J Shoulder Elbow Surg (2017) 26, e59–e64

Journal of Shoulder and Elbow Surgery

www.elsevier.com/locate/ymse

ORIGINAL ARTICLE

The "July effect" in total shoulder arthroplasty

Allison J. Rao, MD, Daniel D. Bohl, MD, Rachel M. Frank, MD, Gregory L. Cvetanovich, MD, Gregory P. Nicholson, MD, Anthony A. Romeo, MD*

Department of Orthopaedic Surgery, Rush University Medical Center, Chicago, IL, USA

Background: New medical doctors enter their residency fields in July, a time in the hospital in which patient morbidity and mortality rates are perceived to be higher. It remains controversial whether a "July effect" exists in different areas of medicine and surgery, including in orthopedic surgery. The purpose of this study is to test for the July effect in patients undergoing primary total shoulder arthroplasty (TSA).

Methods: Patients who underwent primary TSA from 2005-2012 were identified using the American College of Surgeons National Surgical Quality Improvement Program database. Cases were categorized as involving residents or fellows and as occurring during the first academic quarter. Rates of composite and any adverse event outcomes were compared between patient groups using multivariate logistic regression.

Results: A total of 1591 patients met the inclusion criteria. Of these cases, 711 (44.7%) had resident or fellow involvement and 390 (24.5%) were performed in the first academic quarter. There were few demographic and comorbidity differences between cases with and without residents or fellows or between cases performed during the first quarter and during the rest of the year. Overall, the rate of serious adverse events was 1.6% and the rate of any adverse events was 6.5%.

Discussion and conclusion: Using one of the largest cohorts of primary TSA patients, this study could not provide evidence for a July effect. In the context of the recent growth in the volume of TSA procedures, these findings provide important reassurance to patients that it is safe to schedule their elective procedures at training institutions during the first part of the academic year.

Level of evidence: Epidemiology Study; Large Database Analysis

Keywords: Total shoulder arthroplasty; July effect; American College of Surgeons National Surgical Quality Improvement Program; surgical outcomes; resident involvement; seasonal effect

Every year on July 1, recently graduated medical students become interns and current residents are promoted to elevated levels of expectations and responsibilities. The so-called July effect is a perceived phenomenon in hospitals in which increased morbidity and mortality rates are associated with the influx of new trainees. Multiple high-profile articles have been written in the *New York Times* and *Time* magazine as well as other national news sources highlighting the so-called July effect.[3,8,23,24,27,29] However, it remains controversial whether a July effect exists in different areas of medicine and surgery, including in orthopedic surgery. Although previous reports have suggested higher mortality rates in July, this effect may also represent a sicker patient population and higher volume seen in hospitals during the month of July.

Throughout the medical literature, different specialties have presented data both supporting and negating the July effect.[12,13,25,26,33] The thought of new, inexperienced resi-

Institutional review board approval was not required for this database study.

*Reprint requests: Anthony A. Romeo, MD, Department of Orthopaedic Surgery, Rush University Medical Center, 1611 W Harrison St, Chicago, IL 60661, USA.

E-mail address: Anthony.romeo@rushortho.com (A.A. Romeo).

1058-2746/$ - see front matter © 2017 Journal of Shoulder and Elbow Surgery Board of Trustees. All rights reserved.
http://dx.doi.org/10.1016/j.jse.2016.09.043

dents participating in surgery may result in a public perception of higher risks and may lead patients to avoid elective surgery during the month of July. In the surgical literature, studies have been performed refuting the July effect, relating patient level of disease burden as a risk factor during that time.[9,10,15,20,32] However, some studies still report on this seasonal variation.[11] Recently, Anderson et al[1] used the National Inpatient Sample to look at overall mortality rates of elderly patients hospitalized for a femoral neck or intertrochanteric hip fracture in teaching versus nonteaching hospitals. The overall mortality rate was slightly higher in teaching hospitals (3.69% vs 3.61%, not statistically significant); however, when assessing the adjusted relative risk (RR) in July and August, the authors reported a 12% greater RR of mortality in teaching hospitals during these months, suggesting a July effect. Similarly, Nandyala et al[22] reported on perioperative outcomes after anterior cervical spine fusion using the National Inpatient Sample. They reported that during July, patients treated in teaching hospitals incurred higher rates of superficial infections, longer hospital stays, and more complications such as deep venous thrombosis. Gruskay et al[14] also found a significantly higher incidence of wound infection after spinal surgery during the beginning of the academic year.

Other authors, however, have refuted the existence of the July effect with notable studies involving closed reduction and percutaneous pinning of supracondylar humeral fractures,[2] elective spine surgery,[7,21] primary joint replacement,[6] and adolescent idiopathic scoliosis surgery.[18] Overall, the implications of the July effect can have a significant impact for patients, resident trainees, attending physicians, and hospital systems. With a perceived difference in patient outcomes, such a myth could greatly affect elective orthopedic procedures, deterring patients from undergoing surgery during the early months of the academic year.

The purpose of this study is to test for the July effect in patients undergoing elective primary total shoulder arthroplasty (TSA). We hypothesized that the data would not identify the perceived July effect in patients undergoing elective primary TSA.

Methods

This study used the American College of Surgeons National Surgical Quality Improvement Program (ACS NSQIP) database, a prospective, multi-institutional national database of outcomes. It is an established database that collects outcome-based measures on surgical patients from over 350 hospitals. The collected data are based on medical records rather than insurance records, and include data for patients undergoing both inpatient and outpatient surgery, specifically indicating preoperative comorbidities, intraoperative variables, and postoperative morbidity and mortality outcomes within 30 days.

Patients who underwent primary TSA (reverse or anatomic) during 2005-2012 were identified using the ACS NSQIP improvement program. Cases were categorized based on resident or fellow involvement, as well as whether they occurred during July, August, or September (first academic quarter) versus October through June. By use of ACS NSQIP criteria, each patient was characterized in terms of age (18-59 years, 60-69 years, 70-79 years, ≥80 years); sex; functional status (dependent vs independent); current smoking status; American Society of Anesthesiologists score (1 or 2 vs 3 or 4); and the presence of anemia, chronic obstructive pulmonary disease, dyspnea on exertion, and hypertension.

In addition, we examined 2 composites of adverse events, designated "serious adverse events" (SAEs) and "any adverse events" (AAEs), as well as 23 individual adverse event outcomes. SAEs were defined as previously described and included the following: acute intubation, acute renal failure, cardiac event (including cardiac arrest or myocardial infarction), cerebrovascular event (including stroke), coma for more than 24 hours, pulmonary embolism, sepsis, unanticipated return to the operating room, ventilator dependence for more than 48 hours, and death.[9] AAEs were also defined as previously described and included the following: any of the SAEs previously listed, deep vein thrombosis (including thrombophlebitis), failure of any graft or prosthesis used, injury to the peripheral nerve, infection (including superficial, deep surgical site, deep space, urinary tract, respiratory, or organ), renal insufficiency, transfusion of greater than 5 U, or wound dehiscence.

Statistical analyses were conducted in Stata (version 13.1; StataCorp, College Station, TX, USA). We first conducted comparisons of patient characteristics between groups. A Student *t* test was used for analyses of continuous variables, and a Pearson χ^2 test was used for analyses of categorical variables. Patient characteristics were compared between (1) cases with and without resident involvement and (2) cases occurring during the first academic quarter and during the rest of the year.

Rates of SAEs and AAEs were compared between patient groups using multivariate Poisson regression with robust error variance between (1) cases with and without resident involvement and (2) cases occurring from July through September and occurring from October through June. Multivariate Poisson regression was used so that outcomes could be reported as RRs.[34] These comparisons all included controls for the demographic characteristics and comorbidities noted earlier.

The presence of the July effect was evaluated for using an interaction term. Specifically, multivariate models were constructed with SAEs and AAEs as the outcomes with predictor variables including resident or fellow involvement, academic season, an interaction term between resident or fellow involvement and academic season, and each of the baseline patient characteristics noted earlier. Statistical significance of the interaction term in these models would indicate an interaction between resident involvement and academic quarter. This would represent a change that is specific to having residents present during the first quarter of the academic year—a change that is over and above any baseline change between cases with and without resident involvement or seasonal variation. This process was repeated for each of the individual adverse events. As a final step, operative times were compared between groups using multivariate linear regression with controls for all baseline characteristics, as well as interaction terms, in a manner parallel to that noted earlier.

Results

A total of 1591 patients met the inclusion criteria. Of these cases, 711 (44.7%) had resident or fellow involvement and 390 (24.5%) were performed in the first academic quarter.

Table I Patient demographic characteristics and comorbidities among cases with and without resident or fellow involvement

	Cases without resident or fellow involvement (n = 711)	Cases with resident or fellow involvement (n = 880)	*P* value
Age (mean ± SD), y	68.9 ± 10.8	69.4 ± 11.0	.478
Body mass index (mean ± SD), kg/m^2	30.3 ± 6.2	30.7 ± 6.3	.353
American Society of Anesthesiologists class (mean ± SD)	2.5 ± 0.6	2.4 ± 0.6	.682
Female sex, %	55.3	58.1	.263
Functional dependence, %	3.7	5.7	.060
Diabetes mellitus, %	10.4	14.4	.016
Dyspnea on exertion, %	8.0	7.1	.465
Hypertension, %	68.4	68.5	.943
Chronic obstructive pulmonary disease, %	4.1	3.8	.736
Current smoker, %	7.3	9.1	.201
Anemia, %	15.1	16.7	.370

Table II Patient demographic characteristics and comorbidities among cases performed during first academic quarter versus cases performed during rest of year

	Cases during rest of year (n = 1201)	Cases during first academic quarter (n = 390)	*P* value
Age (mean ± SD), y	69.6 ± 10.6	68.0 ± 11.9	.012
Body mass index (mean ± SD), kg/m^2	30.5 ± 6.2	30.6 ± 6.5	.737
American Society of Anesthesiologists class (mean ± SD)	2.4 ± 0.6	2.5 ± 0.6	.282
Female sex, %	56.2	58.7	.384
Functional dependence, %	4.3	6.2	.142
Diabetes mellitus, %	12.7	12.3	.842
Dyspnea on exertion, %	6.7	9.7	.050
Hypertension, %	69.3	65.9	.212
Chronic obstructive pulmonary disease, %	3.7	4.6	.399
Current smoker, %	7.7	10.3	.106
Anemia, %	16.1	15.6	.841

There were few demographic and comorbidity differences between cases with and without residents or fellows (Table I). Similarly, there were few demographic and comorbidity differences between cases performed during the first 3 months of the academic year and cases performed during the rest of the year (Table II).

After adjustment for demographic characteristics and comorbidities, resident involvement in cases had no impact on the rate of SAEs (1.28% vs 1.67%; RR, 0.77; 95% confidence interval [CI], 0.35-1.70; $P = .520$) or the rate of AAEs (7.50% vs 5.34%; RR, 1.38; 95% CI, 0.94 to 2.01; $P = .098$). Similarly, after adjustment for demographic characteristics and comorbidities, seasonality had no impact on the rate of SAEs (1.28% vs 1.67%; RR, 0.79; 95% CI, 0.29 to 2.20; $P = .662$) or AAEs (6.67% vs 6.49%; RR, 0.98; 95% CI, 0.64-1.49; $P = .912$).

Overall, the rate of SAEs was 1.6% and the rate of AAEs was 6.5%. Critically, after adjustment for demographic characteristics and comorbidities, the interaction term was not associated with SAEs (RR, 0.5; 95% CI, 0.1-3.7; $P = .529$) or AAEs (RR, 0.8; 95% CI, 0.3-1.9; $P = .586$; Table III). Similarly, in the analyses of each of the individual adverse events, in no case was the interaction term associated with occurrence of the adverse event ($P > .05$ in all cases; Table III).

Cases with resident involvement had a shorter operative time than cases without resident involvement (113.2 minutes vs 121.1 minutes, $P < .001$). However, there was no difference in operative time between cases occurring during the first academic quarter and cases occurring during the rest of the year (117.2 minutes vs 116.6 minutes, $P = .882$). Finally, the interaction term was not associated with operative time (coefficient, 9.2; 95% CI, –1.3 to 19.7; $P = .087$).

Discussion

The July effect is a hypothetical, perceived phenomenon that associates higher morbidity and mortality rates among patients treated in July with the addition of new residents and trainees. By using the ACS NSQIP database, one of the largest cohorts of primary TSA patients to date, this study could not provide evidence for a July effect in primary TSA.

Seasonality in elective surgical outcomes has previously focused on resident inexperience as responsible for a July

Table III Evaluation for July effect in total shoulder arthroplasty

	Adverse event rate, %				Interaction term*		
	Rest of year (n = 1201)		First academic quarter (n = 390)				
	No residents or fellows (n = 546)	Residents or fellows (n = 655)	No residents or fellows (n = 165)	Residents or fellows (n = 255)	RR	95% CI	*P* value
Composite adverse event outcomes							
Serious adverse events	1.74	1.57	1.99	0.88	0.49	0.07-3.39	.470
Any adverse events	5.17	7.74	5.85	6.89	0.78	0.33-1.87	.586
Individual adverse events†							
Death	0.00	0.31	0.00	0.44	—	—	—
Coma	0.00	0.00	0.00	0.00	—	—	—
Failure to wean from ventilator	0.00	0.00	0.61	0.00	—	—	—
Re-intubation	0.00	0.00	0.00	0.44	—	—	—
Cerebrovascular accident	0.37	0.31	0.00	0.00	—	—	—
Pulmonary embolism	0.18	0.15	0.61	0.00	—	—	—
Cardiac arrest requiring resuscitation	0.18	0.00	0.00	0.44	—	—	—
Myocardial infarction	0.18	0.15	0.00	0.00	—	—	—
Renal insufficiency	0.00	0.00	0.00	0.00	—	—	—
Sepsis	0.18	0.15	0.61	0.00	—	—	—
Septic shock	0.00	0.15	0.00	0.44	—	—	—
Return to operating room	0.73	0.46	0.61	0.44	0.71	0.02-24.03	.851
Dehiscence	0.00	0.15	0.00	0.00	—	—	—
Superficial surgical site infection	0.00	0.00	0.00	0.44	—	—	—
Deep surgical site infection	0.00	0.15	0.00	0.00	—	—	—
Organ/space surgical site infection	0.00	0.15	0.00	0.00	—	—	—
Urinary tract infection	0.92	0.92	1.82	1.78	1.00	0.14-6.96	.997
Pneumonia	0.55	0.46	1.21	0.44	0.35	0.02-6.79	.486
Anemia requiring transfusion	1.83	4.73	2.42	4.00	0.64	0.18-2.31	.492
Renal failure	0.00	0.00	0.00	0.00	—	—	—
Graft, prosthesis, or flap failure	0.18	0.00	0.00	0.00	—	—	—
Peripheral nerve injury	0.18	0.76	0.00	0.00	—	—	—
Deep vein thrombosis	0.37	0.15	0.61	0.44	2.10	0.09-48.74	.643

CI, confidence interval; RR, relative risk.

* Interaction term derived from multivariate regression with predictor variables that included resident involvement, first quarter of the year, an interaction term for resident involvement and first quarter of the year, and controls for demographic and comorbidity variables. Statistical significance of the interaction term would indicate an interaction between the presence of residents and the first academic quarter. This would represent a change that is specific to having residents present during the first quarter of the academic year—a change that would be over and above any baseline seasonal variation and over and above any baseline change between cases with and without resident involvement. In short, a statistically significant term would indicate the presence of a July effect.

† Statistical analysis could not be performed when there were no adverse events occurring in one or more groups in the four groups.

effect. However, this study showed no significant differences in TSAs performed from July through September compared with the remainder of the year. Gruskay et al[14] examined spine surgery rates of postoperative infection and did find a significant difference in summer compared with the other seasons. However, they acknowledge that many additional factors contributed to seasonal differences including elevated temperatures and humidity conducive to infection and increased trauma-related admissions in the summer months.

In addition, our study specifically found no significant difference in cases with or without resident involvement. Haughom et al[16,17] similarly reported this finding looking at total hip arthroplasty and total knee arthroplasty. They found that 30-day complication rates were not affected by resident involvement. Factors that did influence 30-day complication rates included increased age, comorbidities, history of stroke and/or cardiac surgery, obesity, and operative time.[16,17] However, across all orthopedic specialties, including joint replacement, revision cases, spinal fusions, and orthopedic trauma, Pugely et al[28] did find that resident involvement was associated with increased minor morbidity, operative time, and length of hospital stay. They concluded that to address these concerns, future initiatives should be undertaken to improve resident surgical skills training in the academic setting.

New focus has been placed on resident work hours within surgical fields. In 2003, the Accreditation Council for Graduate Medical Education announced new restrictions, limiting the work week to less than 80 hours, limiting on-call shifts to no more than 1 in 3 nights, and mandating more than 1 day off in a 7-day cycle.[30] However, after the duty-hour reform, no significant changes were seen in outcomes comparing teaching hospitals with nonteaching hospitals.[30] With no differences seen in outcomes after limiting resident work hours, similar to the July effect and the perceived notion that resident inexperience or overextension contributes to poor surgical outcomes, the question became, 'Do these restrictions need to exist?'

The goal of these limited work hours has recently come into question with the Flexibility in Duty Hour Requirements for Surgical Trainees (FIRST) trial.[4,5] In this trial, 118 general surgery residency programs in 154 hospitals were randomized either to the established Accreditation Council for Graduate Medical Education work-hour restrictions or to the intervention arm. The goal of this study will be to examine prospective data to assess the effect of changes in work-hour regulations on patient outcomes as well as resident education and well-being. This could also potentially affect the perceived July effect throughout surgical specialties, showing that work-hour restrictions and restricting resident and fellow involvement in the early months may not adversely affect patient outcomes.

Limitations

There are notable limitations to this study. Notably, there are no available data on the long-term outcomes after TSA. These specific outcomes, including rates of infection, dislocation, and reoperation, as well as functional outcomes, are beyond the scope of this study, which focused on 30-day perioperative outcomes. In addition, data were not available on the resident's level of training, ranging from postgraduate year (PGY) 1 to PGY 5. There is no available information on the level of resident or fellow involvement, and a significant different exists between watching a surgical case and being actively involved. Because TSA is a more complex surgical procedure, there may be a selection bias looking at a procedure with limited junior resident involvement, potentially affecting the 30-day perioperative outcomes. The reported outcomes that come from this pooled database study may be below those of individually reported surgeons; however, given that this database provides only 30-day perioperative reported outcomes, it may be similar to studies focusing on this early period.[19,31] Future studies looking at long-term outcomes and stratifying based on PGY would be valuable studies to further investigate the July effect.

Conclusions

Restricted work hours and the myth of the July effect can both limit trainees' surgical experience. As the ultimate goal of training programs is to produce well-trained, experienced surgeons, disproving the association between seasonality and outcomes can lead to increased resident participation in cases and enhanced clinical training. In the context of the recent growth in the volume of TSA procedures, these findings provide important reassurance to patients that it is safe to schedule their elective shoulder replacement procedures at training institutions during the first portion of the academic year.

Disclaimer

The authors, their immediate families, and any research foundations with which they are affiliated have not received any financial payments or other benefits from any commercial entity related to the subject of this article.

References

1. Anderson KL, Koval KJ, Spratt KF. Hip fracture outcome: is there a "July effect"? Am J Orthop (Belle Mead NJ) 2009;38:606-11.
2. Bagsby DT, Loder RT, Myung K. Operative intervention of supracondylar humerus fractures more complicated in July: analysis of the July effect. J Pediatr Orthop 2015. http://dx.doi.org/10.1097/BPO.0000000000000618. [e-pub ahead of print]
3. Bakalar N. Focus on hospitals "July effect". New York Times. <http://well.blogs.nytimes.com/2013/02/04/focus-on-hospitals-july-effect/>; February 4, 2013. [accessed 31.01.16].
4. Bilimoria KY, Chung JW, Hedges LV, Dahlke AR, Love R, Cohen ME, et al. Development of the flexibility in duty hour requirements for surgical trainees (FIRST) trial protocol: a national cluster-randomized trial of

resident duty hour policies. JAMA Surg 2016;151:273-81. http://dx.doi.org/10.1001/jamasurg.2015.4990

5. Bilimoria KY, Hoyt DB, Lewis F. Making the case for investigating flexibility in duty hour limits for surgical residents. JAMA Surg 2015;150:503-4. http://dx.doi.org/10.1001/jamasurg.2015.0239
6. Bohl DD, Fu MC, Golinvaux NS, Basques BA, Gruskay JA, Grauer JN. The "July effect" in primary total hip and knee arthroplasty: analysis of 21,434 cases from the ACS-NSQIP database. J Arthroplasty 2014;29:1332-8. http://dx.doi.org/10.1016/j.arth.2014.02.008
7. Bohl DD, Fu MC, Gruskay JA, Basques BA, Golinvaux NS, Grauer JN. "July effect" in elective spine surgery: analysis of the American College of Surgeons National Surgical Quality Improvement Program database. Spine 2014;39:603-11. http://dx.doi.org/10.1097/BRS.0000000000000196
8. Brown T. Don't get sick in July. New York Times. <http://opinionator.blogs.nytimes.com/2012/07/14/dont-get-sick-in-july/>; July 22, 2012. [accessed 31.01.16].
9. Ehlert BA, Nelson JT, Goettler CE, Parker FM, Bogey WM, Powell CS, et al. Examining the myth of the "July phenomenon" in surgical patients. Surgery 2011;150:332-8. http://dx.doi.org/10.1016/j.surg.2011.05.016
10. Englesbe MJ, Fan Z, Baser O, Birkmeyer JD. Mortality in Medicare patients undergoing surgery in July in teaching hospitals. Ann Surg 2009;249:871-6. http://dx.doi.org/10.1097/SLA.0b013e3181a501bd
11. Englesbe MJ, Pelletier SJ, Magee JC, Gauger P, Schifftner T, Henderson WG, et al. Seasonal variation in surgical outcomes as measured by the American College of Surgeons-National Surgical Quality Improvement Program (ACS-NSQIP). Ann Surg 2007;246:456-62, discussion 463-5. http://dx.doi.org/10.1097/SLA.0b013e31814855f2
12. Garcia S, Canoniero M, Young L. The effect of July admission in the process of care of patients with acute cardiovascular conditions. South Med J 2009;102:602-7. http://dx.doi.org/10.1097/SMJ.0b013e3181a2f8ca
13. Gopaldas RR, Overbey DM, Dao TK, Markley JG. The impact of academic calendar cycle on coronary artery bypass outcomes: a comparison of teaching and non-teaching hospitals. J Cardiothorac Surg 2013;8:191. http://dx.doi.org/10.1186/1749-8090-8-191
14. Gruskay J, Smith J, Kepler CK, Radcliff K, Harrop J, Albert T, et al. The seasonality of postoperative infection in spine surgery. J Neurosurg Spine 2013;18:57-62. http://dx.doi.org/10.3171/2012.10.SPINE12572
15. Harring TR, Nguyen NT, Liu H, Goss JA, O'Mahony CA. Liver transplant fellowship and resident training is not a part of the "July effect". J Surg Res 2013;182:1-5. http://dx.doi.org/10.1016/j.jss.2012.08.008
16. Haughom BD, Schairer WW, Hellman MD, Yi PH, Levine BR. Does resident involvement impact post-operative complications following primary total knee arthroplasty? An analysis of 24,529 cases. J Arthroplasty 2014a;29:1468-72, e2. http://dx.doi.org/10.1016/j.arth.2014.02.036
17. Haughom BD, Schairer WW, Hellman MD, Yi PH, Levine BR. Resident involvement does not influence complication after total hip arthroplasty: an analysis of 13,109 cases. J Arthroplasty 2014b;29:1919-24. http://dx.doi.org/10.1016/j.arth.2014.06.003
18. Hoashi JS, Samdani AF, Betz RR, Bastrom TP, Harms Study Group, Cahill PJ. Is there a "July effect" in surgery for adolescent idiopathic scoliosis? J Bone Joint Surg Am 2014;96:e55. http://dx.doi.org/10.2106/JBJS.M.00150
19. Leroux TS, Basques BA, Frank RM, Griffin JW, Nicholson GP, Cole BJ, et al. Outpatient total shoulder arthroplasty: a population-based study comparing adverse event and readmission rates to inpatient total shoulder arthroplasty. J Shoulder Elbow Surg 2016;25:1780-6. http://dx.doi.org/10.1016/j.jse.2016.04.006.
20. Lieber BA, Appelboom G, Taylor BE, Malone H, Agarwal N, Connolly ES Jr. Assessment of the "July effect": outcomes after early resident transition in adult neurosurgery. J Neurosurg 2016;125:213-21. http://dx.doi.org/10.3171/2015.4.JNS142149
21. McDonald JS, Clarke MJ, Helm GA, Kallmes DF. The effect of July admission on inpatient outcomes following spinal surgery. J Neurosurg Spine 2013;18:280-8. http://dx.doi.org/10.3171/2012.12.SPINE12300
22. Nandyala SV, Marquez-Lara A, Fineberg SJ, Singh K. Perioperative characteristics and outcomes of patients undergoing anterior cervical fusion in July: analysis of the "July effect". Spine 2014;39:612-7. http://dx.doi.org/10.1097/BRS.0000000000000182
23. O'Connor A. Really? The claim: hospital mortality rates rise in July. New York Times. <http://well.blogs.nytimes.com/2011/07/04/really-the-claim-hospital-mortality-rates-rise-in-july/>; July 4, 2011. [accessed 31.01.16].
24. Park A. The July effect: why summer is the most dangerous time to go to the hospital. Time. <http://healthland.time.com/2011/07/12/the-july-effect-why-summer-is-the-most-dangerous-time-to-go-to-the-hospital/>; July 12, 2011. [accessed 31.01.16].
25. Park TH, Redelmeier DA, Li S, Pongmoragot J, Saposnik G, the Investigators of the Registry of the Canadian Stroke network (RCSN) for the Stroke Outcomes Research (SORCan) Working Group. Academic year-end changeover and stroke outcomes. J Stroke Cerebrovasc Dis 2015;24:500-6. http://dx.doi.org/10.1016/j.jstrokecerebrovasdis.2014.09.030
26. Phillips DP, Barker GE. A July spike in fatal medication errors: a possible effect of new medical residents. J Gen Intern Med 2010;25:774-9. http://dx.doi.org/10.1007/s11606-010-1356-3
27. Pines ZF, Ma JM. "July effect" revisited: why experienced docs may not deliver the best care. Time. <http://healthland.time.com/2012/07/17/the-july-effect-revisited-why-the-most-experienced-doctors-dont-always-deliver-the-best-medical-care/>; July 17, 2012. [accessed 31.01.16].
28. Pugely AJ, Gao Y, Martin CT, Callagh JJ, Weinstein SL, Marsh JL. The effect of resident participation on short-term outcomes after orthopaedic surgery. Clin Orthop Relat Res 2014;472:2290-300. http://dx.doi.org/10.1007/s11999-014-3567-0
29. Rabin RC. Risks: perhaps July's reputation is justified. New York Times. <http://www.nytimes.com/2011/07/12/health/research/12risks.html>; July 11, 2011. [accessed 31.01.16].
30. Scally CP, Ryan AM, Thumma JR, Gauger PG, Dimick JB. Early impact of the 2011 ACGME duty hour regulations on surgical outcomes. Surgery 2015;158:1453-61. http://dx.doi.org/10.1016/j.surg.2015.05.002
31. Smucny M, Menendez ME, Ring D, Feeley BT, Zhang AL. Inpatient surgical site infection after shoulder arthroplasty. J Shoulder Elbow Surg 2015;24:747-53. http://dx.doi.org/10.1016/j.jse.2014.12.024
32. Soleimani Rahbar A, Hsu JC, Han FT, Nguyen N, Kwon M, Azadani PN, et al. Trainee inexperience is associated with longer procedure times but no increase in complications for cardiac device implantation. Heart Rhythm 2013;10:1755-8. http://dx.doi.org/10.1016/j.hrthm.2013.09.003
33. Young JQ, Ranji SR, Wachter RM, Lee CM, Niehaus B, Auerbach AD. "July effect": impact of the academic year-end changeover on patient outcomes: a systematic review. Ann Intern Med 2011;155:309-15. http://dx.doi.org/10.7326/0003-4819-155-5-201109060-00354
34. Zou G. A modified Poisson regression approach to prospective studies with binary data. Am J Epidemiol 2004;159:702-6. http://dx.doi.org/10.1093/aje/kwh090