

Annotated Bibliography

Higher Mortality During Off-peak Periods

2010

Aylin, P., Yunus, A., Bottle, A., Majeed, A., Bell, D. (2010, January 28). Weekend mortality for **emergency admissions**. A large, multicentre study. *Quality and Safety in Health Care*, Epub ahead of print retrieved March 17, 2010, from <http://www.ncbi.nlm.nih.gov/pubmed/20110288>.

The differences in weekend care for hospitalized patients include not only overall complications but also delays in undergoing urgent procedures, survival from in-hospital cardiac arrest, and mortality from acute myocardial infarction. This study adds to the existing literature by analyzing more than 4 million emergency department admissions to all public acute hospitals in England for 2005/2006 to provide a broader view of the relationship between weekend admissions and clinical outcomes. Investigators discovered that patients admitted during the weekend experienced 10% higher odds of death. The study also reported that for the 50 diagnosis groups with the highest number of deaths, 17 were associated with significantly higher odds of mortality if admitted on a weekend. The authors estimate that nearly 3400 excess deaths during 2005-2006 could be attributed to weekend care.

Cavallazzi, R., Marik, P., Hirani, A., Pachinburavan, M., Vasu, T., Leiby, B. (2010, April 23).

Association between time of admission to the **Intensive Care Unit** and mortality: a systematic review and meta-analysis. *Chest*, Epub ahead of print retrieved June 17, 2010, from <http://www.ncbi.nlm.nih.gov/pubmed/20418364>.

A systematic review of the literature to assess whether admission to an ICU during off hours is associated with an increased mortality was done. Medline, Embase, and citation review of relevant primary and review articles was searched. Studies that evaluated the association

between time of admission to the ICU and mortality, with adjustment for severity of disease were selected. Studies that included pediatric and non-ICU patients were excluded. Study characteristics extracted included date of publication, study design, country where study was carried out, study population, time factor (weekend or night shift), severity adjustment tool, and outcome. Numerical data extracted from each study included total number of patients in the study, number of patients in each group, mortality in each group, and the adjusted relative risk estimate (odds ratio [OR]) for mortality with corresponding 95% confidence interval (CI). Ten cohort studies met our inclusion criteria; eight of these studies evaluated nighttime admissions while six studies evaluated weekend admissions. The pooled analysis demonstrated that nighttime admission was not associated with an increased mortality (OR: 1.0 [95% CI, 0.87 to 1.17]; $p=0.956$); however, patients admitted over the weekend had a significant increase in the adjusted risk of death (OR: 1.08 [95% CI, 1.04 to 1.13]; $p<0.001$). Significant heterogeneity was found in the studies that evaluated nighttime admissions. While patients admitted to an ICU over the weekend appear to be at an increased risk of death, nighttime admissions were not associated with an increased mortality. The lower level of staffing and intensity of care provided by many hospitals over the weekend may account for this finding. The heterogeneity noted between studies evaluating nighttime admissions likely reflects the diverse organizational structure of the hospitals and ICUs where these studies were carried out.

de Graaf, J., Ravelli, A., Visser, G., Hukkelhoven, C., Tong, W., Bonsel, G., et al. (2010). Increased adverse **perinatal outcome** of hospital delivery at night. *BJOG: An International Journal of Obstetrics and Gynaecology*, 117, 1098–1107.

The objective was to determine whether delivery in the evening or at night and some organisational features of maternity units are related to perinatal adverse outcome. This was a

7-year national registry-based cohort study in all 99 Dutch hospitals. From nontertiary hospitals (n = 88), 655,961 singleton deliveries from 32 gestational weeks onwards, and, from tertiary centres (n = 10), 108,445 singleton deliveries from 22 gestational weeks onwards. Multiple logistic regression analysis of national perinatal registration data over the period 2000–2006 was done. In addition, multilevel analysis was applied to investigate whether the effects of time of delivery and other variables systematically vary across different hospitals. Delivery-related perinatal mortality (intrapartum or early neonatal mortality) and combined delivery-related perinatal adverse outcome (any of the following: intrapartum or early neonatal mortality, 5-minute Apgar score below 7, or admission to neonatal intensive care). After case mix adjustment, relative to daytime, increased perinatal mortality was found in nontertiary hospitals during the evening (OR, 1.32; 95% CI, 1.15–1.52) and at night (OR, 1.47; 95% CI, 1.28–1.69) and, in tertiary centres, at night only (OR, 1.20; 95% CI, 1.06–1.37). Similar significant effects were observed using the combined perinatal adverse outcome measure. Multilevel analysis was unsuccessful; extending the initial analysis with nominal hospital effects and hospital–delivery time interaction effects confirmed the significant effect of night in nontertiary hospitals, whereas other organisational effects (nontertiary, tertiary) were taken up by the hospital terms. Hospital deliveries at night are associated with increased perinatal mortality and adverse perinatal outcome. The time of delivery and other organisational features representing experience (seniority of staff, volume) explain hospital-to-hospital variation.

Dorn, S., Shah, N., Berg, B., Naessens, J. (2010). Effect of weekend hospital admission on **gastrointestinal hemorrhage** outcomes. *Digestive Diseases and Sciences*, 55(6), 1658-1666.

This was a cross-sectional comparison of mortality, resource use, and the utilization and timing of esophagogastroduodenoscopy (EGD) among patients admitted with upper

gastrointestinal hemorrhage (UGIH) on weekends to those admitted on a weekday. Hospitals in 31 states from the Nationwide Inpatient Sample between 1998 and 2003 were included. This resulted in 75,636 patients admitted during the week and 23,339 admitted on a weekend with UGIH. Multivariable analyses were conducted to evaluate the effect of weekend admission on UGIH outcomes. Compared to patients admitted on a weekday, for those admitted on a weekend: in-hospital mortality was higher (unadjusted mortality 3.76 vs. 3.33%; $P = 0.003$; adjusted HR = 1.09, 95% CI = 1.00-1.18); adjusted length of stay was 1.7% longer ($P = 0.0098$); and adjusted in-hospital charges were 3.3% higher ($P = 0.0038$). Although these patients were less likely to undergo endoscopy (adjusted OR = 0.94; $P = 0.004$) and waited longer for this procedure (adjusted HR = 0.87; $P < 0.001$), these discrepancies did not fully explain their inferior outcomes. Weekend admission for UGIH is associated with an increased risk of death, slightly longer lengths of stay, and marginally higher in-patient charges. Discrepancies in the use and timing of endoscopy do not account for these differences.

Hamilton, P., Mathur, S., Gemeinhardt, G., Eschiti, V., Campbell, M. (2010). Expanding what we know about **off-peak mortality** in hospitals. *The Journal of Nursing Administration*, 40(3), 124-128.

This ethnographic study explores perceptions of patient safety among nurses working night and weekend shifts, and discusses these findings as a means of identifying methods to reduce the documented increase in adverse clinical outcomes for patients hospitalized at night or on weekends.

Hong, J., Kang, H., Lee, S. (2010). Comparison of case fatality rates for **acute myocardial infarction** in weekday vs weekend admissions in South Korea. *Circulation Journal*, 74(3), 496-502.

The study evaluated differences in the case fatality rate of Korean patients admitted with an acute myocardial infarction (AMI) on weekdays vs those admitted on weekends. The dataset was constructed from the Korea National Health Insurance Claims Database. The study population was 97,466 patients who were admitted to a hospital in Korea from 2003 to 2007 with AMI. Patients admitted on weekends had a higher 30-day fatality rate (20.1% vs 17.3%) than did those admitted on weekdays. Differences in the 30-day fatality rate were significant after adjusting for baseline characteristics and the severity of disease (odds ratio (OR), 1.21; 95% confidence interval (CI), 1.16-1.26). However, the 30-day fatality rate was insignificantly different after additional adjustment for medical or invasive management (OR 1.05; 95% CI 0.99-1.11). Differences in the case fatality rate of AMI patients admitted on weekdays and on weekends in Korea are caused by differences in the rate of performance of medical or invasive procedures.

James, M., Wald, R., Bell, C., Tonelli, M., Hemmelgarn, B., Waikar, S., et al. (2010). Weekend hospital admission, **acute kidney injury**, and mortality. *JASN: Journal of the American Society of Nephrology*, 21(5), 845-851.

Using the Nationwide Inpatient Sample, a large database of admissions to acute care, nonfederal hospitals in the United States, we identified 963,730 admissions with a diagnosis of acute kidney injury (AKI) between 2003 and 2006. Of these, 214,962 admissions (22%) designated AKI as the primary reason for admission (45,203 on a weekend and 169,759 on a weekday). We used logistic regression models to examine the adjusted odds of in-hospital mortality associated with weekend versus weekday admission. Compared with admission on a weekday, patients admitted with a primary diagnosis of AKI on a weekend had a higher odds of death [adjusted odds ratio (OR) 1.07, 95% confidence interval (CI) 1.02 to 1.12].

The risk for death with admission on a weekend for AKI was more pronounced in smaller

hospitals (adjusted OR 1.17, 95% CI 1.03 to 1.33) compared with larger hospitals (adjusted OR 1.07, 95% CI 1.01 to 1.13). Increased mortality was also associated with weekend admission among patients with AKI as a secondary diagnosis across a spectrum of co-existing medical diagnoses. In conclusion, among patients hospitalized with AKI, weekend admission is associated with a higher risk for death compared with admission on a weekday.

Kazley, A., Hillman, D., Johnston, K., Simpson, K. (2010). Hospital care for patients experiencing weekend vs weekday **stroke**: a comparison of quality and aggressiveness of care. *Archives of Neurology*, 67(1), 39-44.

The quality and aggressiveness of care for the treatment of acute ischemic stroke (AIS) was examined on weekends vs weekdays. AIS is a leading cause of death and disability in the United States and aggressive treatment must be provided within 3 hours for optimal patient outcomes. Because of this short treatment window for the administration of tissue plasminogen activator, patients need around-the-clock access to high-quality and aggressive care. A retrospective study of patients with AIS in Virginia was conducted. Two logistic regression analyses assessed the relationship between weekend admission and quality and aggressiveness of care, while controlling for appropriate patient-level and hospital-level control variables. Patients with AIS admitted on weekends are more likely to receive tissue plasminogen activator than those admitted on weekdays ($P < .05$). No statistically significant difference was noted in patient mortality based on day of admission ($P \geq .05$). We detected no difference in the likelihood to seek hospital care on weekends between patients with AIS vs patients with hemorrhagic stroke. Patients experiencing AIS are more likely to receive tissue plasminogen activator on weekends than on weekdays. Patients experiencing AIS who are admitted on weekends are no more likely to die than those who are admitted on

weekdays. Further research is necessary to understand differences in weekend vs weekday care.

Marco, J., Barba, R., Plaza, S., Losa, J., Canora, J., Zapatero, A. (2010, May 19). Analysis of the Mortality of Patients **Admitted to Internal Medicine Wards** Over the Weekend. *American Journal of Medical Quality*, Epub ahead of print retrieved June 17, 2010 from <http://www.ncbi.nlm.nih.gov/pubmed/20484660>.

The authors analyzed the clinical data of 429,880 adults >14 years of age who were admitted to internal medicine wards in Spain after having presented to the hospitals' emergency departments. Overall mortality and early mortality (occurring in the first 48 hours) were examined, taking into account whether a patient was admitted on a weekend or a weekday, in addition to other parameters. Weekend admissions were associated with a significantly higher in-hospital mortality than weekday admissions among patients admitted to an internal medicine service (odds ratio [OR] = 1.1; 95% confidence interval [CI] = .14-1.08).

Differences in mortality persisted after adjustment for age, sex, and coexisting disorders (OR = 1.071; 95% CI = 1.046-1.097). Analyses of deaths within 2 days after admission showed larger relative differences in mortality between weekend and weekday admissions (OR = 1.28; 95% CI = 1.22-1.33). For patients admitted to an internal medicine service via an acute care visit to the emergency room, admission on weekends is associated with higher mortality than admission during the week.

Ryan, K., Levit, K., Davis, H. (2010, March). Statistical Brief #87. **Characteristics** of weekday and weekend hospital admissions, 2007. *HCUP: Healthcare Cost and Utilization Project. Agency for Healthcare Research and Quality, Rockville, MD*: www.hcup-us.ahrq.gov/reports/statbriefs/sb87.jsp.

Using data from the Healthcare Cost and Utilization Project, this report analyzed characteristics of weekend hospital stays and found that patients experienced delays in receiving care compared with patients admitted during the week. Of the 39.5 million community hospital stays in 2007, 7.7 million stays or about 19 percent began on a weekend. A smaller share of weekend than weekday admissions was elective (11 percent weekend and 28 percent weekday); a larger share was admitted through the emergency department (65 percent weekend and 44 percent weekday) or died in-hospital (2.4 percent weekend and 1.8 percent weekday). Patients admitted on weekends tend to experience delays in receiving major procedures. On the day of admission, weekend-admitted patients received 36 percent of major procedures that they would receive during their stays, compared to 65 percent for patients admitted on weekdays. This delay may be related to the scheduled nature of weekday procedures, but may also be an indicator of quality of care. By the first day after admission, 64 percent of weekend-admitted patients with heart attacks received major cardiac procedures, compared with 76 percent for weekday-admitted patients. Similarly, 44 percent of weekend-admitted patients with GI bleeds received GI endoscopy, compared with 58 percent of weekday-admitted patients. Thirty-four percent of all admissions for crushing or internal injuries and 32 percent for brain injuries prompted weekend admissions in 2007.

Schilling, P., Campbell, D., Englesbe, M., Davis, M. (2010). A comparison of **in-hospital mortality risk** conferred by high hospital occupancy, differences in nurse staffing levels, weekend admission, and seasonal influenza. *Medical Care*, 48(3), 224-232.

Hospital occupancy, nurse staffing levels, weekend admission, and seasonal influenza have all been shown to be associated with in-hospital mortality. This was a retrospective cohort study of 166,920 patients admitted to 39 Michigan hospitals between 2003 and 2006.

Participants were adults, age > or = 65 years, admitted through the emergency department

with 6 common discharge diagnoses (acute myocardial infarction, congestive heart failure, stroke, pneumonia, hip fracture, gastrointestinal bleeding). Logistic regression was used to compare the differences in the predicted probability of death conferred by each of the 4 factors, controlling for patient age, gender, discharge diagnosis, and comorbid conditions. Each of the 4 factors had a statistically significant, independent association with in-hospital mortality. Seasonal influenza conferred the greatest increase in absolute risk of in-hospital mortality (0.5 percentage points; 95% CI, 0.23-0.76), followed by weekend admission (0.32, 0.11-0.54), and high hospital occupancy on admission (0.24, 0.06-0.43). Increased nurse staffing levels decreased the absolute risk of mortality by 0.25 percentage points (0.04-0.48) for each additional full-time equivalent nurse per patient-day. Hospital occupancy, nurse staffing levels, weekend admission, and seasonal influenza all appear to be independently associated with in-hospital mortality, but to varying degrees in the current sample. These findings may guide hospital administrators as they consider factors that influence weekly and seasonal patient flow and capacity, as well as staffing.

2009

Albright, K., Raman, R., Ernstrom, K., Halleivi, H., Martin-Schild, S., Meyer, B., et al. (2009). Can comprehensive **stroke centers** erase the 'weekend effect'? *Cerebrovascular Diseases*, 27(2), 107-113.

The aim was to assess stroke patient outcomes in order to determine the significance of the 'weekend effect' at 2 comprehensive stroke centers in the US. Patients were categorized into 4 groups: intracerebral hemorrhage (ICH group), ischemic strokes not treated with IV t-PA (intravenous tissue plasminogen activator; IS group), acute ischemic strokes treated with IV t-PA (AIS-TPA group), and transient ischemic attack (TIA group). Weekend admission was defined as the period from Friday, 17:01, to Monday, 08:59. Adverse events, poor functional outcome (modified Rankin scale, mRS, 3-6), and mortality were compared. A total of 2,211 patients were included (1,407 site 1; 804 site 2). Thirty-six percent (800/2,211) arrived on a weekend. No significant differences were found in the ICH, IS, AIS-TPA, or TIA groups with respect to the rate of symptomatic ICH, mRS on discharge, discharge disposition, 90-day mRS, or 90-day mortality when comparing weekend and weekday groups. Using multivariate logistic regression to adjust for site, age, admission NIHSS, and blood glucose, weekend admission was not a significant independent predictive factor for in-hospital mortality in all strokes (OR = 1.10, 95% CI 0.74-1.63, p = 0.631). Our results suggest that comprehensive stroke centers (CSC) may ameliorate the 'weekend effect' in stroke patients. These results may be due to 24/7 availability of stroke specialists, advanced neuroimaging, or ongoing training and surveillance of specialized nursing care available at CSC. While encouraging, these results require confirmation in prospective studies.

Ananthakrishnan, A., McGinley, E., Saeian, K. (2009). Outcomes of weekend admissions for **upper gastrointestinal hemorrhage**: a nationwide analysis. *Clinical Gastroenterology and Hepatology*, 7(3), 296-302.

The aim of this study was to analyze if weekend admissions for upper gastrointestinal hemorrhage (UGIH) have higher mortality and longer hospital stay compared with those admitted on weekdays, and to examine if this effect differs by hospital teaching status. This was a cross-sectional study using the Nationwide Inpatient Sample 2004. A total of 28,820 discharges with acute variceal hemorrhage (AVH) and 391,119 discharges with acute non-variceal UGIH (NVUGIH) were identified through appropriate International Classification of Diseases, ninth edition codes. Admissions were considered to be weekend admissions if they were admitted between midnight on Friday through midnight on Sunday. In-hospital mortality, frequency, and timing of endoscopy were measured. On multivariate analysis, NVUGIH patients admitted on weekends had higher adjusted in-hospital mortality (odds ratio [OR], 1.21; 95% confidence interval [CI], 1.09-1.35) and were less likely to undergo early endoscopy within 1 day of hospitalization (OR, 0.64; 95% CI, 0.61-0.68). Weekend admission was not predictive of in-hospital mortality in patients with AVH (OR, 0.94; 95% CI, 0.75-1.18), but was associated with lower likelihood of early endoscopy in nonteaching hospitals (OR, 0.65; 95% CI, 0.51-0.82). Early endoscopy was associated with significantly shorter hospital stays (NVUGIH, -1.08 days; AVH, -2.35 days) and lower hospitalization charges (NVUGIH, -\$1958; AVH, -\$8870). Patients with NVUGIH admitted on the weekend had higher mortality and lower rates of early endoscopy. Patient with AVH admitted to nonteaching hospitals also had lower utilization of early endoscopy, but no difference in survival.

Aujesky, D., Jiménez, D., Mor, M., Geng, M., Fine, M., Ibrahim, S. (2009). Weekend versus weekday admission and mortality after **acute pulmonary embolism**. *Circulation*, 119(7), 962-968.

Optimal management of acute pulmonary embolism (PE) requires medical expertise, diagnostic testing, and therapies that may not be available consistently throughout the entire week. Whether associations exist between weekday or weekend admission and mortality and length of hospital stay for patients hospitalized with PE was assessed. Patients discharged with a primary diagnosis of PE from 186 acute care hospitals in Pennsylvania (January 2000 to November 2002) were evaluated. Random-effect logistic models were used to study the association between weekend admission and 30-day mortality and used discrete survival models to study the association between weekend admission and time to hospital discharge, adjusting for hospital (region, size, and teaching status) and patient factors (race, insurance, severity of illness, and use of thrombolytic therapy). Among 15,531 patient discharges with PE, 3286 patients (21.2%) had been admitted on a weekend. Patients admitted on weekends had a higher unadjusted 30-day mortality rate (11.1% versus 8.8%) than patients admitted on weekdays, with no difference in length of stay. Patients admitted on weekends had significantly greater adjusted odds of dying (odds ratio 1.17, 95% confidence interval 1.03 to 1.34) than patients admitted on weekdays. The higher mortality among patients hospitalized on weekends was driven by the increased mortality rate among the most severely ill patients. Patients with PE who are admitted on weekends have a significantly higher short-term mortality than patients admitted on weekdays.

Crowley, R., Yeoh, H., Stukenborg, G., Ionescu, A., Kassell, N., Dumont, A. (2009). Influence of weekend versus weekday hospital admission on mortality following **subarachnoid hemorrhage**. *Journal of Neurosurgery*, 111(1), 60-66.

This study examines the relationship between short-term mortality risk and weekend admission among patients hospitalized following subarachnoid hemorrhage (SAH). This retrospective cohort study examines mortality outcomes among patients included in the Nationwide Inpatient Sample (NIS) for 2004. Patients included in the cohort were identified using the International Classification of Diseases, 9th revision, Clinical Modification (ICD-9-CM) code for SAH. Multivariable logistic regression analyses and Cox proportional hazard regression analyses are used to measure the association of weekend admission on mortality for patients with SAH, adjusted for differences in patient characteristics that also contribute to mortality risk. Weekend admissions occurred among 27.5% of the 5667 patients with SAH in the NIS database. Weekend admission was not a statistically significant independent predictor of death in the SAH study population at 7 days (OR 1.07, 95% CI 0.91-1.25), 14 days (OR 1.01, 95% CI 0.87-1.17), or 30 days (OR 1.03, 95% CI 0.89-1.19). Weekend admission is not associated with significantly increased short-term mortality risk among patients hospitalized with SAH.

Crowley, R., Yeoh, H., Stukenborg, G., Medel, R., Kassell, N., Dumont, A. (2009). Influence of weekend hospital admission on short-term mortality after **intracerebral hemorrhage**. *Stroke*, 40(7), 2387-2392.

A retrospective cohort study was performed of patients with intracerebral hemorrhage extracted from the 2004 Nationwide Inpatient Sample. Multivariable logistic regression analyses and Cox proportional hazards regression were conducted to calculate the odds of death (within 7, 14, and 30 days) and the hazard ratio of death for patients with weekend intracerebral hemorrhage admissions compared with weekday intracerebral hemorrhage admissions. All analyses were adjusted for concurrent differences in length of stay, patient demographics, and comorbid disease. Weekend hospital admissions accounted for 26.8% of

the 13,821 patients with a diagnosis of intracerebral hemorrhage in the National Inpatient Sample. Admission during the weekend was a statistically significant independent predictor of death within 7 days (OR, 1.14; 95% CI, 1.05 to 1.25), within 14 days (OR, 1.15; 95% CI, 1.05 to 1.25), and within 30 days (OR, 1.15; 95% CI, 1.05 to 1.25). The adjusted hazard of in-hospital death (hazard ratio, 1.12; CI, 1.05 to 1.20) indicates that the overall risk of in-hospital death with intracerebral hemorrhage is 12% higher with weekend admission. Weekend admission for intracerebral hemorrhage was associated with increased risk-adjusted mortality when compared with admission during the remainder of the week.

Cubeddu, R., Cruz-Gonzalez, I., Kiernan, T., Truong, Q., Rosenfield, K., Leinbach, R., et al. (2009).

ST-elevation myocardial infarction mortality in a major academic center "on-" versus "off-" hours. *The Journal of Invasive Cardiology*, 21(10), 518-523.

This study was conducted in a tertiary hospital where primary percutaneous coronary intervention (PCI) is routinely performed in all patients with ST-elevation myocardial infarction (STEMI). Patients admitted during on-hours (Monday through Friday 7 am-7 pm) where compared to off-hours patients (including weekends). The primary endpoint of in-hospital mortality, cardiogenic shock and recurrent MI was examined. A second analysis that excluded STEMI transfers, in-hospital mortality and reperfusion times was examined. Between 2003 and 2007, 747 STEMI patients (46% on-hours vs. 56% off-hours) underwent primary PCI. Demographic characteristics were similar between on- and off-hours groups. However, off-hours STEMI admissions had significantly greater in-hospital mortality rates (8% vs. 3.7%; $p = 0.01$) and higher rates of cardiogenic shock (37% vs. 24%; $p = 0.0001$). Admission arrival time was an independent predictor of in-hospital mortality (hazard ratio [HR] 3.98, 95% confidence interval [CI] 1.10-14.38; $p = 0.035$). Longer door-to-balloon times (DTB) were observed during off-hours (134 vs. 109 minutes; $p < 0.0001$), even after

excluding the transfer population (63 vs. 89 minutes; $p < 0.0001$). Higher rates of in-hospital mortality and cardiogenic shock may be expected in STEMI patients admitted during off-hours, even when primary PCI is performed. Longer DTB times during off-hours may partially explain our findings. Strategies to optimize reperfusion time during off-hours, including perhaps a 24/7 in-house "STEMI team" may be necessary.

Horwich, T., Hernandez, A., Liang, L., Albert, N., Labresh, K., Yancy, C., et al. (2009). Weekend hospital admission and discharge for **heart failure**: association with quality of care and clinical outcomes. *American Heart Journal*, 158(3), 451-458.

This study investigates the association of weekend compared to weekday heart failure (HF) admissions and discharges with quality of care and weekend versus weekday HF admissions with length of stay (LOS) and mortality in the hospital. Data were analyzed for 81,810 HF admissions at 241 sites participating in Get With the Guidelines (GWTG)-HF from January 2005 to September 2008. The cohort was stratified by weekend versus weekday admission and discharge. Generalized estimating equations adjusted for patient and hospital characteristics and clustering. Mean age was 72 +/- 14 years; left ventricular ejection fraction (LVEF) was 39+/-17%. Inhospital mortality was 3.0% and median LOS 4 days. Weekend HF admission compared to weekday admission was associated with slightly higher risk-adjusted odds of longer inpatient LOS (1.03 [1.01-1.05] and increased inpatient mortality (1.13 [1.02-1.27]). Risk-adjusted LOS was slightly longer and mortality moderately higher for weekend HF admissions.

Laupland, K., Ball, C., Kirkpatrick, A. (2009). Hospital mortality among **major trauma victims** admitted on weekends and evenings: a cohort study. *Journal of Trauma Management and Outcomes*, 3, 8.

All victims of major trauma admitted to all four major acute care hospitals in the Calgary Health Region between April 1, 2002 and March 31, 2006 were included. Clinical and outcome information was obtained from regional databases. Weekends were defined as anytime Saturday or Sunday, evenings as 18:00-22:59, and nights as 23:00-07:59. Four thousand patients were included; 2,901 (73%) were male, the median age was 39.5 [interquartile range (IQR), 22.4-58.2] years, and the median injury severity score (ISS) was 20 (IQR, 16-26). Thirty-five percent (1,405) of patients were admitted on a weekend, 30% (1,197) during evenings, and 36% (1,422) at night. Seventy-eight percent (3,106) of cases presented during the "after hours" (evenings, nights, and/or weekends). The in-hospital case-fatality rate was 447 (11%), and was not significantly different during daytime (165/1,381; 37%), evening (128/1,197; 30%), and night (154/1,422; 36%) admissions ($p = 0.53$), or among patients admitted on weekends as compared to weekdays (157/1,405; 11% vs. 290/2,595; 11%; $p = 1.0$). Admission during the after hours as compared to business hours (343/3,106; 11% vs. 104/894; 12%; $p = 0.63$) did not increase risk. A multivariable logistic regression model was developed to assess factors associated with in-hospital death ($n = 3,891$). Neither admission on weekends nor on evenings or nights increased the risk for in-hospital mortality. In our region, the time of admission during the day or day of the week does not influence the risk for adverse outcome and may reflect our highly developed multi-hospital acute care and trauma system.

Meynaar, I., van der Spoel, J., Rommes, J., van Spreuwel-Verheijen, M., Bosman, R., Spronk, P. (2009). Off hour admission to an **intensivist-led ICU** is not associated with increased mortality. *Critical Care*, 13(3), R84.

This retrospective multicentre cohort study was carried out in three non-academic teaching hospitals in the Netherlands. All consecutive patients admitted to the three ICUs between

2004 and 2007 were included in the study, except for patients who did not fulfill APACHE II criteria (readmissions, burns, cardiac surgery, younger than 16 years, length of stay less than 8 hours). Data were collected prospectively in the ICU databases. Hospital mortality was the primary endpoint of the study. Off hours was defined as the interval between 10 pm and 8 am during weekdays and between 6 pm and 9 am during weekends. Intensivists, with no responsibilities outside the ICU, were present in the ICU during daytime and available for either consultation or assistance on site during off hours. Residents were available 24 hours a day 7 days a week in two and fellows in one of the ICUs. A total of 6725 patients were included in the study, 4553 (67.7%) admitted during daytime and 2172 (32.3%) admitted during off hours. Baseline characteristics of patients admitted during daytime were significantly different from those of patients admitted during off hours. Hospital mortality was 767 (16.8%) in patients admitted during daytime and 469 (21.6%) in patients admitted during off hours ($P < 0.001$, unadjusted odds ratio 1.36, 95% CI 1.20-1.55). Standardized mortality ratios were similar for patients admitted during off hours and patients admitted during daytime. In a logistic regression model APACHE II expected mortality, age and admission type were all significant confounders but off-hours admission was not significantly associated with a higher mortality ($P = 0.121$, adjusted odds ratio 1.125, 95% CI 0.969-1.306). The increased mortality after ICU admission during off hours is explained by a higher illness severity in patients admitted during off hours.

Myers, R., Kaplan, G., Shaheen, A. (2009). The effect of weekend versus weekday admission on outcomes of **esophageal variceal hemorrhage**. *Canadian Journal of Gastroenterology*, 23(7), 495-501.

The objective was to assess the differences in mortality, hospital length of stay (LOS), and costs between patients admitted on weekends versus patients who were admitted on

weekdays. The United States Nationwide Inpatient Sample database was used to identify patients hospitalized for EVH between 1998 and 2005. Differences in mortality, LOS, and costs between patients admitted on weekends and weekdays were evaluated using regression models with adjustment for patient and clinical factors, including the timing of endoscopy. Between 1998 and 2005, 36,734 EVH admissions to 2207 hospitals met the inclusion criteria. Compared with patients admitted on weekdays, individuals admitted on the weekend were slightly less likely to undergo endoscopy on the day of admission (45% versus 43%, respectively; $P=0.01$) and by the second day (81% versus 75%; $P<0.0001$). However, mortality (11.3% versus 10.8%; $P=0.20$) and the requirement for endoscopic therapy (70% versus 69%; $P=0.08$) or portosystemic shunt insertion (4.4% versus 4.7%; $P=0.32$) did not differ between weekend and weekday admissions. After adjusting for confounding factors, including the timing of endoscopy, the risk of mortality was similar between weekend and weekday admissions (OR 1.05; 95% CI 0.97 to 1.14). Although LOS was similar between groups, adjusted hospital charges were 4.0% greater (95% CI 2.3 to 5.8%) for patients hospitalized on the weekend. In patients with EVH, admission on the weekend is associated with a small delay in receiving endoscopic intervention, but no difference in mortality or the requirement for portosystemic shunt insertion. The weekend effect observed for some medical and surgical conditions does not apply to patients with EVH.

Reeves, M., Smith, E., Fonarow, G., Hernandez, A., Pan, W., Schwamm, L. (2009). Off-hour admission and in-hospital **stroke** case fatality in the get with the guidelines-stroke program. *Stroke*, 40(2), 569-576.

The effect of presenting during off-hours, defined as weekends and weeknights (versus weekdays) was analyzed, on in-hospital mortality and on quality of care in the Get With The Guidelines (GWTG)-Stroke program. The data from 187,669 acute ischemic stroke

and 34,845 acute hemorrhagic stroke admissions who presented to the emergency departments of 857 hospitals that participated in the GWTG-Stroke program during the 4-year period 2003 to 2007 was analyzed. The relationship between off-hour presentation and in-hospital case fatality was examined using generalized estimating equation logistic regression adjusting for demographics, risk factors, arrival mode, and hospital characteristics. Half of ischemic stroke admissions and 57% of hemorrhagic stroke admissions presented during off-hours. Among ischemic stroke admissions, the in-hospital case fatality rate was 5.8% for off-hour presentation compared with 5.2% for on-hour presentation ($P < 0.001$). For hemorrhagic stroke admissions, in-hospital case fatality was 27.2% for off-hour presentation compared with 24.1% for on-hour presentation ($P < 0.001$). After adjusting for patient-level and hospital-level factors, presentation during off-hours was significantly associated with higher in-hospital mortality for both ischemic stroke (adjusted OR, 1.09; 95% CI, 1.03 to 1.14) and hemorrhagic stroke admissions (adjusted OR, 1.19; 95% CI, 1.12 to 1.27). Off-hour presentation was associated with an increased risk of dying in-hospital, although the absolute effect was small for ischemic stroke admissions (0.6% difference; number needed to harm=166) and moderate for hemorrhagic stroke (3.1% difference; number needed to harm=32). Reducing the disparity in hospital-based outcomes for admissions that present during off-hours represents a potential target for quality improvement efforts.

Shaheen, A., Kaplan, G., Myers, R. (2009). Weekend versus weekday admission and mortality from gastrointestinal hemorrhage caused by **peptic ulcer disease**. *Clinical Gastroenterology Hepatology*, 7(3), 303-310.

The 1993-2005 U.S. Nationwide Inpatient Sample was used to identify patients hospitalized for UGIB caused by peptic ulceration. Differences in in-hospital mortality between patients

admitted on weekends and weekdays were evaluated by using logistic regression models, adjusting for patient and clinical factors including the timing of upper endoscopy. Between 1993 and 2005, there were 237,412 admissions to 3,166 hospitals for peptic ulcer-related UGIB. Compared with patients admitted on a weekday, those admitted on the weekend had an increased risk of death (3.4% vs 3.0%; adjusted odds ratio [OR], 1.08; 95% confidence interval [CI], 1.02-1.15), higher rates of surgical intervention (3.4% vs 3.1%; OR, 1.09; 95% CI, 1.03-1.15), prolonged hospital stays, and increased hospital charges ($P < .0001$ for all comparisons). Patients admitted on the weekend had a longer mean time to endoscopy (2.21 +/- 0.01 vs 2.06 +/- 0.01 days; $P < .0001$) and were less likely to undergo endoscopy on the day of admission (30% vs 34%; $P < .0001$). After adjusting for the timing of endoscopy, weekend admission remained an independent predictor of increased mortality (OR, 1.12; 95% CI, 1.05-1.20). Patients admitted to hospital on the weekend for peptic ulcer-related hemorrhage have higher mortality and more frequently undergo surgery. Although wait times for endoscopy are prolonged in patients hospitalized on the weekend, this delay does not appear to mediate the weekend effect for mortality.

Tung, Y., Chang, G., Chen, Y. (2009). Associations of physician volume and weekend admissions with **ischemic stroke** outcome in Taiwan: a nationwide population-based study. *Medical Care*, 47(9), 1018-1025.

Nationwide population-based data was used to explore the influences of physician volume and weekend admissions on stroke mortality. All 34,347 ischemic stroke patients admitted in 2005, treated by 2424 physicians practicing in 245 hospitals in Taiwan through Taiwan's National Health Insurance Research Database were analyzed. Multilevel logistic regression analysis was performed after adjustment for patient, physician, and hospital characteristics to explore the individual and combined impact of annual physician volume and annual hospital

volume, as well as the impact of weekend admissions, on 30-day mortality. Higher physician volume, simultaneous contribution of higher physician and higher hospital volume, and weekday admissions were associated with decreased 30-day mortality, after adjusting for patient gender and age, comorbidities, surgery, physician age and specialty, hospital ownership, accreditation level, teaching status, geographic location, regional resources, and competition. Higher physician volume, rather than higher hospital volume is associated with lower 30-day ischemic stroke mortality, but the relationship has become stronger in higher-volume hospitals. Stroke patients admitted on weekends also have a higher mortality than those admitted on weekdays.

Turin, T., Kita, Y., Rumana, N., Sugihara, H., Morita, Y., Tomioka, N., et al. (2009). Incidence, admission and case-fatality of acute **myocardial infarction**: weekend versus weekday in a Japanese population: 16-year results from Takashima AMI Registry (1988-2003). *European Journal of Epidemiology*, 24(2), 93-100.

Day of the week variation in AMI was examined using an entire community covering 16-year AMI registration data from Japan. Data were obtained from the Takashima AMI Registry, which covers a stable population of approximately 55,000 in central Japan. There were 379 registered first ever AMI cases with 121 fatal events within 28 days of onset during 1988-2003. We divided the days into two groups: 'Weekend' (Saturday and Sunday) and 'Weekdays' (Monday to Friday). The incidence rate (per 100,000 person-year), admission rate (per 1,000 days) and 28-day case-fatality rates (per 100 events) as well as corresponding rate ratios were calculated with 95% confidence intervals. The distribution of the day of the week for onset, admission and fatality for all subjects was fairly random in our study population; incidence (chi (2) test, $P = 0.8$), admission (chi (2) test, $P = 0.9$) and case-fatality (chi (2) test, $P = 0.8$). The incidence, admission, and case-fatality rates were similar

for the 2 day-groups. The incidence rate ratio 1.06 (95% CI: 0.9-1.3), admission ratio 1.03 (95% CI: 0.8-1.3), and case-fatality ratio 1.18 (95% CI: 0.7-1.9) showed no significant risk difference between weekend and weekday. After various adjustments, hazard ratio for weekend AMI in reference to weekday AMI was 1.07 (95% CI: 0.5-2.1). There were no obvious differences in occurrence, hospital admission and acute outcome for AMI patients in the weekday or weekend.

Uyarel, H., Ergelen, M., Akkaya, E., Ayhan, E., Demirci, D., Gul, M., et al. (2009). Impact of day versus night as intervention time on the outcomes of primary angioplasty for **acute myocardial infarction**. *Catheterization and Cardiovascular Interventions*, 74(6), 826-834.

2,644 consecutive patients in Turkey with STEMI (mean age 56.7 +/- 11.9, years, 2,188 male) undergoing primary percutaneous coronary intervention (PCI) between October 2003 and March 2008 were retrospectively enrolled into this study (single high-volume center: >3,000 PCIs/year). Day time was defined according to intervention between 08:00 am and 06:00 pm and night as intervention time between 06:00 pm and 08:00 am. 1,141 patients (43.2%) were treated during the day and 1,503 (56.8%) at night. The baseline characteristics of both groups were similar except for more frequent hypertension (42.6 vs. 36.5%; P = 0.002), women (19.7 vs. 15.4%; P = 0.003), and old (> or =75 y) patients (9.6 vs. 7.4; P = 0.046) in the day time group. Compared with those treated during night time, day time patients had longer angina-reperfusion times (mean, 205 vs. 188 minutes, P = 0.016). Door-to-balloon times were similar (P = 0.87), and less than 90 minutes in both groups. There were no differences concerning clinical events and PCI success between the two groups. Hospital mortality was 6.1% during the day and 5.2% during the night (OR 0.98, 95% CI 0.7-1.36; P = 0.89). The median follow-up time was 21 months. The Kaplan-Meier survival plot for long-term cardiovascular death was not different for both groups (P = 0.78). In-hospital and long-term cardiovascular

mortality was also similar in shock and nonshock subgroups. Primary PCI can be performed safely during the night at a high-volume PCI center with suitable and effective organization of cardiology department and catheterization laboratory with 24 hours per day, 7 days per week onsite staffing.

2008

Arslankoylu, A., Bayrakci, B., Oymak, Y. (2008). Admission time and mortality rates. *Indian Journal of Pediatrics*, 75(7), 691-694.

The objective of this study was to determine whether there are any associations between time of admission and mortality rates in the **pediatric intensive care** unit in Turkey.

Retrospectively 210 consecutive admissions to the PICU from November 2005 to April 2006 for patients aged 1 month to 18 yr were analyzed. There was no significant difference for overall mortality rates between weekend and weekday admissions (12.2% vs 17.4%, $p=0.245$), and daytime and evening admissions (11.3 % vs 15.4%, $p=0.254$). There was also no significant difference between different admission times for within 24 hours, 48 hours and 72 hours mortality rates. In respect of the overall mortality rates, it can be said that in a closed system PICU management under the control of a pediatric intensivist there is no association between time of admission and mortality rates.

Berger, A., Stauffer, J., Radovanovic, D., Urban, P., Bertel, O., Erne, P. (2008). Comparison of in-hospital mortality for acute **myocardial infarction** in Switzerland with admission during routine duty hours versus admission during out of hours (insight into the AMIS plus registry). *American Journal of Cardiology*, 101(4), 422-427.

To improve long-term survival, prompt revascularization of the infarct-related artery should be done in patients with acute myocardial infarction (AMI); therefore, a large proportion of these patients would be hospitalized during out of hours. The clinical effects of out-of-hours AMI management were already questioned, with conflicting results. The purpose of this investigation was to compare the in-hospital outcome of patients admitted for AMI during out of hours and working hours. All patients with AMI included in the AMIS Plus Registry from January 1, 1997, to March 30, 2006, were analyzed. The working-hours group included

patients admitted from 7 a.m. to 7 p.m. on weekdays, and the out-of-hours group included patients admitted from 7 p.m. to 7 a.m. on weekdays or weekends. Major cardiac events were defined as cardiovascular death, reinfarction, and stroke. The study primary end points were in-hospital death and major adverse cardiac event (MACE) rates. A total of 12,480 patients met the inclusion criteria, with 52% admitted during normal working hours, and 48%, during out of hours. Patients admitted during weekdays included more women (28.1% vs 26%; $p = 0.009$), older patients (65.5 +/- 13 vs 64.1 +/- 13 years; $p = 0.0011$), less current smokers (40.1% vs 43.5%; $p < 0.001$), and less patients with a history of ischemic heart disease (31.5% vs 34.5%; $p = 0.001$). A significantly higher proportion of patients admitted during out of hours had Killip's class III and IV. No differences in terms of in-hospital survival rates between the 2 groups (91.5% vs 91.2%; $p = 0.633$) or MACE-free survival rates (both 88.5%; $p = 1.000$) were noted. In conclusion, the outcome of patients with AMI admitted out of hours was the same compared with those with a weekday admission. Of predictors for in-hospital outcome, timing of admission had no significant influence on mortality and/or MACE incidence.

Chan, P., Krumholz, H., Nichol, G., Nallamothu, B. (2008). **Delayed time to defibrillation** after in-hospital cardiac arrest. *New England Journal of Medicine*, 358(1), 9-17.

6789 patients who had cardiac arrest due to ventricular fibrillation or pulseless ventricular tachycardia were identified at 369 hospitals participating in the National Registry of Cardiopulmonary Resuscitation. Using multivariable logistic regression, characteristics associated with delayed defibrillation were identified. The association between delayed defibrillation (more than 2 minutes) and survival to discharge after adjusting for differences in patient and hospital characteristics was examined. Characteristics associated with delayed defibrillation included black race, noncardiac admitting diagnosis, and occurrence of cardiac

arrest at a hospital with fewer than 250 beds, in an unmonitored hospital unit, and during after-hours periods (5 p.m. to 8 a.m. or weekends). Delayed defibrillation was associated with a significantly lower probability of surviving to hospital discharge (22.2%, vs. 39.3% when defibrillation was not delayed; adjusted odds ratio, 0.48; 95% confidence interval, 0.42 to 0.54; $P < 0.001$).

Cho, S., Hwang, J., Kim, J. (2008). **Nurse staffing** and patient mortality in intensive care units.

Nursing Research, 57(5), 322-330.

Research evidence suggests that nurse staffing influences patient outcomes. The objective was to examine the relationship between nurse staffing and patient mortality in Korean intensive care units (ICUs). Using survey and administrative databases, this study included 27,372 ICU patients discharged from 42 tertiary and 194 secondary hospitals. Ownership (public vs. private), location (metropolitan city vs. province), size, specialization of ICUs (specialized vs. mixed), physician staffing and nurse staffing, and years of nurse experience were included as hospital and ICU characteristics. Nurse staffing was measured as the ratio of average daily census to the total number of full-time equivalent registered nurses in ICUs. Age, gender, 26 categories of primary diagnoses, 16 groups of co-morbid conditions, and source of payment were used for risk adjustment. Mortality was defined as deaths that occurred in the hospital or on the date of hospital discharge. Using SAS GLIMMIX procedures, multivariate logistic regression analysis was employed separately for tertiary and secondary hospitals. In tertiary hospitals, a greater likelihood of dying was found among patients who were admitted to a mixed ICU (odds ratio [OR] = 1.61, 95% confidence interval [CI] = 1.14-2.26) and where there was no board-certified physician present for 4 or more hours per day (OR = 1.56, 95% CI = 1.20-2.01). In secondary hospitals, every additional patient per RN was associated with a 9% increase in the odds of dying (OR = 1.09, 95% CI = 1.04-1.14). Nurse experience had no

significant relationship with mortality. Nurse and physician staffing and specialization of ICUs impacted patient mortality. Associations differed in tertiary and secondary hospitals. Further investigation of the impact of organizational environments in ICUs is needed.

Fonarow, G., Abraham, W., Albert, N., Stough, W., Gheorghiade, M., Greenberg, B., et al. (2008).

Day of admission and clinical outcomes for patients hospitalized for **heart failure**: findings from the Organized Program to Initiate Lifesaving Treatment in Hospitalized Patients With Heart Failure (OPTIMIZE-HF). *Circulation. Heart Failure*, 1(1), 50-57.

A total of 259 US hospitals participating in the Organized Program to Initiate Lifesaving Treatment in Hospitalized Patients With Heart Failure (OPTIMIZE-HF) submitted data on 48,612 patients with HF. Sixty- to 90-day post-discharge follow-up data were collected prospectively in a pre-specified 10% sample. Day of admission and discharge, demographic, medical history, medication use, laboratory, and in-hospital procedure data for their association with hospital LOS and death rate were analyzed. Patient characteristics were similar for weekday and weekend presentation. LOS was a median of 4.0 days and a mean of 5.7 \pm 5.7 days; in-hospital death rate was 3.8%. In-hospital and post-discharge risk of death were similar for each day of the week in the hospital and follow-up cohorts, respectively. LOS, however, was significantly influenced by day of admission, even after adjustment for other LOS risk factors. The shortest LOS by admission day of the week was Tuesday (5.39 days), and the longest was Friday (5.88 days; $P < 0.001$). No differences in death rate by day of admission or discharge for HF hospitalizations were evident. Hospitalizations for HF on Thursday and Friday were associated with prolonged LOS. Understanding the factors responsible for the increased LOS and potential adjustments in staffing to facilitate weekend discharges may improve the efficiency of HF hospital care.

Glaser, R., Naidu, S., Selzer, F., Jacobs, A., Laskey, W., Srinivas, V., et al. (2008). Factors associated

with poorer prognosis for patients undergoing primary **percutaneous coronary intervention** during off-hours: biology or systems failure? *JACC Cardiovascular Interventions*, 1(6), 681-688.

Clinical, angiographic, and procedural characteristics were compared in consecutive patients (n = 685) undergoing primary percutaneous coronary intervention (PCI) in the National Heart, Lung, and Blood Institute Dynamic Registry between 1997 and 2006 that were classified as occurring during routine-hours (07:00 to 18:59) or off-hours (19:00 to 06:59). The primary end points were in-hospital death, MI, and target vessel revascularization. Median time from symptom onset to PCI was similar (off-hours 3.4 h vs. routine-hours 3.3 h). Patients presenting in off-hours were more likely to present with cardiogenic shock and multivessel coronary artery disease but were equally likely to present with complete occlusion of the infarct-related artery. Procedural complications including dissection were more frequent in off-hours patients. In-hospital death, MI, and target vessel revascularization were significantly higher in off-hours patients (adjusted odds ratio [OR]: 2.66, p = 0.001), and differences in outcomes were worse even if the procedure was immediately successful (adjusted OR: 2.58, p = 0.005, adjusting for angiographic success). Patients undergoing PCI on weekends had better outcomes during the daytime than nighttime. Patients undergoing primary PCI for acute MI during off-hours are at significantly higher risk for in-hospital death, MI, and target vessel revascularization. These findings appear related to both diurnal differences in presentation and lesion characteristics, as well as differences in procedural complication and success rates that extend beyond differences in symptom-to-balloon time.

Hanane, T., Keegan, M., Seferian, E., Gajic, O., Afessa, B. (2008). The association between **nighttime transfer from the intensive care unit** and patient outcome. *Critical Care Medicine*, 36(8), 2232-2237.

Data was collected from three intensive care units of a tertiary care medical center. It was prospectively collected information from the Acute Physiology and Chronic Health Evaluation III database of 11,659 patients transferred from the ICU to the regular ward. Based on the time of transfer, patients who were transferred from the ICU to the regular ward were categorized into daytime (7:00 am-6:59 pm) and nighttime (7:00 pm-6:59 am) transfers. Patients who were transferred to other ICUs or other facilities, died in the ICU, were discharged home, or did not authorize their medical records to be reviewed for research were excluded. Only the first ICU admission of each patient was considered for outcome analysis. Of the 11,659 study patients, 418 (3.6%) were transferred at night. The first ICU day predicted mortality rate and the last ICU day Acute Physiology Score and Acute Physiology and Chronic Health Evaluation III scores in the nighttime transfer group were higher compared with the daytime transfers. The hospital mortality rate of the nighttime transfers was 5.3% compared with 4.5% of the daytime transfers ($p = 0.478$). There was no statistically significant difference between the two groups in severity adjusted hospital mortality rate. The ICU readmission rate of the nighttime transfers was higher (12.2% compared with 9.0%, $p = 0.027$) and the median (interquartile range) hospital length of stay longer (8 [5-15] vs. 7 [4-13] days, $p = 0.013$) compared with the daytime transfer group. The study did not find an association between nighttime ICU discharge and hospital mortality. However, the ICU readmission rate was higher and the hospital length of stay longer in the nighttime transfer group.

Holmes, D., Bell, M., Gersh, B., Rihal, C., Haro, L., Bjerke, C., et al. (2008). Systems of care to improve timeliness of reperfusion therapy for **ST-segment elevation myocardial infarction** during off hours: the Mayo Clinic STEMI protocol. *JACC Cardiovascular Interventions*, 1(1), 88-96.

The Mayo ST-segment elevation myocardial infarction (STEMI) protocol was implemented in May 2004 to optimize timeliness of reperfusion therapy for STEMI patients presenting to Saint Mary's Hospital, a tertiary facility with on-site percutaneous coronary intervention (PCI), and for those presenting to 28 regional hospitals located up to 150 miles away from Saint Mary's Hospital. We compared door-to-balloon times and door-to-needle times for 597 consecutive patients who presented during off hours (weekdays from 5 pm to 7 am and any time on weekends or holidays) versus regular hours (weekdays from 7 am to 5 pm). In 2003, prior to implementing the protocol, median door-to-balloon time at Saint Mary's Hospital was 85 min during regular hours and 98 min during off hours. Among 258 patients who presented to Saint Mary's Hospital, median door-to-balloon time was 65 min during regular hours versus 74 min during off hours ($p = 0.085$). Among 105 patients transferred from regional hospitals for primary PCI, median door-to-balloon time was 118 min during regular hours versus 114 min during off hours ($p = 0.15$). Among 131 patients treated with fibrinolytic therapy at regional hospitals, median door-to-needle time was 21 min during regular hours versus 26 min during off hours ($p = 0.067$). The Mayo Clinic STEMI protocol demonstrates the rapid times that can be achieved through coordinated systems of care for STEMI patients presenting during off hours and regular hours.

Jneid, H., Fonarow, G., Cannon, C., Palacios, I., Kilic, T., Moukarbel, G., et al. (2008). Impact of time of presentation on the care and outcomes of **acute myocardial infarction**. *Circulation*, 117(19), 2502-2509.

Using a contemporary national clinical registry, we examined differences in medical care and in-hospital mortality among AMI patients admitted during regular hours (weekdays 7 am to 7 pm) versus off-hours (weekends, holidays, and 7 pm to 7 am weeknights). The study cohort included 62,814 AMI patients from the Get With the Guidelines-Coronary Artery

Disease database admitted to 379 hospitals throughout the United States from July 2000 through September 2005. Overall, 33,982 (54.1%) patients arrived during off-hours. Compared with those arriving during regular hours, eligible off-hour patients were slightly less likely to receive primary percutaneous coronary intervention (adjusted odds ratio [OR], 0.93; 95% confidence interval [CI], 0.89 to 0.98), had longer door-to-balloon times (median, 110 versus 85 minutes; $P < 0.0001$), and were less likely to achieve door-to-balloon ≤ 90 minutes (adjusted OR, 0.34; 95% CI, 0.29 to 0.39). Arrival during off-hours was associated with slightly lower overall revascularization rates (adjusted OR, 0.94; 95% CI, 0.90 to 0.97). No measurable differences, however, were found in in-hospital mortality between regular hours and off-hours in the overall AMI, ST-elevated MI, and non-ST-elevated MI cohorts (adjusted OR, 0.99; 95% CI, 0.93 to 1.06; adjusted OR, 1.05; 95% CI, 0.94 to 1.18; and adjusted OR, 0.97; 95% CI, 0.90 to 1.04, respectively). Similar observations were made across most age and sex subgroups and with an alternative definition for arrival time (weekends/holidays versus weekdays). Despite slightly fewer primary percutaneous coronary interventions and overall revascularizations and significantly longer door-to-balloon times, patients presenting with AMI during off-hours had in-hospital mortality similar to those presenting during regular hours.

Krüth, P., Zeymer, U., Gitt, A., Jünger, C., Wienbergen, H., Niedermeier, F., et al. (2008). Influence of presentation at the weekend on treatment and outcome in **ST-elevation myocardial infarction** in hospitals with catheterization laboratories. *Clinical Research in Cardiology: The Official Journal of the German Cardiac Society*, 97(10), 742-747.

Data of the prospective MITRA-PLUS registry of 11,516 patients in Germany with ST-elevation myocardial infarction (STEMI) admitted to hospitals with catheterization facilities for differences of in-hospital mortality between patients admitted during regular working

hours, at night and on weekends. was analyzed. The pre-hospital delay and "door-to-balloon"-time were significantly longer on weekends and at nights than at regular working hours (median 196 Vs. 240 Vs. 155 min; $P < 0.0001$; 60 Vs. 84 min at weekends, resp. 75 min at nights; $P < 0.0001$). Reperfusion therapy was performed in 72.8% (8,248/11,332) patients, and there were less patients treated on weekend versus "on"-hours (69.7 Vs. 77 %, $P < 0.0001$). On weekends we found a significant higher in-hospital mortality (11.1 Vs. 9.4%, $P = 0.01$) and at night there was a trend to higher in-hospital mortality when compared with regular working hours (10.6 Vs. 9.4%, $P = 0.07$). In patients with STEMI admitted to hospitals with catheterization facilities, admission during the "off"-hours is associated with higher in-hospital mortality. This may be due to lower rates of revascularization therapy and longer pre-hospital and in-hospital delays as compared to "on"-hours.

Laupland, K., Shahpori, R., Kirkpatrick, A., Stelfox, H. (2008). Hospital mortality among adults admitted to and discharged from **intensive care** on weekends and evenings. *Journal of Critical Care Medicine*, 23(3), 317-324.

All adults admitted to ICUs in the Calgary Health Region, Alberta, Canada, during 2000 to 2006 were included. The in-hospital mortality risk was assessed with admissions or discharges on weekdays (Monday to Friday) and daytime (8:00 am to 5:59 pm) as compared with weekends (Saturday and Sunday) and nights (6:00 pm to 7:59 am). Intensive care unit admissions ($n = 20,466$) occurred during weekends in 18%, nights in 41%, and nights and/or weekends in 49%. Among the 17,864 survivors to ICU discharge, 26% were discharged on weekends, 21% at night, and 41% on nights and/or weekends. Increased crude mortality rates were associated with both admission (24% vs 14%, $P < .0001$) and discharge (12% vs 5%, $P < .0001$) during nights as compared with days. Admission to (26% vs 16%, $P < .0001$) but not discharge from (6% vs 7%, $P = .42$) ICU during weekends as compared with

weekdays was associated with increased mortality. After controlling for confounding variables using logistic regression analyses, neither weekend admission nor discharge was associated with death. However, both night admission and discharge were independently associated with mortality. Our observations of excess risk associated with admission to or discharge from ICU at night merits further exploration as to whether it may reflect inconsistencies in care after hours.

Lee, K., Ng, I., Ang, B. (2008). Outcome of **severe head injured patients** admitted to intensive care during weekday shifts compared to nights and weekends. *Annals of the Academy of Medicine, Singapore*, 37(5), 390-396.

This study was undertaken to investigate the demographic profile, medical interventions and outcome of severe head injury patients stratified according to day and time of admission to a specialized neurosciences intensive care unit (NICU). This was a retrospective study using a prospectively maintained severe head injury database in a tertiary hospital. Admissions to the NICU were grouped into weekdays, weeknights and weekends. A total of 838 severe head injury patients admitted to NICU were included in the study, of which 263 were admitted on weekdays, 327 on weeknights and 248 on weekends. More patients were admitted during the night (496) compared to during the day (342). There were no significant differences in the demographic profile, mechanism of injury, severity of injury, need for neurosurgical intervention, and duration of mechanical ventilation, intensive care unit (ICU) stay and mortality associated with day and time of admission. In multivariate analyses controlling for confounding factors, no statistically significant difference in ICU mortality was found with the day and time of admission. There were more severe head injury patients admitted to ICU at night and on weekends, with no significant difference in demographic profile, types of injuries, need for neurosurgical interventions and duration of ICU stay and mortality in a

specialized NICU with adequate staffing and requisite diagnostic and therapeutic modalities available.

Numa, A., Williams, G., Awad, J., Duffy, B. (2008). After-hours admissions are not associated with increased risk-adjusted mortality in **pediatric intensive care**. *Intensive Care Medicine*, 34(1), 148-151.

The objective was to examine the influence of time of admission on risk-adjusted mortality and length of stay for non-elective patients admitted to a pediatric intensive care unit (ICU) without 24-h per day in-house intensivist coverage in Australia. Data analyzed came from a comprehensive, prospectively collected ICU database. A 12-bed pediatric ICU located in a university-affiliated tertiary referral children's hospital. Subjects consisted of 4,456 consecutive non-elective patients admitted over a 10-year period (1997-2006). Patients were categorized according to time of admission to the ICU as either in-hours (0800-1800 Monday-Friday and 0800-1200 on weekends), when an intensivist is present in the ICU, or after-hours (all other times), when intensivists attend only on an as-needed basis. Multivariate logistic regression was used to assess the effect of time of admission on outcome after adjustment for severity of illness using the Paediatric Index of Mortality (PIM). Patients admitted after hours had a lower risk-adjusted mortality than those admitted during normal working hours, with an odds ratio for death of 0.712 (95% confidence interval 0.518-0.980, $p = 0.037$). Length of stay was also significantly shorter for patients admitted after hours (44.05h vs. 50.0h, $p = 0.001$). A lack of in-house intensivist presence is not associated with any increase in mortality or length of stay for patients admitted to our pediatric ICU; on the contrary, after-hours admission in this cohort was associated with a decreased risk-adjusted mortality and a shorter length of stay.

Peberdy, M., Ornato, J., Larkin, G., Braithwaite, R., Kashner, T., Carey, S., et al. (2008). Survival

from **in-hospital cardiac arrest** during nights and weekends. *JAMA: Journal of the American Medical Association*, 299(7), 785-792.

The survival from cardiac arrest was examined in hourly time segments, defining day/evening as 7:00 am to 10:59 pm, night as 11:00 pm to 6:59 am, and weekend as 11:00 pm on Friday to 6:59 am on Monday, in 86,748 adult, consecutive in-hospital cardiac arrest events in the National Registry of Cardiopulmonary Resuscitation obtained from 507 medical/surgical participating hospitals from January 1, 2000, through February 1, 2007. The primary outcome of survival to discharge and secondary outcomes of survival of the event, 24-hour survival, and favorable neurological outcome were compared using odds ratios and multivariable logistic regression analysis. Survival rates from in-hospital cardiac arrest are lower during nights and weekends, even when adjusted for potentially confounding patient, event, and hospital characteristics.

Shulkin, D. (2008). Like night and day-shedding light on **off-hours care**. *New England Journal of Medicine*, 358(20), 2091-2093.

A CEO makes late night administration rounds to improve communication with staff and challenges his colleagues to do the same. He feels close attention should be paid to the needs of the patients and their families, any procedural and communications issues among staff members, and most important, the quality dialogue between administration and staff members regarding the organization's inpatient service and safety priorities.

Turin, T., Kita, Y., Rumana, N., Ichikawa, M., Sugihara, H., Morita, Y., et al. (2008). Case fatality of **stroke** and day of the week: is the weekend effect an artifact? Takashima stroke registry, Japan (1988-2003). *Cerebrovascular Diseases*, 26(6), 606-611.

Data were obtained from Takashima Stroke Registry in central Japan. There were 1,578 registered first-ever cerebral infarction and cerebral hemorrhage stroke cases during 1988-

2003. We divided the days into 2 groups: 'weekend' and 'weekdays'. The 7-day and 28-day case fatality rates and 95% confidence intervals (95% CI) were calculated by gender, age and stroke subtype. For all strokes, the 7-day case fatality rate based on the hospital admission day was 9.5% (95% CI: 6.8-13.1) for weekend admissions and 7.3% (95% CI: 6.0-8.9) for weekday admissions. However, case fatality rates based on the onset day were 7.2% (95% CI: 5.1-10.0) for weekend onset and 8.0% (95% CI: 6.6-9.8) for weekday onset. The 28-day case fatality rate for the weekend admission group was 14.7% (95% CI: 11.3-18.8) and for the weekday admission group it was 10.1% (95% CI: 8.5-11.9). In contrast, the 28-day case fatality rate for the weekend onset group was 11.3% (95% CI: 8.6-14.7) and for the weekday onset group it was 11.0% (95% CI: 9.3-13.0). This phenomenon was observed mainly for cerebral infarction and to some extent for cerebral hemorrhage. Stroke fatality rates based on the day of admission were higher during the weekend than weekdays, although the difference did not reach statistical significance. However, this trend disappeared when the fatality rate was based on the day of onset.

2007

Becker, D. (2007). Do hospitals provide lower **quality care** on weekends? *Health Services Research*, 42(4), 1589-1612.

The primary data are longitudinal, administrative claims for 922,074 elderly, non-rural, fee-for-service Medicare beneficiaries hospitalized with AMI from 1989 to 1998. Ordinary least squares regression were used to estimate the effect of weekend hospitalization on rates of cardiac catheterization, angioplasty, and bypass surgery (in various time periods subsequent to the initial hospitalization), 1-year expenditures and rates of adverse health outcomes in various periods following the AMI admission. Weekend AMI patients are significantly less likely to receive immediate intensive cardiac procedures, and experience significantly higher rates of adverse health outcomes. Weekend admission leads to a 3.47 percentage point reduction in catheterization at 1 day, a 1.52 point reduction in angioplasty, and a 0.35 point reduction in by-pass surgery ($p < .001$ in all cases). The primary effect is delayed treatment, as weekend-weekday procedure differentials narrow over time from the initial hospitalization. Weekend patients experience a 0.38 percentage point ($p < .001$) increase in 1-year mortality and a 0.20 point ($p < .001$) increase in 1-year readmission with congestive heart failure. Weekend hospitalization leads to delayed provision of intensive procedures and elevated 1-year mortality for elderly AMI patients.

Bendavid, E., Kaganova, Y., Needleman, J., Gruenberg, L., Weissman, J. (2007). **Complication rates** on weekends and weekdays in US hospitals. *The American Journal of Medicine*, 120(5), 422-428.

This study analyzed nearly 5 million admissions to determine if patient safety is truly compromised on weekends. Complication rates were determined for specific surgical and obstetric procedures by using the Agency for Healthcare Research and Quality's (AHRQ)

Patient Safety Indicators, with extensive adjustment for comorbid conditions and other confounders. Overall complication rates were modestly but significantly increased for some obstetric indicators and for vascular surgical procedures. The study adds to prior research documenting that patients with an acute myocardial infarction, or other conditions requiring urgent treatment, have increased mortality if admitted on a weekend.

Domínguez-Rodríguez, A., García-González, M., Abreu-González, P. (2007). Outcome of primary angioplasty for ST-segment elevation **myocardial infarction** during routine duty hours versus during off-hours. Results of a single-center in Spain. *International Journal of Cardiology*, 119(2), 227-229.

A circadian variation in the time of onset of ST-segment elevation myocardial infarction (STEMI) with peak in the morning hours has been described. We sought to investigate the impact of circadian patterns on the practice of primary angioplasty in individuals residing in Tenerife Island (Spain). 90 consecutive patients with STEMI were treated in our hospital. All patients were admitted within 6 h from symptom onset. Patients were divided into 2 groups according to the time of treatment: routine duty hours (0800-1800) and off-hours (1800-0800). There were no differences in baseline clinical characteristics or treatment delays between routine duty hours and off-hours patients. There is a significant higher rate of angioplasty failure and in-hospital mortality from 1800 to 0800 h compared to the time range from 0800 to 1800 h. Circadian variations have a profound effect on the practice of primary angioplasty.

Hamilton, P., Eschiti, V., Hernandez, K., Neill, D. (2007). Differences between weekend and weekday **nurse work environments** and patient outcomes: a focus group approach to model testing. *The Journal of Perinatal and Neonatal Nursing*, 21(4), 331-341.

This focus group study was exploratory and descriptive to identify differences between weekend and weekday nurse work environments that might explain higher rates of neonatal mortality among babies born on weekends. The convenience sample consisted of 14 nurses from labor and delivery and neonatal intensive care units in 4 hospitals in 3 Texas cities. Focus group sessions were audiotaped and then transcribed verbatim. Responses were analyzed inductively and then compared to the model of Organizational Support of Nursing Care presented by Aiken, Clarke, and Sloane. The focus group responses fit the model moderately well. However, there were additional constructs found in the data that went beyond the model. Additional constructs included patient need/demand, nurse characteristics/skill level, and external motivating and inhibiting factors. Nurses identified significant differences between weekend and weekday work environments such as less direct supervision and problems getting physician backup for emergencies on weekends. They gave examples where they felt weekend work environments resulted in both negative and positive patient outcomes. The nurses made no real distinction between night shift and weekend environments. The knowledge gained can be used to design effective strategies to improve the process of care and patient outcomes on weekends.

Hutchison, C., Crowe, A., Stevens, P., Harrison, D., Lipkin, G. (2007). Case mix, outcome and activity for patients admitted to intensive care units requiring **chronic renal dialysis**: a secondary analysis of the ICNARC Case Mix Programme Database. *Critical Care*, 11(2), R50.

This report describes the case mix, outcome and activity for admissions to intensive care units (ICUs) of patients who require prior chronic renal dialysis for end-stage renal failure (ESRF), and investigates the effect of case mix factors on outcome. This was a secondary analysis of a high-quality clinical database, namely the Intensive Care National Audit & Research Centre (ICNARC) Case Mix Programme Database, which includes 276,731 admissions to 170 adult

ICUs across England, Wales and Northern Ireland from 1995 to 2004. During the eight year study period, 1.3% (n = 3,420) of all patients admitted to ICU were receiving chronic renal dialysis before ICU admission. This represents an estimated ICU utilization of six admissions (32 bed-days) per 100 dialysis patient-years. The ESRF group was younger (mean age 57.3 years versus 59.5 years) and more likely to be male (60.2% versus 57.9%) than those without ESRF. Acute Physiology and Chronic Health Evaluation II score and Acute Physiology Score revealed greater severity of illness on admission in patients with ESRF (mean 24.7 versus 16.6 and 17.2 versus 12.6, respectively). Length of stay in ICU was comparable between groups (median 1.9 days versus 1.8 days) and ICU mortality was only slightly elevated in the ESRF group (26.3% versus 20.8%). However, the ESRF group had protracted overall hospital stay (median 25 days versus 17 days), and increased hospital mortality (45.3% versus 31.2%) and ICU readmission (9.0% vs. 4.7%). Multiple logistic regression analysis adjusted for case mix identified the increased hospital mortality to be associated with increasing age, emergency surgery and nonsurgical cases, cardiopulmonary resuscitation before ICU admission and extremes of physiological norms. The adjusted odds ratio for ultimate hospital mortality associated with chronic renal dialysis was 1.24 (95% confidence interval 1.13 to 1.37). Patients with ESRF admitted to UK ICUs are more likely to be male and younger, with a medical cause of admission, and to have greater severity of illness than the non-ESRF population. Outcomes on the ICU were comparable between the two groups, but those patients with ESRF had greater readmission rates, prolonged post-ICU hospital stay and increased post-ICU hospital mortality. This study is by far the largest comparative outcome analysis to date in patients with ESRF admitted to the ICU. It may help to inform clinical decision-making and resource requirements for this patient population.

Kostis, W., Demissie, K., Marcella, S., Shao, Y., Wilson, A., Moreyra, A. (2007). Weekend versus weekday admission and mortality from **myocardial infarction**. *New England Journal of Medicine*, 356(11), 1099-1109.

The differences in mortality between patients admitted on weekends and those admitted on weekdays for a first acute myocardial infarction were examined, using the Myocardial Infarction Data Acquisition System. All such admissions in New Jersey from 1987 to 2002 (231,164) were included and grouped in 4-year intervals. There were no significant differences in demographic characteristics, coexisting conditions, or infarction site between patients admitted on weekends and those admitted on weekdays. However, patients admitted on weekends were less likely to undergo invasive cardiac procedures, especially on the first and second days of hospitalization ($P < 0.001$). In the interval from 1999 to 2002 (59,786 admissions), mortality at 30 days was significantly higher for patients admitted on weekends (12.9% vs. 12.0%, $P = 0.006$). The difference became significant the day after admission (3.3% vs. 2.7%, $P < 0.001$) and persisted at 1 year (1% absolute difference in mortality). The difference in mortality at 30 days remained significant after adjustment for demographic characteristics, coexisting conditions, and site of infarction (hazard ratio, 1.048; 95% confidence interval [CI], 1.022 to 1.076; $P < 0.001$), but it became non-significant after additional adjustment for invasive cardiac procedures (hazard ratio, 1.023; 95% CI, 0.997 to 1.049; $P = 0.09$). For patients with myocardial infarction, admission on weekends is associated with higher mortality and lower use of invasive cardiac procedures. Our findings suggest that the higher mortality on weekends is mediated in part by the lower rate of invasive procedures, and we speculate that better access to care on weekends could improve the outcome for patients with acute myocardial infarction.

Luyt, C., Combes, A., Aegerter, P., Guidet, B., Trouillet, J., Gibert, C., et al. (2007). Mortality among patients **admitted to intensive care units** during weekday day shifts compared with "off" hours. *Critical Care Medicine*, 35(1), 3-11.

Retrospective cohort study of data collected prospectively from 23 ICUs located in the Paris metropolitan region, France. Between January 2000 and December 2003, 51,643 patients were admitted to these ICUs. Patients were grouped according to their day and time of admission and compared using univariable and multivariable analyses. Of the 51,643 patients admitted to ICUs, 33,857 (65.6%) were admitted during off hours. These latter patients were less critically ill than those admitted during day shifts, had fewer failed organs, required fewer support procedures, and their crude in-hospital mortality was lower (20.7 vs. 24.5%, $p < .0001$). After adjustment for initial disease severity, in-hospital mortality was not higher for off-hours admissions than weekday day admissions and even remained slightly lower (adjusted odds ratio, 0.93; 95% confidence interval, 0.87-0.98). Admission during off hours is common. In our ICUs, off-hours admissions were not associated with higher mortality and might even be associated with a lower death rate.

Matsui, K., Kojima, S., Sakamoto, T., Ishihara, M., Kimura, K., Miyazaki, S., et al. (2007). Weekend onset of acute **myocardial infarction** does not have a negative impact on outcome in Japan. *Circulation Journal*, 71(12), 1841-1844.

Using the Japanese Acute Coronary Syndrome Study (JACSS) database, this study included 4,805 consecutive patients who were admitted within 48 h of onset of AMI (3,526 [73.4%] patients with weekday onset [Monday through Friday] and 1,279 [26.6%] with weekend onset [Saturday and Sunday]). There were no significant differences between the 2 groups in patient background and clinical features. The proportions of patients who underwent emergency catheterization (88.4% vs 88.0%) and reperfusion therapy (81.5% vs 81.4%) were also

similar. There were no differences between the 2 groups in the in-hospital, 30-day, and 1-year mortality rates. Even after various adjustments, there was no difference in the risk of death associated with weekend versus weekday onset of AMI. There were no obvious differences in outcome for Japanese AMI patients in the weekday- or weekend-onset group, suggesting the quality of the Japanese healthcare system is similar for the entire week.

Obel, N., Schierbeck, J., Pedersen, L., Storgaard, M., Pedersen, C., Sørensen, H., et al. (2007).

Mortality after **discharge from the intensive care** unit during the early weekend period: a population-based cohort study in Denmark. *Acta Anaesthesiologica Scandinavica*, 51(9), 1225-1230.

As a result of a shortage of intensive care capacity, patients may be discharged prematurely early during weekends which may lead to an increased mortality and risk of readmission to intensive care units (ICU). We examined whether discharge from the ICU during the first part of the weekend was associated with an increased mortality and readmission to the ICU. The study was conducted at a university clinic of internal medicine and included all patients admitted for the first time to the ICU, and discharged alive in the period 1 January 2001 to 31 December 2005. Patients were divided in those discharged between 00.00 h Friday and 24.00 h Saturday (weekend group) and those discharged Sunday to Thursday (non-weekend group). The main outcome was time from discharge from the ICU to the combined endpoint death or re-admission to ICU which ever came first. We used Kaplan-Meier analysis and Cox's proportional-hazards regression to compute survival curves and risk ratio estimates. There were 228 patients in the weekend group and 555 patients in the non-weekend group. Crude and adjusted 28-day risk ratio of the combined endpoint was 1.50 [95% confidence interval (CI): 1.15-1.97] and 1.43 (1.09-1.87) in the weekend group. Although an increased risk of death was observed in the weekend group immediately after discharge from the ICU, the

difference in mortality between the two groups had disappeared after 2 years. Medical patients discharged from the ICU early in the weekends seem to have an increased mortality and risk of readmission to the ICU.

Ortolani, P., Marzocchi, A., Marrozzini, C., Palmerini, T., Saia, F., Aquilina, M., et al. (2007).

Clinical comparison of "normal-hours" vs "off-hours" percutaneous coronary interventions for **ST-elevation myocardial infarction**. *American Heart Journal*, 154(2), 366-372.

The objective of this study was to evaluate the mortality rates in ST-elevation myocardial infarction (STEMI) patients undergoing primary percutaneous coronary interventions (PPCI) during "off-hours" in a more recent population of patients with STEMI treated with PPCI in a high-volume tertiary center in Bologna, Italy specifically dedicated to STEMI treatment. We analyzed in-hospital/1-year mortality among 985 consecutive patients with STEMI treated with PPCI between January 2003 and December 2005 in a high-volume (>1400 PCI/year) hub center in a STEMI provincial network organization during "normal-hours" (weekdays 08:00 am to 07:29 pm) and "off-hours" (weekdays 07:30 pm to 07:59 am and weekends). Most (61.2%) patients were treated during "off-hours". Clinical and angiographic characteristics of the "normal-hours" and "off-hours" groups were comparable (in both groups, glycoprotein IIb/IIIa were administered to approximately 80% patients). The off-hours group tended toward higher median (25th-75th percentiles) total ischemic time (199 [135-312] minutes vs 179 [126-285] minutes; $P = .052$). Median electrocardiogram-to-balloon time was less than 90 minutes in both groups. Despite 20 minutes longer median total ischemic time, patients who underwent PPCI during "off-hours" showed similar post-PPCI Thrombolysis in Myocardial Infarction 3 flow grade and mean left ventricular ejection fraction. No difference could be observed between the 2 groups in terms of in-hospital and 1-year mortality rates. This study provides evidence that the clinical effectiveness of "normal" and "off-hours" PPCI can be

equivalent, at least when performed at a center specifically dedicated to STEMI treatment with frequent use of glycoprotein IIb/IIIa agents.

Saposnik, G., Baibergenova, A., Bayer, N., Hachinski, V. (2007). Weekends: a dangerous time for having a **stroke**? *Stroke*, 38(4), 1211-1215.

The aim was to evaluate the impact of weekend admissions on stroke mortality in different settings. All hospital admissions were analyzed for ischemic stroke from April 2003 to March 2004 through the Hospital Morbidity Database. The Hospital Morbidity Database is a national database that contains patient-level sociodemographic, diagnostic, procedural, and administrative information including all acute care facilities across Canada. The major inclusion criterion was admission to an acute care facility with a principal diagnosis of ischemic stroke. Clinical variables and facility characteristics were included in the analysis. Overall, 26,676 patients were admitted to 606 hospitals for ischemic stroke. Weekend admissions comprised 6629 (24.8%) of all admissions. Seven-day stroke mortality was 7.6%. Weekend admissions were associated with a higher stroke mortality than weekday admissions (8.5% vs 7.4%; odds ratio, 1.17; 95% CI, 1.06 to 1.29). Mortality was similarly affected among patients admitted to rural versus urban hospitals or when the most responsible physician was a general practitioner versus specialist. In the multivariable analysis, weekend admissions were associated with higher early mortality (odds ratio, 1.14; 95% CI, 1.02 to 1.26) after adjusting for age, sex, comorbidities, and medical complications. Stroke patients admitted on weekends had a higher risk-adjusted mortality than did patients admitted on weekdays. Disparities in resources, expertise, and healthcare providers working during weekends may explain the observed differences in weekend mortality.

Sheu, C., Tsai, J., Hung, J., Yang, C., Hung, H., Chong, I., et al. (2007). Admission time and outcomes of patients in a **medical intensive care unit**. *Kaohsiung Journal of Medical Sciences*, 23(8), 395-404.

This study in Taiwan aimed to evaluate the effects of admission time and day on patient outcomes in a medical ICU equipped with patient management guide-lines, and staffed by intensivists on call for 24 hours, who led the morning rounds on all days of the week but did not stay in-house overnight. The study enrolled 611 consecutive patients admitted to a 26-bed medical ICU in a university hospital during a 7-month period. We divided them into two groups, which we labeled as "office hours" (08:00-18:00 on weekdays) and "non-office hours" (18:00-08:00 on weekdays, and all times on weekends) according to their ICU admission times. The clinical outcomes were compared between the groups. The effects of admission on weekends, at night, and various days of the week on hospital mortality were also evaluated. Our results showed that there were no significant differences in ICU and hospital mortalities between patients admitted during office hours and those admitted during non-office hours (27.2% vs. 27.4%, $p = 1.000$; 38.9% vs. 37.6%, $p = 0.798$). The ICU length of stay, ICU-free time within 21 days, and length of stay in the hospital were also comparable in both groups. Among the 392 patients requiring mechanical ventilation, the ventilator outcomes were not significantly different between those in the office-hour group and the non-office-hour group. Multivariate logistic regression analyses showed that the adjusted odds of hospital mortality were not significantly higher for patients admitted to our ICU on weekends, at night, or on any days of the week. In conclusion, our results showed that non-office-hour admissions to our medical ICU were not associated with poorer ICU, hospital, and ventilator outcomes, compared with office-hour admissions. Neither were time of day and day of the week admissions to our ICU associated with significant differences in hospital mortality.

Ślonka, G., Gasior, M., Lekston, A., Gierlotka, M., Hawranek, M., Tajstra, M., et al. (2007).

Comparison of results of percutaneous coronary interventions in patients with ST-segment elevation **myocardial infarction** during routine working hours or off-hours. *Kardiologia Polska*, 65(10), 1171-1177.

The aim was to compare the results of percutaneous coronary interventions (PCI) in STEMI patients admitted to hospital during the daytime and off-shift hours and to identify factors which influence prognosis. From January 1998 to October 2003, 1992 patients with STEMI were hospitalised and 1778 of them were treated with immediate PCI, including 482 admitted in the daytime (weekdays 8 a.m. - 3 p.m.; group I) and 1296 during off-shift hours (weekdays 3 p.m. - 8 a.m., weekends and holidays; group II). The clinical characteristics of both groups were similar, except for less frequent hypercholesterolaemia in the daytime group (52.1 vs. 59.7%; $p=0.0041$). There was no significant difference between the groups regarding time from admission to angiography (30 vs. 25 minutes), rates of reocclusion (5.2 vs. 4.9%), stroke (1.4 vs. 1.6%), haemorrhagic complications (8.1 vs. 6.9%), in-hospital mortality (6.8 vs. 6.2%) and long-term (24 months) mortality (13.7 vs. 13.6%) ($p > 0.05$ for all parameters). The rate of stent implantation was significantly higher in the daytime group (71.2 vs. 66.2%; $p=0.047$). The proper organisation of duties of the division of cardiology and the cardiac catheterisation laboratory, with focus on providing onsite staffing of the cardiac catheterisation laboratory around the clock, enables similar results of PCI in patients with ST-segmentelevation myocardial infarction treated during off-shift hours as compared with patients treated during the daytime.

2006

Arabi, Y., Alshimemeri, A., Taher, S. (2006). **Weekend and weeknight admissions** have the same outcome of weekday admissions to an intensive care unit with onsite intensivist coverage.

Critical Care Medicine, 34(3), 605-611.

The objective of this study was to determine whether weekend and nighttime admissions compromise patient outcome in an intensive care unit staffed by an onsite intensivist 24 hrs a day and 7 days a week. This was a cohort study in a tertiary care medical-surgical intensive care unit in Saudi Arabia staffed 24 hrs/7 days by onsite consultant intensivists with predominantly North American Critical Care Board certifications. All emergency admissions over 4 yrs were included (March 1999 to February 2003) from a prospectively collected intensive care unit database. Admissions were grouped into weekday, weeknight, and weekend admissions. Predicted mortality rates were calculated using Mortality Probability Models II0 and II24. The primary outcome was hospital mortality. Standardized mortality ratios were calculated. Secondary end points included intensive care unit mortality, duration of mechanical ventilation, intensive care unit length of stay, and the need for renal replacement therapy, tracheostomy, and pulmonary artery catheter during the intensive care unit course. A total of 2,093 admissions were included in the study, of which 31% were admitted on weekdays, 35% on weeknights, and 34% on weekends. The three groups were similar in baseline characteristics. There was no significant difference in hospital mortality rates among the three time periods (36%, 36%, and 37%, respectively, $p=.90$). There were also no significant differences in any of the secondary end points. In an intensive care unit staffed by onsite certified intensivists 24 hrs/7 days, we found no compromise in the care of patients admitted during weekends and weeknights. These findings suggest that such coverage

helps in ensuring consistency of care and therefore represents a potentially improved model for intensive care unit practice.

Barba, R., Losa, J., Velasco, M., Guijarro, C., García de Casasola, G., Zapatero, A. (2006). Mortality among **adult patients** admitted to the hospital on weekends. *European Journal of Internal Medicine*, 17(5), 322-324.

This study was conducted to assess what independent influence, if any, weekend admission might have on mortality in a hospital in Madrid, Spain. The clinical data of 35,993 adult (>14 years) patients admitted to the emergency department of Fundación Hospital Alcorcón from 1999 to 2003 were analyzed. We compared global mortality and mortality within the first 48 h according to whether the patients were admitted on the weekend or on a weekday. Elective admissions, critical care patients, children under 14 and births were not included. Global mortality was similar in both groups, but mortality within the first 48 h was higher for patients admitted on the weekend (OR 1.40, 95% CI 1.18-1.62, $P < 0.001$), even after controlling for age, gender and comorbidity (weight of diagnosis-related group and Charlson comorbidity index). The risk of mortality within the first 48 h is higher for patients admitted on weekends than for patients admitted on a weekday.

Foss, N., Kehlet, H. (2006). Short-term mortality in **hip fracture** patients admitted during weekends and holidays. *British Journal of Anaesthesia*, 96(4), 450-454.

We examined early postoperative mortality in Denmark in hip fracture patients admitted during weekends and holiday periods, compared with normal weekdays. Prospective, descriptive study in 600 consecutive hip fracture patients treated with a well-defined multimodal care plan, in a specialized hip fracture unit between September 2002 and July 2004. Patients were stratified according to admission on a weekday or during weekends/holiday periods. Results were analysed with univariate and multivariate analyses.

Three hundred and thirty-two patients were admitted during weekdays, 118 during weekends and 150 during holiday periods. Both 5- and 30-day postoperative mortality were significantly higher in patients admitted during holiday periods than during weekends and weekdays, 8.0% vs 2.5% and 1.8%, respectively (P=0.01) and 19.3% vs 12.7% and 11.1%, respectively (P=0.05). In a multivariate analysis, admission during holiday periods was still a significant independent risk factor for both 5-day (4.34, 95% CI 1.74-10.8) and 30-day mortality (1.84, 95% CI 1.08-3.12). Staff reduction during holiday periods in units that care for acute surgical patients may adversely influence postoperative outcome. This may have important consequences both for outcome analysis of interventions and the planning of resource management in surgical units.

Hamilton, P., Restrepo, E. (2006). **Sociodemographic factors** associated with weekend birth and increased risk of neonatal mortality. *Journal of Obstetric, Gynecologic, and Neonatal Nursing: JOGNN/NAACOG*, 35(2), 208-214.

To learn whether weekend risk of neonatal mortality is related to selected sociodemographic factors, a retrospective cohort design with logistic regression was used to obtain odds ratios, and analysis of variance and chi-square to identify differences in values and incidence of key variables. The data were derived from matched Texas birth and infant death certificates from 1999 through 2001. A subset of deaths up to 28 days of life attributable to conditions originating in the perinatal period. These deaths were called neonatal mortality-p. Women who were White, married, had Medicaid assistance, and had private prenatal care were less likely to deliver on weekends. Odds of neonatal mortality-p increased 36.5% when a birth took place on the weekend. The weekend crude odds of neonatal mortality-p increased for all racial/ethnic groups, but the differences were not statistically significant. The likelihood of

delivering on the weekend increases with certain sociodemographic factors. This fact is important because the risk of neonatal mortality is higher among weekend births.

Priestap, F., Martin, C. (2006). Impact of intensive care unit **discharge time** on patient outcome. *Critical Care Medicine*, 34(12), 2946-2951.

Multiple-center, retrospective observational cohort study in Canadian hospitals. A prospectively collected dataset containing information on 79,090 consecutive admissions from 31 Canadian community and teaching hospitals was used. Patients were categorized according to the time of ICU discharge into daytime (07:00-20:59) and nighttime (21:00-06:59). Admissions were excluded if the patients were a) ≤ 16 yrs of age (392); b) admitted following cardiac surgery (6,641); c) admitted following the initial admission for patients readmitted to the ICU within the same hospital stay (3,632); d) admitted due to a lack of available ward or specialty care beds (457); or e) transferred to another acute care facility (7,724). 62,056 patients were discharged to the ward following the initial ICU admission. Of the 47,062 discharges eligible for analyses, 10.1% were discharged at night. The unadjusted odds of death for patients discharged from ICU at night was 1.35 (95% confidence interval, 1.23, 1.49), compared with patients discharged during the daytime. After adjustment for illness severity, source, case-mix, age, gender, and hospital size, the mortality risk was increased by 1.22-fold (95% confidence interval, 1.10, 1.36) for nighttime discharges. Multivariate regression analysis revealed that patients discharged from the ICU at night have a significantly shorter ICU length of stay than those discharged during the day ($p < .001$). Whereas hospital length of stay was similar for daytime and nighttime discharges who survived hospital stay, patients discharged at night who did not survive hospital stay had a significantly shorter hospital length of stay ($p = .002$). Patients discharged from the ICU at night have an increased risk of mortality compared with those discharged during the day.

Tobin, A., Santamaria, J. (2006). **After-hours discharges** from intensive care are associated with increased mortality. *The Medical Journal of Australia*, 184(7), 334-337.

The objective was to investigate the change in pattern of discharge of patients from an intensive care unit (ICU) to hospital wards and to determine the impact of discharge time on subsequent hospital mortality. A retrospective cohort study of 10,903 patients discharged alive from a single ICU between 1 January 1992 and 31 December 2002. The main outcome was in-hospital mortality. Of the 10,903 patients discharged alive from the ICU, 486 (4.5%) died in hospital wards. When discharge times were categorised according to nursing shift (morning, 07:00-14:59; afternoon, 15:00-21:59; and night, 22:00-06:59), patients were more likely to be discharged on an afternoon shift (odds ratio, 3.63; 95% CI, 3.05-4.30) or night shift (4.52; 95% CI, 3.15-6.64) in 2000-2002 compared with 1992-1994. In a multiple logistic model, hospital mortality after discharge from the ICU was increased by higher APACHE II score (1.14; 95% CI, 1.12-1.16); admission to ICU from the operating room (1.47; 95% CI, 1.11-1.95) and from the general ward (1.75; 95% CI, 1.37-2.23); and discharge during the afternoon (1.36; 95% CI, 1.08-1.70) and night shifts (1.63; 95% CI, 1.03-2.57). Over an 11-year period, more patients are being discharged from the ICU in the afternoon and night suggesting increasing pressure on ICU beds. Patients discharged on these shifts have an increased risk of death.

2005

Gould, J., Qin, C., Chavez, G. (2005). **Time of birth** and the risk of neonatal death. *Obstetrics and Gynecology*, 106(2), 352-358.

To assess whether mortality is increased in the United States in infants born at night, we compared case-mix adjusted neonatal mortality for low- and high-risk infants born during the daytime (7 am to 6 pm), early night (7 pm to 12 am), and late night (1 am to 6 am). California linked birth-death certificate data on 3,363,157 infants, weighing more than 500 g and born without lethal congenital anomalies in 1992-1999, were analyzed. Logistic regression, adjusting for birth weight, gender, prenatal care initiation, maternal hypertension, eclampsia, diabetes, and placental abruption/previa, was used to estimate the relationship between neonatal mortality and time of birth. The overall neonatal mortality was 2.08 deaths per 1,000 live births. Neonatal mortality was 1.88 for daytime births, increasing to 2.37 for early night and 2.31 for late night births. After adjusting for case mix, early night births had a 12% increase and late night births a 16% increase in the odds of neonatal death, an excess that accounts for 9.6% of all neonatal deaths. Mortality was increased for night births that were less than 1,500 g or more than 1,500 g, singletons or multiples, and those delivered vaginally or by cesarean. The increased risk was identified in hospitals that provide intermediate, community, and regional neonatal intensive care, but not in hospitals that provide primary care. Identifying the causal factors and reducing the increased burden of mortality for infants born at night should be a major priority for perinatal medicine.

Hasegawa, Y., Yoneda, Y., Okuda, S., Hamada, R., Toyota, A., Gotoh, J., et al. (2005). The effect of weekends and holidays on **stroke** outcome in acute stroke units. *Cerebrovascular Diseases*, 20(5), 325-331.

In almost all acute stroke units in Japan, staffing level is lower on weekends and holidays and rehabilitative services are provided only on weekdays. We sought to investigate the effects of low-volume care early after stroke resulting from weekends and holidays on the outcome of stroke. Patients with completed stroke within 72 h of onset were prospectively registered by 10 acute stroke units in Japan. Main outcome measures were favorable outcomes as indicated by a score of 0-1 on the modified Rankin scale (mRS01) on their 21st hospital day and at discharge and case fatality during the hospital stay. Cox proportional hazards models were used to identify the effects of weekday admission and a weekday ratio (a number of weekdays / total length of hospital stay, or 21 days if hospitalization was longer than 21 days) on the main outcome measures. In a total of 1,134 patients, Cox proportional hazards regression analyses demonstrated that the weekday admission was significantly associated with mRS01 at discharge (hazard ratio, HR: 1.385, 95% CI: 1.087-1.764) and case fatality (HR: 0.477, 95% CI: 0.285-0.798). In 858 patients with rehabilitative therapy, the weekday ratio was significantly associated with mRS01 at discharge ($p = 0.014$). Compared with the lowest tertile of weekday ratio (<66.6%), the highest tertile (>71.4%) was significantly positively associated with mRS01 at discharge (HR: 1.524, 95% CI: 1.053-2.206; $p < 0.026$). Weekday admission was an independent negative predictor of case fatality and a positive predictor of favorable outcome (mRS01) at discharge from acute stroke units. In patients with rehabilitative therapy, a reduction in the weekday ratio was also associated with unfavorable outcome, probably due to a reduction in multidisciplinary care.

Hixson, E., Davis, S., Morris, S., Harrison, A. (2005). Do weekends or evenings matter in a **pediatric intensive care** unit? *Pediatric Critical Care Medicine*, 6(5), 523-530.

The objective was to assess what independent influence, if any, weekend or evening admission to a pediatric intensive care unit (PICU) staffed 24 hrs/day, 7 days/wk by in-

house, board-certified pediatric intensivists might have on mortality. A retrospective study of 5,968 consecutive admissions to the PICU from August 1996 to December 2003 for patients aged 0 days to 21 yrs in a single, 14-bed multidisciplinary PICU at an academic medical center. Standardized mortality ratios of observed-to-predicted mortality were derived with their corresponding p values. Multivariate logistic regression was used to test the independent effect of weekend admission, weekend discharge/death, and evening PICU admission on mortality for the entire sample and, separately, for only emergency admissions, controlling for other significant predictor variables or interaction terms. Overall, crude mortality was significantly higher on the weekend (weekday, 2.2%; weekend, 5.0% [p = .0000]) and in the evening (day, 2.1%; evening, 3.8% [p = .0004]). Assessing the entire sample using multivariate logistic regression, neither weekend admission (p = .146), weekend discharge/death (p = .348), nor evening PICU admission (p = .711) showed a significant relationship with mortality controlling for other significant factors. Limiting the scope to the emergency admissions subset, neither weekend admission (p = .135), weekend discharge/death (p = .278), nor evening PICU admission (p = .867) were significant predictors of mortality. Weekend and evening admissions differed in important ways from weekday and daytime admissions, making simple comparisons of crude mortality rates inappropriate. Weekend and evening admissions were more likely to be emergency, non-operative patients; have a lower Pediatric Risk of Mortality III score but have a higher overall predicted mortality risk; and differ in the distributions of patients by primary diagnosis. Using multivariate logistic regression to control for important clinical differences, neither weekend admission, weekend discharge/death, nor evening admission had a significant independent effect on mortality risk in the entire sample or for the emergency

patient subset. Our findings are consistent with previous work demonstrating the benefit of intensive care units staffed 24 hrs/day, 7-days/wk by in-house, board-certified intensivists.

Keatinge, W., Donaldson, G. (2005). Changes in mortalities and hospital admissions associated with **holidays and respiratory illness**: implications for medical services. *Journal of Evaluation in Clinical Practice*, 11(3), 275-281.

To see whether net mortalities increase during and after reductions in medical services, either at average weekends, or at Christmas when pressure from illness is unusually high. (1) Paired t-tests to compare mean daily deaths and hospital admissions during and after weekends (Saturday-Tuesday) with means for the week, in south-east England; (2) Linear regressions to see whether trends of daily deaths change when admissions are reduced at Christmas. Neither mean daily all-cause, respiratory nor ischaemic heart deaths exceeded weekly averages during weekends, or during Saturday-Monday or Saturday-Tuesday, despite falls in daily elective and daily emergency hospital admissions at weekends that averaged 61-72% and 14-22%, respectively. During 19-24 December, daily deaths were above annual means, respiratory deaths by 49% (29, 1-58), but elective admissions fell and although emergency admissions tended to rise, total admissions rose only for respiratory disease, and only by 33% (376, -47 to 799). On Christmas Day (25 December), even emergency admissions fell sharply below previous trends, respiratory emergency admissions by 18% ($P < 0.01$). Respiratory deaths alone then immediately increased ($P < 0.01$) above trend, by 5.9% (5.8 deaths/day) on 26 December and by 12.9% (12.9) on 27 December. No adverse effect on mortality was apparent within 2 days from reduction in medical services at weekends. However, respiratory deaths accelerated sharply after reduction in elective and emergency admissions at Christmas, when rates of infection and mortality from respiratory

disease were high. Implications for medical services during respiratory epidemics are discussed.

Magid, D., Wang, Y., Herrin, J., McNamara, R., Bradley, E., Curtis, J., et al. (2005). Relationship between time of day, day of week, timeliness of reperfusion, and in-hospital mortality for patients with **acute ST-segment elevation myocardial infarction**. *JAMA: Journal of the American Medical Association*, 294(7), 803-812.

A cohort study of 68,439 patients with ST-segment elevation myocardial infarction (STEMI) treated with fibrinolytic therapy and 33,647 treated with percutaneous coronary intervention (PCI) from 1999 through 2002 were conducted. Patient hospital arrival period was classified into regular hours (weekdays, 7 am-5 pm) and off-hours (weekdays 5 pm-7 am and weekends). Most fibrinolytic therapy (67.9%) and PCI patients (54.2%) were treated during off-hours. Door-to-drug times were slightly longer during off-hours (34.3 minutes) than regular hours (33.2 minutes; difference, 1.0 minute; 95% confidence interval [CI], 0.7-1.4; $P < .001$). In contrast, door-to-balloon times were substantially longer during off-hours (116.1 minutes) than regular hours (94.8 minutes; difference, 21.3 minutes; 95% CI, 20.5-22.2; $P < .001$). A lower percentage of patients met guideline recommended times for door-to-balloon during off-hours (25.7%) than regular hours (47%; $P < .001$). Door-to-balloon times exceeding 120 minutes occurred much more commonly during off-hours (41.5%) than regular hours (27.7%; $P < .001$). Longer off-hours door-to-balloon times were primarily due to a longer interval between obtaining the electrocardiogram and patient arrival at the catheterization laboratory (off-hours, 69.8 minutes vs regular hours, 49.1 minutes; $P < .001$). This pattern was consistent across all hospital subgroups examined. Furthermore, patients presenting during off-hours had significantly higher adjusted in-hospital mortality than patients presenting during regular hours (odds ratio, 1.07; 95% CI, 1.01-1.14; $P = .02$).

Presentation during off-hours was common and was associated with substantially longer times to treatment for PCI but not for fibrinolytic therapy. To achieve the best outcomes, hospitals providing PCI during off-hours should commit to doing so in a timely manner.

Restrepo, E., Hamilton, P. (2005). The role of hospital birth volume in increase **neonatal mortality** among weekend births in Texas. *Obstetrics and Gynecology*, 105(4), 59S-60S.

We obtained matched birth and death certificates for Tarrant County for years 1999 through 2001 (N = 86,438). We calculated birth volume for each of the county's 15 hospitals, merging hospital volume with every birth certificate record. We stratified by volume quartile and used logistic regression to estimate effect of weekend birth on risk for neonatal mortality and found that only in Quartile 3, moderately high-volume hospitals (mean births per year = 1,800), was there a significant increase in crude odds of neonatal mortality among births on weekends (odds ratio 2.562, 95% confidence interval 1.189 –5.368, $P = .016$). Additional analyses were conducted controlling for case-mix covariates and additional hospital quality indicators. Among very low birth weight babies, the neonatal mortality rate was highest in volume quartile 2. Our findings are the adjusted likelihood of complications was higher among high volume and medium-volume groups of hospitals compared with the very– high-volume group. Hospital quality interacts with weekend birth to alter risk of neonatal mortality.

Schmulewitz, L., Proudfoot, A., Bell, D. (2005). The impact of weekends on outcome for **emergency patients**. *Clinical Medicine*, 5(6), 621-625.

Levels of staffing and access to diagnostics at weekends are recognized to be significantly lower than on weekdays. It is unclear if subsequent inpatient mortality and readmission rates for acute medical admissions are increased for weekend admissions compared to those on a weekday. A large Canadian study demonstrated increased weekend mortality but does the

Edinburgh healthcare model support these findings? This study analyzed all hospital admissions in 2001 to the Royal Infirmary of Edinburgh for six predetermined diagnoses (total 3,244): chronic obstructive pulmonary disease, cerebrovascular accidents, pulmonary embolism, pneumonia, collapse and upper gastrointestinal bleed. We compared hospital mortality rates, readmission rates and hospital length of stay for weekend admissions as compared to those on a weekday. Weekend admission was not associated with significantly higher in-hospital mortality, readmission rates or increased length of stay compared to the weekday equivalent for any of the six conditions. The implementation of an acute medical admissions unit in the Royal Infirmary of Edinburgh, with consistent staffing levels and 24-hour access to diagnostics for the early phase of critical illness, may have helped address the discrepancy in care suggested by previous studies.

2004

Arias, Y., Taylor, D., Marcin, J. (2004). Association between evening admissions and higher mortality rates in the **pediatric intensive care unit**. *Pediatrics*, 113(6), e530-534.

The objective was to determine whether an association between the time of admission (weekday versus weekend and daytime versus evening) and the risk of death exists among pediatric patients included in a cohort of children admitted to a national sample of PICUs. Retrospectively a cohort of consecutive admissions to 15 PICUs included in the Pediatric Intensive Care Unit Evaluations database was analyzed. The odds of death were analyzed by using mixed-effects, multivariate, logistic regression, with clustering at the hospital level. The primary independent variables were admission to the PICU on a weekend and admission to the PICU during evening hours. The severity of illness was adjusted by using the Pediatric Risk of Mortality III probability of death score. All 20,547 emergency PICU admissions made between May 1995 and December 2001 were included in the analyses. The primary outcome was death within 48 hours after admission to the PICU. Pediatric patients admitted to the PICU during evening hours had higher odds of death (odds ratio [OR]: 1.28; 95% confidence interval [CI]: 1.00-1.62) than did those admitted during daytime hours. Subgroup analyses revealed higher odds of death among patients admitted with shock (OR: 4.09; 95% CI: 1.65-10.1), with congenital cardiovascular disease (OR: 3.90; 95% CI: 1.37-11.1), or after cardiac arrest (OR: 1.80; 95% CI: 1.04-3.13). There was no association between mortality rates and the day of admission (weekend admissions versus weekday admissions). An increased risk of death exists for some pediatric patients admitted to the PICU during evening hours. It remains necessary to determine whether this finding results from differences in the structure of care, processes of care, or both.

Bell, C., Redelmeier, D. (2004). Waiting for **urgent procedures** on the weekend among emergently hospitalized patients. *The American Journal of Medicine*, 117(3), 175-181.

The use of selected urgent procedures for emergently hospitalized patients were evaluated and measured the time until procedure based upon the day of hospital admission. All acute care admissions from all 190 emergency departments in Ontario, Canada, between 1988 and 1997 were analyzed. Patients (n = 126,754) who underwent one of six pre-specified procedures as their most responsible procedure were selected: fiberoptic bronchoscopy, esophageal gastroduodenoscopy, magnetic resonance imaging, echocardiography, ventilation-perfusion scanning, or coronary angiography. Only 5% (n = 5903) of the urgent procedures were performed on the weekend. Of the six selected procedures, coronary angiography showed the most skewed pattern of performance (1.5% performed on the weekend) and esophageal gastroduodenoscopy showed the least skewed pattern (8% performed on the weekend). Patients admitted on Fridays or Saturdays had the longest waits for procedures. For all six procedures, patients with relatively longer waits had relatively longer total in-hospital stays (P <0.001 for each). Relatively few urgent procedures are performed in emergently hospitalized patients on the weekend, suggesting that greater attention to weekend care might result in more timely interventions and shorter lengths of stay.

Busse, J., Bhandari, M., Devereaux, P. (2004). The impact of time of admission on major complications and mortality in patients undergoing **emergency trauma surgery**. *Acta Orthopaedica Scandinavica*, 75(3), 333-338.

Previous studies have shown a relationship between time of admission to hospital and mortality rates; however, it is uncertain whether such a relationship exists for patients requiring emergency trauma surgery. We included all trauma patients, except those with moderate to severe burns, who presented to a university-affiliated level 1 trauma center in

Canada and underwent surgery, from 1995 until 2001 (n = 1044). We conducted univariate and multivariate analyses in which the dependent variables were in-hospital mortality and major complications, and the independent variables were the time of presentation to the trauma centre (nighttime vs. daytime, weekend vs. weekday, month of year, and year), age, sex, injury severity score, type of operative procedure, and total number of operative procedures. None of the factors related to time of presentation were associated with major complications or mortality. Factors predictive of increased mortality were higher ISS (odds ratio 1.07; 95% confidence interval 1.03-1.08), older age (1.04; 1.03-1.07), operations involving the cardiovascular system (1.7; 1-2.6), "miscellaneous" operative procedures (1.8; 1.1-2.9), and major complications (2.4; 1.4-4.2). Time of presentation for emergency trauma surgery was not associated with differences in major complications or in mortality.

Cram, P., Hillis, S., Barnett, M., Rosenthal, G. (2004). Effects of weekend admission and **hospital teaching** status on in-hospital mortality. *The American Journal of Medicine*, 117(3), 151-157.

The effect of reduced hospital staffing during weekends on in-hospital mortality is not known. We compared mortality rates between patients admitted on weekends and weekdays and whether weekend-weekday variation in rates differed between patients admitted to teaching and nonteaching hospitals in California. The sample comprised patients admitted to hospitals from the emergency department with any of 50 common diagnoses (N = 641,860). Mortality between patients admitted on weekends and those admitted on weekdays (the "weekend effect") was compared. The magnitude of the weekend effect was also compared among patients admitted to major teaching, minor teaching, and nonteaching hospitals. The adjusted odds of death for patients admitted on weekends when compared with weekdays was 1.03 (95% confidence interval [CI]: 1.01 to 1.06; P = 0.0050). Three diagnoses (cancer of the ovary/uterus, duodenal ulcer, and cardiovascular symptoms) were associated with a

statistically significant weekend effect. None of the 50 diagnoses demonstrated a statistically significant reduction in mortality for weekend admissions as compared with weekday admissions. Mortality was similar among patients admitted to major (odds ratio [OR] = 1.06; 95% CI: 0.94 to 1.19) and minor (OR = 1.03; 95% CI: 0.97 to 1.09) teaching hospitals, compared with nonteaching hospitals. However, the weekend effect was larger in major teaching hospitals compared with nonteaching hospitals (OR = 1.13 vs. 1.03, P = 0.03) and minor teaching hospitals (OR = 1.05, P = 0.11). Patients admitted to hospitals on weekends experienced slightly higher risk-adjusted mortality than did patients admitted on weekdays. While overall mortality was similar for patients admitted to all hospital categories, the weekend effect was larger in major teaching hospitals and is cause for concern.

Duke, G., Green, J., Briedis, J. (2004). **Night-shift discharge** from intensive care unit increases the mortality-risk of ICU survivors. *Anaesthesia and Intensive Care*, 32(5), 697-701.

Intensive Care (ICU) survivors discharged from ICU to the general ward at night have a higher mortality. We sought to clarify which factors, including night-shift discharge, influence outcome following ICU discharge in a metropolitan hospital in Australia, using a cohort study of critically-ill patients between 1/1/1999-30/4/2003. Patients were excluded from analysis if they (a) died in ICU, (b) were transferred to another hospital, (c) had an ICU length of stay <8 hours, or (d) age <16 years. Logistic regression was used to derive a predictive model based on the following variables: patient demographics, severity of illness following ICU admission (APACHE II mortality-risk, p(m)), final diagnosis, discharge timing including premature or delayed (>4 hours) ICU discharge, and "limitation of medical treatment" orders. The outcome measures were patient status at hospital discharge and ICU readmission rate. Of the 1870 ICU survivors, 92 (4.9%) died after discharge from ICU. Patients discharged to the ward during the night-shift (2200-0730 hours) had a higher

APACHE II score and crude mortality. The difference in APACHE II p(m) did not reach statistical significance. No significant calendar or seasonal pattern was identified. Logistic regression identified night-shift discharge (RR=1.7; 95% CI 1.03-2.9; P=0.03), limited medical treatment order (RR=5.1; 95% CI 2.2-12) and admission APACHE II p(m) (RR=3.3; 95% CI 1.3-7.6) as independent predictors of patient outcome following ICU transfer to the ward. At the time of ICU discharge to the ward three factors are predictive of hospital outcome: timing of ICU discharge, limited medical treatment orders and initial illness severity.

Ensminger, S., Morales, I., Peters, S., Keegan, M., Finkielman, J., Lymp, J., et al. (2004). The hospital mortality of patients **admitted to the ICU** on weekends. *Chest*, 126(4), 1292-1298.

This study was conducted to determine whether weekend admission to the ICU increases the risk of dying in the hospital. This was a retrospective cohort study in an ICU of a single tertiary care medical center in the US. A total of 29,084 patients were admitted to medical, surgical, and multispecialty ICUs from October 1994 through September 2002. The weekend ICU admissions comprised 27.9% of all ICU admissions (8,108 ICU admissions). The overall hospital mortality rate was 8.2% (2,385 deaths). Weekend ICU admission was associated with a higher unadjusted hospital mortality rate than that for weekday ICU admission (11.3% vs 7.0%, respectively; odds ratio [OR], 1.70; 95% confidence interval [CI], 1.55 to 1.85). In multivariable analyses controlling for the factors associated with mortality such as APACHE (acute physiology and chronic health evaluation) III predicted mortality rate, ICU admission source, and intensity of treatment, no statistically significant difference in hospital mortality was found between weekend and weekday admissions in the overall study population (OR, 1.06; 95% CI, 0.95 to 1.17). For weekend ICU admissions, the observed hospital mortality rates of the medical, multispecialty, and surgical ICUs were

15.2%, 17.2%, and 6.4%, respectively, and for weekday ICU admissions the rates were 16.3%, 10.1%, and 3.5%, respectively. Subgroup analyses showed that weekend ICU admission was associated with higher adjusted hospital mortality rates than was weekday ICU admission in the surgical ICU (OR, 1.23; 95% CI, 1.03 to 1.48), but not in the medical or multispecialty ICUs. The overall adjusted hospital mortality rate of patients admitted to the ICU on a weekend was not higher than that of patients admitted on a weekday. However, weekend ICU admission to the surgical ICU was associated with an increased hospital mortality rate.

Luo, Z., Liu, S., Wilkins, R., Kramer, M. (2004). Risks of **stillbirth and early neonatal death** by day of week. *Canadian Medical Association Journal*, 170(3), 337-341.

We investigated weekend-associated risks of stillbirth and early neonatal death in most Canadian provinces. We studied all 3,239,972 births recorded in Canada, excluding Ontario, between 1985 and 1998. The main outcome measures were the relative risks (RRs) of stillbirth and early neonatal death for infants born on weekends versus weekdays. The proportion of births on weekend days was 24% lower than the proportion on weekdays. Infants born on weekend days had slightly but significantly elevated risks of stillbirth (RR 1.06, 95% confidence interval [CI] 1.02-1.09) and early neonatal death (RR 1.11, 95% CI 1.07-1.16). However, the higher risks disappeared after adjustment for gestational age. The crude risks of stillbirth and early neonatal death remained slightly higher for births on weekend days, but the excesses were much smaller than those reported from other countries.

Sadeghi, H., Grines, C., Chandra, H., Mehran, R., Fahy, M., Cox, D., et al. (2004). Magnitude and impact of treatment delays on weeknights and weekends in patients undergoing primary angioplasty for **acute myocardial infarction** (the Cadillac trial). *The American Journal of Cardiology*, 94(5), 637-640.

In 2,082 patients in the CADILLAC trial, the outcomes of patients presenting during peak hours were compared with those presenting during peak hours (Monday to Friday 8a.m. to 8 p.m., n = 1,047, 51%) were compared with those of patients presenting during off-peak hours (weeknights from 8 p.m. to 8 a.m. and weekends, n = 989, 49%). Although treatment times to percutaneous coronary intervention (PCI) were delayed approximately 21 minutes, in patients with acute myocardial infarctions occurring on weeknights and weekends, this modest delay did not adversely affect procedural success, myocardial recovery, or survival after PCI.

Saleem, M., Kannam, H., Aronow, W., Weiss, M., Kalapatapu, K., Pucillo, A., et al. (2004). The effects of off-normal hours, age, and gender for coronary angioplasty on hospital mortality in patients undergoing coronary angioplasty for **acute myocardial infarction**. *The American Journal of Cardiology*, 93(6), 763-764.

Percutaneous transluminal coronary angioplasty (PTCA) was performed in all 1,050 patients hospitalized within 24 hours of symptoms of documented acute myocardial infarction (AMI) from 1998 to 2002 in a New York hospital. Hospital mortality was similar in women and men who underwent PTCA for AMI but was higher in patients aged 75 to 95 years (10%) than in patients aged 21 to 50 (2.1%, $p < 0.001$), 51 to 64 (2.3%, $p < 0.001$), and 65 to 74 years (4%, $p < 0.02$). Hospital mortality was higher in patients who had PTCA for AMI during off-normal (5.8%) than normal hours (3.2%, $p < 0.05$).

Wunsch, H., Mapstone, J., Brady, T., Hanks, R., Rowan, K. (2004). Hospital mortality associated with day and time of admission to **intensive care units**. *Intensive Care Medicine*, 30(5), 895-901.

The objective was to investigate whether hospital mortality of patients was associated with the day of the week or time of admission to intensive care units (ICUs). This was a cohort

study of one hundred two adult, general (mixed medical/surgical) ICUs in England, Wales and Northern Ireland. A total of 56,250 admissions from 1995 to 2000 that fit the inclusion criteria for calculation of the APACHE II probability of hospital mortality. Crude and case mix adjusted hospital mortality were examined by day of the week and time of day of admission to ICU. Patients admitted on Saturday and Sunday had higher crude hospital mortality compared with admissions on Wednesday [Saturday crude odds ratio (OR) 1.41, 95% CI 1.32-1.52; Sunday OR 1.56, 1.45-1.68]. The association was still significant after adjustment using the UK APACHE II model (Saturday OR 1.16, 1.107-1.26; Sunday OR 1.24, 1.14-1.35) but not after adjustment using individual components of the APACHE II model (Saturday OR 1.03, 0.95-1.12; Sunday OR 1.09, 1.00-1.19). Night admissions were also associated with higher mortality compared with day both before and after adjustment for case mix using the UK APACHE II model (crude OR 1.43, 1.37-1.51; adjusted OR 1.16, 1.10-1.23) but not after adjustment using components of the APACHE II model (OR 1.02, 95% CI 0.96-1.09). After appropriate adjustment for case mix, day of the week and time of day of admission of patients to ICU were not associated with significant differences in hospital mortality.

2003

Gould, J., Qin, C., Marks, A., Chavez, G. (2003). **Neonatal** mortality in weekend vs weekday births.

JAMA: Journal of the American Medical Association, 289(22), 2958-2962.

The objective was to compare the neonatal mortality of infants born on weekdays and weekends. Case series of 1,615,041 live births (weight ≥ 500 g) in California between 1995-1997 to determine patterns of births, cesarean deliveries, and neonatal deaths. Analyses were stratified by birth weight and delivery method. To assess the role of weekend differences in case mix, observed and birth weight-adjusted odds ratios (ORs) for increased weekend mortality were estimated using logistic regression. Birth weight-adjusted neonatal mortality was the main outcome measure. There was a 17.5% decrease in births on weekends, accompanied by a decrease in the proportion of cesarean deliveries from 22% on weekdays to 16% on weekends. Weekend decreases in births were least pronounced in smaller infants, resulting in a weekend concentration of high-mortality, very low-birth-weight (<1500 g) births. Observed neonatal mortality increased from 2.80 per 1000 weekday births to 3.12 per 1000 weekend births (OR, 1.12; 95% confidence interval [CI], 1.05-1.19; $P = .001$) for all births, and from 4.94 to 6.85 (OR, 1.39; 95% CI, 1.25-1.55; $P < .001$) for cesarean deliveries. After adjusting for birth weight, the increased odds of death for infants born on the weekend were no longer significant. The provision of optimal care regardless of the day of week is an important goal for perinatal medicine. Comparing the neonatal mortality of infants born on weekdays and weekends provides a straightforward assessment of this goal. After controlling for birth weight, we found no evidence that the quality of perinatal care in California was compromised during the weekend.

Hamilton, P., Restrepo, E. (2003). Weekend birth and higher **neonatal** mortality: a problem of patient acuity or quality of care? *Journal of Obstetric, Gynecologic, and Neonatal Nursing: JOGNN/NAACOG*, 32(6), 724-733.

The objective was to address the differences in neonatal mortality among births to teenage mothers on weekdays and weekends using a retrospective descriptive design. Rates of neonatal mortality linked to maternal risk factors, low birth weight, gestational age, day of the week of the birth, and ethnicity/race were examined. The population consisted of all recorded births to teenage mothers (< 20 years of age) in Texas in 1999 and 2000 (N = 111,749). These births were linked to death certificates for a subset of neonatal deaths within the same time period (n = 397). The outcome of interest was any death attributed to conditions originating in the perinatal period and recorded as such on the infant death certificate. Neonatal mortality was higher among the births on weekends than those during the week. Maternal risks and patient acuity levels of mothers and babies were not consistently higher on weekends. However, when risk factors were present, weekend births were more dangerous for Hispanics than for other ethnic or racial groups. Differences in patient acuity did not satisfactorily explain higher neonatal mortality rates on weekends. Thus, quality of care indicators such as lower hospital staffing and reduced availability of services on weekends may be critical sources of unnecessary neonatal deaths.

Heller, G., Schnell, R., Misselwitz, B., Schmidt, S. (2003). [Why are babies born at night at increased risk of early **neonatal** mortality?] *Zeitschrift fur Geburtshilfe Neonatologie*, 207(4), 137-142.

Increased perinatal and neonatal mortality rates have been previously reported in night-time births compared with births during the day. This effect has been attributed to decreased quality of medical care during the night. However, alternative explanations exist such as decreased birth-weight of night births. The objective of this study was to further investigate

this relationship. Data from 590,332 low risk births (singleton births, \geq 2500 g birth-weight, no major congenital anomaly) were obtained from the perinatal birth register of Hesse, Germany, 1990-2000. Outcome was defined as either death during labour or within 7 days of life. Night-time births were defined as births between 9.00 p.m. and 6.59 a.m., otherwise day-time births were assumed. Subgroup analyses and logistic regression analyses were performed to assess whether the excess mortality of night-births might be explained by other factors. Mortality rates were increased in night-time births (RR = 1.26; 95% CI = 0.94-1.70). This relationship was more pronounced in spontaneous births (RR = 1.58; 95% CI = 0.96-2.61) and emergency cesarean sections (RR = 1.76; 95% CI = 1.10-2.82). Significance persisted after adjusting for numerous potential confounders. Our results confirm an increased mortality risk for night-time births which could not be explained by other accessible risk factors. This suggests that the increased risk at night might be attributable to a reduced availability to provide appropriate medical care in delivery units at night. As mainly the presence of staff is decreased during the night, introduction of better designed shifts can be expected to reduce neonatal mortality.

Henriques, J., Haasdijk, A., Zijlstra, F. (2003). Outcome of primary angioplasty for **acute myocardial infarction** during routine duty hours versus during off-hours. *Journal of the American College of Cardiology*, 41(12), 2138-2142.

We sought to investigate the impact of circadian patterns in the onset of acute myocardial infarction (AMI) on the practice of primary angioplasty. A circadian variation in the time of onset of AMI with a peak in the morning hours has been described. We studied 1,702 consecutive patients with acute ST-segment elevation myocardial infarction treated with primary angioplasty. We observed circadian variation in frequency of symptom onset, hospital admission, and first balloon inflation. Circadian patterns of symptom onset, hospital

admission, and balloon inflation are similar. A majority of patients have symptom onset (53%), hospital admission (53%), and first balloon inflation (52%) during routine duty hours (0800 to 1800 h). There were no differences in baseline clinical characteristics or treatment delays between routine duty hours and off-hours patients. Hospital admission between 0800 and 1800 was associated with an angioplasty failure rate of 3.8%, compared with 6.9% between 1800 and 0800, $p < 0.01$. Thirty-day mortality was 1.9% in patients with hospital admission between 0800 and 1800, compared with 4.2% in patients with hospital admission between 1800 and 0800, $p < 0.01$. Circadian variations may have a profound effect on the practice of primary angioplasty. A majority of patients are treated during routine duty hours. Patients treated during off-hours have a higher incidence of failed angioplasty and consequently a worse clinical outcome than patients treated during routine duty hours.

Lee, S., Lee, D., Andrews, W., Baboolal, R., Pendray, M., Stewart, S., et al. (2003). Higher mortality rates among inborn infants admitted to **neonatal intensive care units** at night. *The Journal of Pediatrics*, 143(5), 592-597.

Circadian variation in deaths among infants ≤ 32 weeks' gestation admitted to Canadian neonatal intensive care units (NICU) was examined. We examined all infants ($n=5192$) between 24 and 32 weeks' gestation with complete data, who were admitted to 17 tertiary Canadian Neonatal Network NICUs from January 1996 to October 1997. Multivariable logistic regression was used to compare risk-adjusted early neonatal mortality rates (death within 7 days of NICU admission) of infants admitted during daytime (8 am to 5 pm) with infants admitted at night. Sixty percent ($n=3131$) of infants were admitted to the NICU at night. Patient risk factors significantly ($P < .05$) predictive of early neonatal death from multivariable logistic regression were male sex, outborn status, APGAR score < 7 at 5 minutes, presence of congenital anomalies, low gestational age, and high admission Score for

neonatal acute physiology, version II (SNAP-II). For inborn infants, in-house presence of a neonatal fellow or attending neonatologist at night (odds ratio, 0.6) and NICU admission at night (odds ratio, 1.6) were also predictive. Risk-adjusted early neonatal mortality odds was 60% higher among inborn infants ≤ 32 weeks' gestation admitted to NICUs at night compared with during daytime, equivalent to 29 excess deaths per 1000 infants.

Morales, I., Peters, S., Afessa, B. (2003). Hospital mortality rate and length of stay in patients admitted at night to the **intensive care unit**. *Critical Care Medicine*, 31(3), 858-863.

The objective of this study was to determine whether there are any associations between the timing of patient admission to a medical intensive care unit and hospital outcome. A retrospective cohort study that used an Acute Physiology and Chronic Health Evaluation III database containing prospectively collected demographic, clinical, and outcome information for patients. Patients were divided according to the time of admission into daytime (from 7:00 am to 5:00 pm) and nighttime admissions. We further subdivided nighttime admissions into two groups (regular and heavy workload) according to the number of patients who were admitted during the same shift. 6,034 patients consecutively admitted to our medical intensive care unit (academic referral hospital). over a 5-yr period starting April 10, 1995. The patients admitted at night had a lower mortality rate (13.9 vs. 17.2%, $p < .0001$), adjusted for admission source and severity of illness. Their hospital stay was shorter, 11.0 days \pm 13.5 (median 7) vs. 12.7 \pm 14.8 (median 8; $p < .0001$), as was their intensive care unit stay, 3.5 \pm 4.4 days (median 2) vs. 3.9 \pm 4.7 (median 2; $p < .0001$), compared with the daytime admission group. The nighttime shifts that admitted three or more patients (heavy workload) had the same mortality rate (13.2%) as those with fewer admissions (14.5%; $p = .5961$). Hospital and intensive care unit stays were also similar in both workload groups. Nighttime admission to our intensive care unit is not associated with a higher

mortality rate or a longer hospital or intensive care unit stay compared with daytime admission.

Stephansson, O., Dickman, P., Johansson, A., Kieler, H., Cnattingius, S. (2003). **Time of birth** and risk of intrapartum and early neonatal death. *Epidemiology*, 14(2), 218-222.

We undertook a population-based cohort study of 694,888 singleton births without elective cesarean section in Sweden between 1991 and 1997. We estimated relative risks of intrapartum and early neonatal death according to the hour, day and month of delivery. Estimated risk ratios were adjusted for gestational age, birth weight for gestational age, malformations, induction of labor, breech presentations and year of birth. Infants of high-risk deliveries were more often delivered during daytime (8:00 am to 7:59 pm). Compared with infants born during daytime, infants born at night were at increased risk of early neonatal death (adjusted risk ratio = 1.28; 95% confidence interval = 1.13-1.46), but not intrapartum death (1.05; 0.71-1.54). If this association is causal, 12% of early neonatal deaths can be attributed to the increased risk among nighttime births. There was no association of weekend or holiday births with risks of intrapartum or early neonatal death. Infants born at night may be at increased risk of early neonatal death.

Uusaro, A., Kari, A., Ruokonen, E. (2003). The effects of ICU **admission and discharge times** on mortality in Finland. *Intensive Care Medicine*, 29(12), 2144-2148.

We studied the effects of ICU admission and discharge times on mortality and the time of death in critically ill patients. This was a cohort study using a national ICU database in eighteen ICUs in university and central hospitals in Finland. Consecutive series of all 23,134 emergency admissions in January 1998-June 2001. We defined weekend (as opposed to weekday) from 1600 hours Friday to 2400 hours Sunday and "out-of-office" hours (as opposed to "office hours") from 1600 hours to 0800 hours. Mortality was adjusted for disease

severity, intensity of care, and whether restrictions for future care were set. ICU-mortality was 10.9% and hospital mortality 20.7%. Adjusted ICU-mortality was higher for weekend as compared with weekday admissions [odds ratio (OR 1.20) 95% CI 1.01-1.43], but similar for "out-of-office" and "office hour" admissions (OR 0.98, 0.85-1.13). Adjusted risk of ICU death was higher during "out-of-office" hours as compared with office hours (OR 6.89, 5.96-7.96). The time of discharge from ICU to wards was not associated with further hospital mortality. Weekend ICU admissions are associated with increased mortality, and patients in the ICU are at increased risk of dying in evenings and during nighttime. Our findings may have important implications for organization of ICU services.

2002

Barnett, M., Kaboli, P., Sirio, C., Rosenthal, G. (2002). Day of the week of **intensive care admission** and patient outcomes: a multisite regional evaluation. *Medical Care*, 40(6), 530-539.

Relationships between day of the week of admission to hospitals and hospital outcomes have been poorly studied. Intensive care units (ICUs) appear to be uniquely suited to examine such a question given the unpredictability of ICU admissions and the clinical instability of their patient populations. This retrospective cohort study included 156,136 patients admitted to 38 ICUs in 28 hospitals in a large Midwestern metropolitan area during 1991 to 1997.

Demographic and clinical data were collected from patients' medical records and used in multivariable risk-adjustment models that examined the risk for in-hospital death and ICU length of stay. The adjusted odds of in-hospital death were 9% higher (OR 1.09; 95% CI, 1.04-1.15; $P < 0.001$) for weekend admissions (Saturday or Sunday) than in patients admitted midweek (Tuesday through Thursday). However, the adjusted odds of death were also higher ($P < 0.001$) for patients admitted on Monday (OR 1.09) or Friday (OR 1.08). Findings were generally similar in analyses stratified by admission type (medical vs. surgical), hospital teaching status, and illness severity. Adjusted ICU length of stay was 4% longer ($P < 0.001$) for weekend or Friday admissions, compared with midweek admissions. Patients admitted to an ICU on the weekend have a modestly higher risk for death and ICU length of stay.

However, the similar risk for death in patients admitted on Friday and Monday suggests that "weekend effects" may be more related to unmeasured severity of illness and/or selection bias than to differences in quality of care.

Beck, D., McQuillan, P., Smith, G. (2002). Waiting for the break of dawn? The effects of **discharge time** discharge TISS scores and discharge facility on hospital mortality after intensive care. *Intensive Care Medicine*, 28(9), 1287-1293.

The objective was to assess the effects of discharge Therapeutic Intervention Scoring System (TISS) scores, discharge time and type of discharge facility on ultimate hospital mortality after intensive care. This was a retrospective cohort study of one thousand six hundred fifty-four ICU patients discharged to hospital wards or high dependency units (HDUs) in general intensive care unit (ICU) in a district general hospital in Berlin, Germany. Vital status at ultimate hospital discharge was the main outcome measurement. The crude hospital mortality after ICU discharge (12.6%) was significantly associated with increasing discharge TISS scores (chi(2) for trend =9.0, p=0.028). This trend was similarly observed after adjusting for severity of disease. Patients with high TISS scores (>30) who were discharged to hospital wards had a higher risk (1.31; CI: 1.02-1.83) of in-hospital death compared with patients discharged to HDUs. Crude mortality was significantly higher for late 20.00 h to 7.59 h than for early (8.00 h to 19.59 h) discharges (18.8% versus 11.2%, chi (2) =12.1, p=0.0004). Adjusted for disease severity, the mortality risk was 1.70-fold (CI: 1.28-2.25) increased for late ICU discharges. Patients discharged late to hospital wards had significantly higher severity-adjusted risks (1.87; CI: 1.36-2.56) than had patients discharged to HDUs (1.35; CI: 0.77-2.36). Both late discharge and high discharge TISS scores are indicators of "premature" ICU discharge and were associated with increased mortality. Intermediate care reduced the mortality of patients discharged "prematurely" from ICU. This adds to the growing evidence of the benefits of intermediate care after ICU discharge.

Carmody, I., Romero, J., Velmahos, G. (2002). Day for night: should we staff a **trauma center** like a nightclub? *The American Surgeon*, 68(12), 1048-1051.

Most trauma services throughout the country are staffed on a fixed-call rotational basis. Staff is deployed in a linear fashion when trauma often occurs in a skewed sporadic fashion resulting in large fluctuations in volume, injury severity, and mechanism of injury. Medical

error and increased mortality have been associated with certain admission times. We reviewed 8015 consecutive major trauma admissions over a 3-year period in a large academic teaching facility in Los Angeles, California. When reviewing aggregate data we found a significant difference in mortality between patients admitted during the day (7:00 AM to 6:59 PM) compared with those admitted at night (7:00 PM to 6:59 AM) (10.1% vs 13.1%, $P < 0.01$). On further analysis the two populations were found to be significantly different in volume, Injury Severity Score (ISS), and mechanism of injury. More patients were admitted at night and on weekends. They had a higher ISS, higher frequency of penetrating trauma, and a higher likelihood of undergoing operative intervention. Multiple subset analyses were performed stratifying for ISS, time of admission, day of admission, and mechanism of injury using mortality rate as the end point. Six comparisons were performed: 1) morning versus night admission; 2) weekday versus weekend admission; 3) least busy day (Tuesday) versus busiest day (Sunday) admission; 4) weeknight versus weekend night admission; 5) in cases of penetrating trauma, morning versus night admission; and 6) in cases of blunt trauma, morning versus night admission. None of the six comparisons showed a significant difference in mortality. There was no significant difference in ISS-matched mortality related to fixed trauma call staffing.

Herlitz, J., Bång, A., Alsén, B., Aune, S. (2002). Characteristics and outcome among patients suffering from in hospital **cardiac arrest** in relation to whether the arrest took place during office hours. *Resuscitation*, 53(2), 127-133.

A prospective recording of various factors at resuscitation including the time when the CPR team was alerted and a retrospective evaluation via medical records of patients' previous history and final outcome of all patients suffering in hospital cardiac arrest in Sahlgrenska University hospital in Göteborg, Sweden between 1994 and 1999 in whom resuscitative

efforts were attempted and for whom the time when the cardiopulmonary resuscitation (CPR) team was alerted. was done. Among patients in whom the arrest took place during office hours (08:00-16:30 h) the overall survival rate was 49% as compared with 26% among the remaining patients ($P < 0.0001$). The corresponding figures for patients found in ventricular fibrillation were 66 and 44% ($P = 0.0001$), for patients found in asystole 33 and 22% (NS) and for patients found in pulseless electrical activity 14 and 3% (NS). When correcting for dissimilarities in previous history and factors at resuscitation the adjusted odds ratio for patients to be discharged alive who had the arrest during office hours was 2.07 (1.40-3.06) as compared with patients who had an arrest outside office hours. Among patients suffering from in hospital cardiac arrest and in whom CPR was attempted those who had the arrest during office hours had a survival rate being more than twice that of patients who had the arrest during other times of the day and night. These results indicate that the preparedness for optimal treatment of in hospital cardiac arrest is of ultimate importance for the final outcome and that an increased preparedness during evenings and nights might increase survival among patients suffering from in hospital cardiac arrest.

van Walraven, C., Bell, C. (2002). Risk of death or readmission among people **discharged from hospital** on Fridays. *CMAJ: Canadian Medical Journal*, 166(13), 1672-1673.

Discusses whether patients discharged on Fridays have worse outcomes than those discharged on other days. Detail of the study in Ontario; indication that patients discharged from hospitals on Fridays had an increased independent risk of death or non-elective readmission within 30 days of discharge; suggesting that physicians reconsider pushing to get patients home for the weekend.

2001

Bell, C., Redelmeier, D. (2001) Mortality among patients **admitted to hospitals on weekends** as compared with weekdays. *New England Journal of Medicine*, 345(9), 663-668.

All acute care admissions from emergency departments in Ontario, Canada, between 1988 and 1997 were analyzed (a total of 3,789,917 admissions). In-hospital mortality among patients admitted on a weekend with that among patients admitted on a weekday for three pre-specified diseases were compared: ruptured abdominal aortic aneurysm (5454 admissions), acute epiglottitis (1139), and pulmonary embolism (11,686) and for three control diseases: myocardial infarction (160,220), intracerebral hemorrhage (10,987), and acute hip fracture (59,670), as well as for the 100 conditions that were the most common causes of death (accounting for 1,820,885 admissions). Weekend admissions were associated with significantly higher in-hospital mortality rates than were weekday admissions among patients with ruptured abdominal aortic aneurysms (42 percent vs. 36 percent, $P < 0.001$), acute epiglottitis (1.7 percent vs. 0.3 percent, $P = 0.04$), and pulmonary embolism (13 percent vs. 11 percent, $P = 0.009$). The differences in mortality persisted for all three diagnoses after adjustment for age, sex, and coexisting disorders. There were no significant differences in mortality between weekday and weekend admissions for the three control diagnoses. Weekend admissions were also associated with significantly higher mortality rates for 23 of the 100 leading causes of death and were not associated with significantly lower mortality rates for any of these conditions. Patients with some serious medical conditions are more likely to die in the hospital if they are admitted on a weekend than if they are admitted on a weekday.

Luo, Z., Karlberg, J. (2001). **Timing of birth** and infant and early neonatal mortality in Sweden 1973-95: longitudinal birth register study. *BMJ*, 323(7325), 1327-1330.

Analysis of data from the Swedish birth register, 1973-95 of 2,102,324 spontaneous live births of infants without congenital malformation was completed. Absolute and relative risk of infant mortality, early neonatal mortality, and early neonatal mortality related to asphyxia. Infant mortality, early neonatal mortality, and early neonatal mortality related to asphyxia were higher in infants who were born during the night (9 pm to 9 am) compared with those born during the day for 1973-9, 1980-9, and 1990-5. The difference was more dramatic for preterm infants. The largest difference was observed during 1990-5, when there was a 30% increase in early neonatal mortality (relative risk 1.31, 95% confidence interval 1.10 to 1.57) and a 70% increase in early neonatal mortality related to asphyxia (1.70, 1.22 to 2.38) in preterm infants born during the night compared with rates for preterm infants born during the day. A detailed analysis over 24 hours revealed two "high risk" periods: between 5 pm and 1 am and around 9 am. Infants born during the night have a greater risk of infant and early neonatal mortality and early neonatal mortality related to asphyxia than those born during the day. There has been no improvement over the past two decades. The problem is more serious for preterm births and was even worse in the 1990s. Shift changes and the hours immediately after such changes are high risk periods for neonatal care

2000

Goldfrad, C., Rowan, K. (2000). Consequences of discharges from **intensive care at night**. *Lancet*, 355(9210), 1138-1142.

It is generally believed that pressure for beds on intensive-care units (ICUs) has increased in the UK. This study used discharge at night as a proxy measure to investigate pressure. Night was defined in two ways: "out of office hours" from 2200 to 0659 h and "the early hours of the morning" from 0000 to 0459 h. The rate of discharge at night was compared for 21,295 adult admissions to 62 ICUs covering the period 1995-98 with 10806 admissions to 26 ICUs covering the period 1988-90. With data solely from 1995-98, the consequences of discharge at night and premature discharge were investigated. Overall, 2269 (21.0%) admissions did not survive the ICU in 1988-90 compared with 4487 (21.1%) in 1995-98. Of ICU survivors, 2.7% were discharged at night (2200-0659 h) in 1988-90 compared with 6.0% in 1995-98. In 1995-98, night discharges (2200-0659 h) had a higher crude (odds ratio 1.46, 95% CI 1.18-1.80) and case-mix adjusted (1.33, 1.06-1.65) ultimate hospital mortality. Higher odds ratios were observed when the definition of night was 0000-0459 h. Premature discharge was commoner at night, 42.6% vs 5.0% and its importance was apparent when incorporated into the logistic-regression model (premature discharge 1.35, 1.10-1.65; night discharge 1.17, 0.92-1.49). Night discharges from ICU are increasing in the UK. This practice is of concern because patients discharged at night fare significantly worse than those discharged during the day.

1998

Stewart, J., Andrews, J., Cartlidge, P. (1998). Numbers of deaths related to intrapartum asphyxia and **timing of birth** in all Wales perinatal survey, 1993-5. *BMJ*, 316(7132), 657-660.

To investigate the relation between the timing of birth and the occurrence of death related to an intrapartum event an analysis was done of 107,206 births to Welsh residents in 1993-5, including 608 cases of stillbirth and 407 of neonatal death identified in the all Wales perinatal survey, the cause of death classified with the clinicopathological system. 79 normally formed babies stillborn or who died in the neonatal period, birth weight > 1499 g, for whom cause of death was related to an intrapartum event. Relative risk of death due to an intrapartum event according to the hour, day, and month of birth. Mortality was higher in babies born between 9.00 pm and 8.59 am than in those born between 9.00 am and 8.59 pm; relative risk (95% confidence interval) 2.18 (1.37 to 3.47). July and August births also had a higher death rate than births in other months; relative risk 1.99 (1.23 to 3.23). Weekend births had a higher death rate but it was not significant. The excess of deaths at night and during months when annual leave is popular may indicate an overreliance on inexperienced staff at these times. Errors of judgement may also be related to physical and mental fatigue, demanding a more disciplined systematic approach at night. Mistakes may be ameliorated by increasing shiftwork, but shifts should be carefully designed to avoid undue disruption of circadian rhythms. In addition, greater supervision by senior staff may be required at night and during summer months.

1997

Garot, P., Juliard, J., Benamer, H., Steg, P. (1997). Are the results of primary percutaneous transluminal coronary angioplasty for **acute myocardial infarction** different during the "off" hours? *The American Journal of Cardiology*, 79(11), 1527-1529.

This retrospective study assessed the outcome of primary angioplasty for acute myocardial infarction performed during the "off" hours (nights and weekends) or during working hours in 288 consecutive patients in a hospital in Paris, France. The times to admission and reperfusion, as well as the in-hospital outcomes, were similar in the 2 groups.

1988

Paccaud, F., Martin-Béran, B., Gutzwiller, F. (1988). Hour of birth as a prognostic factor for **perinatal death**. *Lancet*, 1(8581), 340-343.

The analysis of the 220,540 births and 2152 perinatal deaths recorded in Switzerland between 1979 and 1981 showed a variation of perinatal mortality rates (PMR) according to the hour of birth. The PMR for babies born between 4 pm and 2 am was 12 per 1000, contrasting with a figure of 8.4 per 1000 for babies born between 2 am and 4 pm. This pattern, which was fairly constant throughout the week, was characterised by a slow and steady increase from the very early morning, reaching a maximum in the late evening. There was also an hour-to-hour variation in the proportion of babies born weighing less than 2500 g, with a maximum in the evening and a less pronounced peak in the morning: the mortality rates by birth weight were raised only in the evening. Since the availability of hospital staff and equipment also follows a circadian rhythm, the variation in PMR may be related to a circadian rhythm of quality of care or possibly to chronobiological or selection factors.

1987

Dowding, V., Duignan, N., Henry, G., MacDonald, D. (1987). Induction of labour, birthweight and **perinatal mortality** by day of the week. *British Journal of Obstetrics and Gynaecology*, 94(5), 413-419.

There were 66,974 births at the three largest Dublin maternity hospitals in the years 1980-1982. Data on numbers of spontaneous and elective births, birthweight and perinatal mortality were analysed by day of the week. Perinatal mortality rates were highest on Wednesdays and Saturdays. The rate on Sunday was close to average. The largest number of perinatal deaths per day occurred on Wednesdays and the smallest on Sundays. Significant variations in mortality rates and percentage low birthweight were found among the 19% of infants who were born electively, but not among those born after a spontaneous onset of labour. High-risk pregnancies, including many with intra-uterine fetal death, were induced in large numbers from Tuesdays through Saturdays with a peak on Wednesdays. Low risk cases were induced mainly from Monday through Fridays with a peak on Fridays. The pattern of perinatal mortality through the week followed closely that of the risk status of pregnancies delivered electively. The results indicate that the pattern of perinatal mortality by day of the week of birth was determined by a highly organized weekly routine of selective elective delivery.

Mitler, M., Hajdukovic, R., Shafor, R., Hahn, P., Kripke, D. (1987). When people die. Cause of death versus **time of death**. *The American Journal of Medicine*, 82(2), 266-274.

A sample of 4,920 disease-related deaths from New York City for 1979 (8.7 percent of all relevant data from New York City's files) showed a 60 percent rise in death rate beginning at 2 A.M. and reaching a peak at 8 A.M. A smaller peak was also noted at 6 P.M. The rise in human mortality beginning at 2 A.M. and peaking at 8 A.M. might be explained by: artifact of deaths occurring anytime during the night that are discovered after daybreak, effect of less

efficient health care between 2 A.M. and 8 A.M., and disease processes that somehow increase risk of death between 2 A.M. and 8 A.M. An attempt was made to differentiate among these possibilities by comparing time of death for various subsamples. The bimodal pattern appeared only in the temporal distribution of deaths of persons over 65 years of age; deaths of persons under 65 did not show significant temporal concentration. There were also prominent differences in the distribution of deaths for different reported causes of death. Ischemic heart disease, which numerically accounted for over 50 percent of the sample, showed peak mortality at 8 A.M. for both males and females. Hypertensive disease showed a significant peak in mortality at 1 A.M. for females only. Cerebrovascular disease peaked significantly at 6 A.M. with a significant peak only for males. The age and disease specificity of the 2 A.M. to 8 A.M. rise in death is consistent with a disease-related explanation for the bimodal circadian pattern in mortality. The quality and efficiency of health care could be improved with more precise information on peak periods of risk for specific morbid conditions.

1986

Domenighetti, G., Paccaud, F. (1986). The night--a dangerous time to be **born**? *British Journal of Obstetrics and Gynaecology*, 93(12), 1262-1267.

An analysis of perinatal mortality by hour of birth among 10,059 births in Canton Ticino (Switzerland) during the years 1979-1982 showed that fewer births occurred at night than during the day. The variations in number of births by hour of birth were attributed to obstetric practices. The perinatal mortality rate for night-time births was more than twice as high as that for the daytime births (+127%, P less than 0.001) and the rates for night-time births exceeded those for daytime births for 13 of the 19 causes of death examined. A higher proportion of the low and very-low-birth weight babies (less than 2500 g and less than 1500 g) were born at night between 19.00 and 06.59 hours.

1983

Mathers, C. (1983). Births and **perinatal deaths** in Australia: variations by day of week. *Journal of Epidemiology and Community Health*, 37(1), 57-62.

Analysis of births occurring in Australia during 1976-9 showed that they followed a seven-day cycle, being concentrated on Tuesdays to Fridays and least numerous on Sundays, which had 26% fewer births than expected. Stillbirth and neonatal death rates were 17% and 29% higher respectively among babies born at weekends than among those born on weekdays. The incidence of low birth weight was also significantly higher in the weekend group in New South Wales. The patterns seen in births and perinatal deaths are largely associated with the selective effects of intervention in delivery rather than with any variation in quality of care throughout the week

1981

Hendry, R. (1981). The weekend--a dangerous **time to be born**? *British Journal of Obstetrics and Gynaecology*, 88(12), 1200-1203.

Analysis of all births occurring in Tayside during the years 1974-1978 inclusive showed that there was a significantly small number of births on Sundays than any other day of the week.

The babies born on Sundays were more at risk of dying during or after birth. The reasons for this are multiple and difficult to ascertain.

Mangold, W. (1981). **Neonatal mortality** by the day of the week in the 1974-75 Arkansas live birth cohort. *American Journal of Public Health*, 71(6), 601-605.

This study is an analysis of daily variations in neonatal mortality among 66,049 live births in the 1974-75 Arkansas live birth cohort. Weekends and holidays in general, and Sundays in particular, were found to have the fewest number of deliveries. Variations in deliveries by the day of the week were attributed to obstetric practices. Births weighing less than 2500 gms were over-represented among weekend deliveries as were infants experiencing a birth-related injury. Neonatal mortality was found to be higher among weekend deliveries with a Sunday rate that was 27 per cent above the weekly average. Separate analysis by race and birth weight revealed the weekend peak to be more pronounced among non-whites. Analysis of daily variations by cause of death showed that Sundays exceeded the overall average for seven of the eight cause of death categories examined.

1978

MacFarlane, A. (1978). Variations in number of births and **perinatal mortality** by day of week in England and Wales. *British Medical Journal*, 2(6153), 1670-1673.

Analysis of the births that occurred in England and Wales during 1970-6 showed that they followed a seven-day cycle, being concentrated from Tuesdays to Fridays and least numerous on Sundays. This pattern became increasingly pronounced during the period examined.

Relatively few births occurred on bank holidays, especially Christmas Day and Boxing Day.

In general perinatal mortality was higher among babies born at weekends than among those born on weekdays. It is likely that the pattern seen in the numbers of births is associated to a large extent with elective intervention. It is not possible to draw any conclusions about the pattern seen in perinatal mortality as so far the analysis has been confined to crude rates.