbel E, Grieve RD, et al.:, Prism Investigators. Early, goal-directed therapy for septic shock—a patient-level meta-analysis. *N Engl J Med* 376(23):2223–2234, 2017.
24. Rhodes A, Evans LE, Alhazzani W, Levy MM, Antonelli M, Ferrer R, Kumar A, Sevransky JE, Sprung CL, Nunnally ME, et al.: Surviving sepsis campaign: international guidelines for management of sepsis and septic shock: 2016. *Intensive Care Med* 43(3):304–377, 2017.
25. Tian DH, Smyth C, Keijzers G, Macdonald SP, Peake S, Udy A, Delaney A: Safety of peripheral administration of vasopressor medications: a systematic review. *Emerg Med Australas* 32(2):220–227, 2020.
26. Lewis T, Merchan C, Altshuler D, Papadopoulos J: Safety of the peripheral administration of vasopressor agents. *J Intensive Care Med* 34(1):26–33, 2019.
27. Medlej K, Kazzi AA, Chehade AE, Eldine MS, Chami A, Bachir R, Zebian D, Abou Dagher G: Complications from administration of vasopressors through peripheral venous catheters: an observational study. *J Emerg Med* 54(1):47–53, 2018.
28. Hajibandeh S, Hajibandeh S, Satyadas T: Impact of weekend effect on postoperative mortality in patients undergoing emergency General surgery procedures: meta-analysis of prospectively maintained national databases across the world. *Surgeon* 18:231–240, 2019.