Systematic Review of the Literature: Resident Duty Hours and Related Topics

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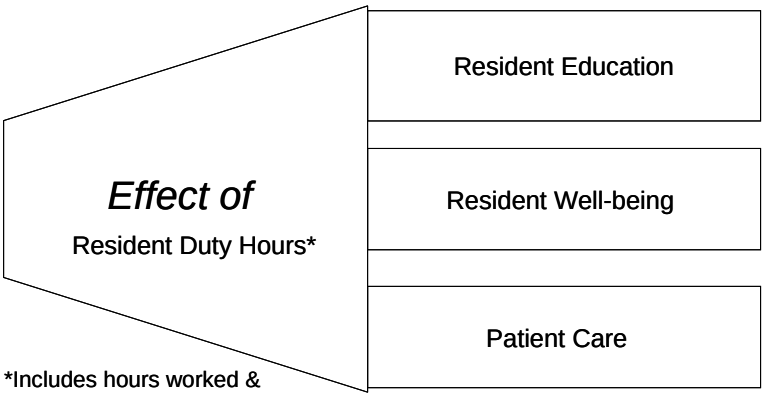
Excecutive Summary

In 2003, the Accreditation Council for Graduate Medical Education (ACGME) mandated duty-hour restrictions with a goal to reduce resident sleep loss and fatigue, and improve patient safety (Philibert, 2002). This decision was fueled in part due to public concerns that physicians-in-training are overworked and that the resulting fatigue contributes to medical errors. Research from the sleep community that demonstrates that sleep deprivation impairs performance also raised concerns. With little data to guide these decisions, the shift limits were largely based on New York State's experiments with duty hour regulations which began in 1998 and limited hours to 80 per week. The New York State Code 405 regulations were a result of the Bell Commission's examination of graduate medical education in the wake of Libby Zion's death, and were based on the best opinions of experts, but not on strict science (Bell, 2007).

Since 2003, several articles examining the effects of the ACGME duty hour regulations on a variety of relevant outcomes (including patient safety, resident education and wellbeing, and working conditions) have been published (Fletcher, 2005; Fletcher, 2004). In addition, research studies examining sleep deprivation and neurocognitive outcomes in physicians and non-physicians have been reviewed (Philibert, 2005). Systematic examination of this literature is of utmost importance five years after the implementation of duty hour reform due to the recent recommendations for further restrictions in duty hours put forth in December 2008 in the Institute of Medicine Report on Duty Hours, Supervision, and Patient Safety (Resident Duty Hours: Enhancing Sleep, Supervision, and Safety, 2008). The ACGME has launched a formal process to refine and revise duty hours. Reviewing the literature and the strength of the evidence is a

critical first-step in designing evidence-based policy changes to the current proposed rules (ACGME Request for Proposals, 2009). Specific attention to field studies examining the impact of duty hour reductions and related interventions among residents in actual practice are particularly relevant given the concerns regarding implementation of the Institute of Medicine recommendations (Blanchard 2009). Reviewing the evidence is also important to inform the current debate and to highlight gaps in the literature from which to direct the design and conduct of future studies in this area.



Standalone reviews:

1. Supervision
2. Workload (including scope of work, etc.)

In response the Request for Proposals from the ACGME for thorough reviews of the literature over the past 20 years relevant to a broad array of topics in graduate medical education, our aims were to perform a systematic review to investigate the effect of the 2003 resident duty hours on resident education, well-being and patient care. In addition, the past 20 years of literature was reviewed to understand the impact of various staffing and scheduling models, such as appropriate shift length, implementation of night float, and moonlighting. Lastly, stand-alone reviews not specifically related to duty hours were performed examining supervision and workload given their central role in resident work environment.

It is important to note that certain literature was not considered the focus of this review. Specifically, this review does not cover sleep literature that focuses on neurocognitive outcomes or the myriad of studies that assess the generic topic of "learning environment." While important to consider in the debate on residency duty hours, sleep deprivation and neurocognitive outcomes in residents have been covered in a prior review (Philibert, 2005). Due to the expansive nature of the learning environment, which includes topics such as curricular evaluation, professionalism, and burnout to name a few, we restricted the focus of this review to studies of learning environment that relate to duty hour restrictions directly or through our focus areas (i.e. workload, supervision). In addition, literature that evaluated the impact of duty hour restrictions prior to 2003 were covered in prior systematic reviews and will not be repeated here (Fletcher, 2005; Fletcher, 2004). Finally, our focus was predominantly limited to studies that took place in the US. While our initial search strategy did not eliminate papers from other countries, the uniqueness of the US medical system/graduate medical education system convinced us to narrow our scope. Synthesizing the volume of data that exists for studies done in the US was daunting, but including the rest of the world's experience would have been nearly impossible.

A comprehensive search strategy was developed in consultation with reference librarian to ensure capture of the target literature. Using this search strategy, Medline, Premedline, and Embase were searched with a focus on studies relating to graduate medical education. Abstracts were reviewed by the three investigators (See Figure). Articles were excluded if they did not describe original research or if they did not address one of the topics in the review. For those articles that were included in this review, data

was abstracted into a structured data abstraction tool in a database called Research Electronic Data Capture (REDCap), which is a secure internet-based program that allows multiple users at different sites to access it at any time. It is maintained by the Medical College of Wisconsin's Clinical Translational Science Institute (Harris, 2009)..

To assess study quality, the Medical Education Research Quality Index (MERSQI) was used. The MERSQI, developed by Dr. Reed and colleagues, has been shown to have content validity, interrater, intrarater, & internal consistency reliability, criterion validity, and predictive validity. (Reed, 2008; Reed, 2007). The MERQSI evaluates six domains of study quality: design, sampling, type of data, validity, data analysis and outcomes. Items are scored on an ordinal scale with a maximum 18 allowable points. Another major advantage of the MERSQI is that is easily applied to any medical education study, regardless of design, method, or outcome. Previous work by Reed et al has demonstrated that a MERSQI score of 9.95 is average for medical education research studies overall (Reed, 2007).

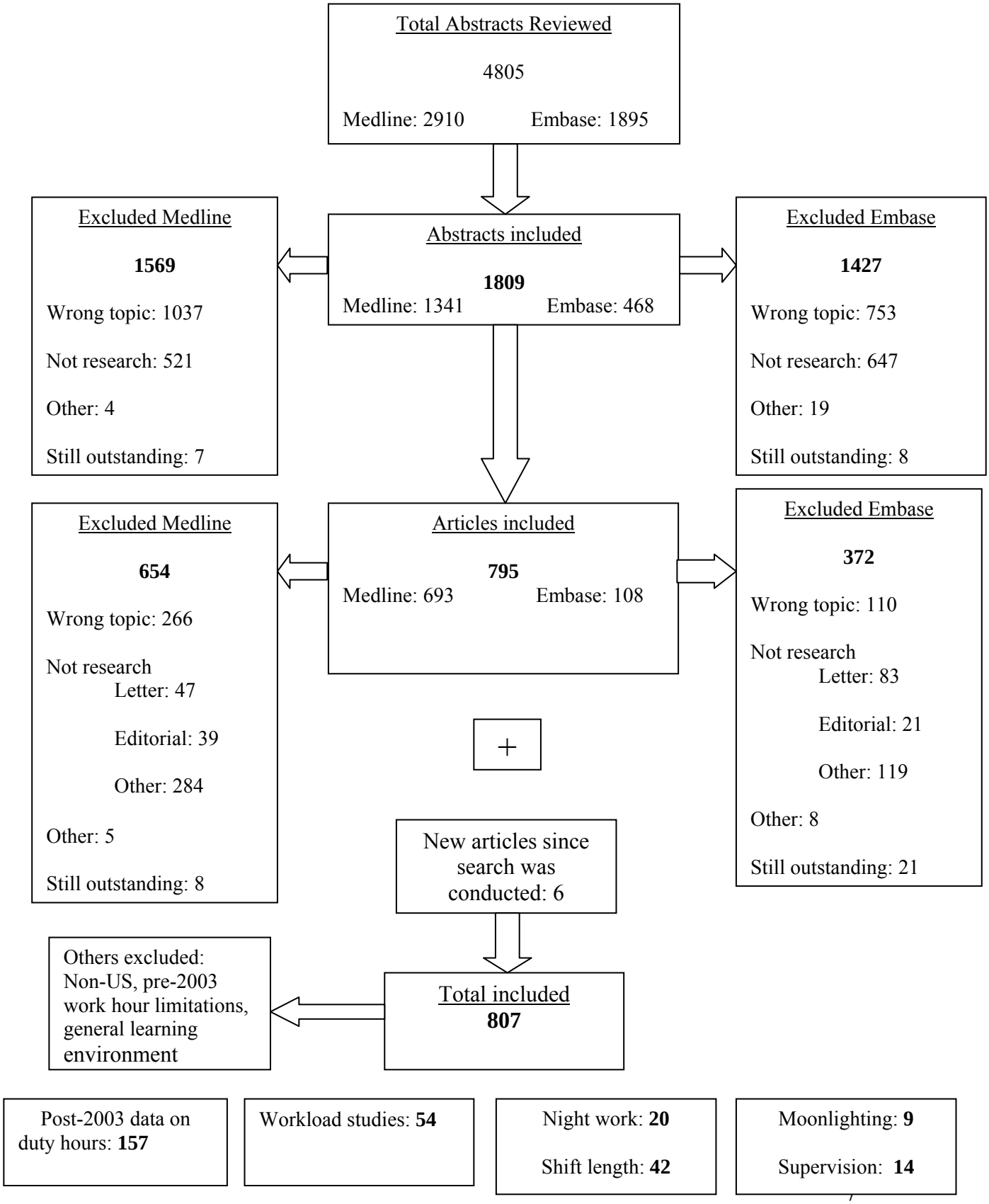
The following paper reflects the major areas of work from this systematic review that are relevant to the current debate on resident duty hours, specifically addressing questions surrounding the impact of the current ACGME duty hour rules, the optimal shift length, what is known about night float systems, workload, supervision, and moonlighting. The areas of the report are as follows:

1) Review of studies examining the impact of the 2003 ACGME duty hour rules on resident health, education (i.e. test scores, operative experience), and patient safety;

2) Review of studies examining the impact of consecutive work hours (shift length) on resident or patient outcomes;
3) Review of studies examining the impact of night float/night work on resident or patient outcomes;
4) Review of studies examining the type of work residents do in addition to the impact of resident workload on resident and patient outcomes, and interventions that have been tested to reduce workload;
5) Review of studies related to moonlighting; and
6) Review of studies related to supervision.

Portions of this report are under review for publication. Attached are the summary abstracts presented at national meetings regarding these topics and the annotated bibliography of all studies in the review.

Figure 1: Inclusion and Exclusion process



Abstracts Presented at National Meetings:

1. Fletcher K, Reed D, Arora VM. What was the Impact of the 2003 ACGME Duty Hour Rules? Patient Safety, Resident Education and Resident Well-Being. (page 9-10)

2. Reed D, Fletcher K, Arora VM. Effect of Shift Length and Protected Sleep Time on Residents' Health, Education, and Patient Care: A Systematic Review. (page 11-12)

3. Arora VM, Fletcher K, Reed D. Systematic Review of Resident Workload and Work Activity: Impact on Resident Education and Patient Care. (pages 13-14)

4. Farnan J, Prochaska M, Georgitis E, Martin S, Petty L, Arora V. Effect of Supervision on Residency Education and Patient Outcomes: Results of a Systematic Review. (page 15-16)

What was the Impact of the 2003 ACGME Duty Hours Rules? Patient Safety, Resident Education, and Resident Well-Being

Kathlyn Fletcher, MD, MA, Darcy Reed, MD, MPH, Vinny Arora, MD, MA

BACKGROUND: In July 2003, the Accreditation Council for Graduate Medical Education implemented duty hour rules for all US residents. In December 2008, the Institute of Medicine released a report urging additional restrictions. The issues at stake are patient safety, resident education and resident well-being. Given that 6 years have elapsed since the initial rules, we under took a systematic review of the literature to determine what progress has been made toward improving these outcomes. METHODS: We developed an electronic search strategy in Medline and Embase in consultation with research librarians. Because this was part of a larger project, we included the years1989-2009. We reviewed the resulting abstracts for inclusion based on whether they represented research and were on a relevant topic relevant. Papers corresponding to the included abstracts were reviewed in detail for inclusion. For this project, included papers had to be from the US and had to contain data collected after the 2003 duty hour rules went into effect. To assess study quality, the previously validated Medical Education Research Quality Index (MERSQI) was used. Abstracted data was entered into a secure web-based database.

RESULTS: The search yielded 4805 papers. Of those, 1809 abstracts were reviewed in further detail. We identified 158 studies of the impact of the 2003 duty hour rules. The main findings were related to patient safety, resident education and resident well- being. Fifteen studies assessed mortality in medical or surgical patients. Several studies showed improvement in mortality in the post-duty hour time period. The others showed no

change. In the sole exception, a subset of patients with stroke had worsened mortality. The 19 studies assessing complications in the post-duty hour period had mixed results with about the same number of studies showing improvements as showed worsening. For resident education, standardized test scores seemed to mostly remain unchanged in the post-duty hour time period. Operative experience was much more variable, with many studies reporting decreased operative experience. No internal medicine studies of experience have been done. Finally, resident well-being, as measured by burnout, appears to have improved in the post-duty hour rule period.

CONCLUSIONS: The 2003 duty hour rules appear to have had an impact on patients and residents. Mortality seems to have improved, or at worst, not changed. The impact on complications is mixed and should be assessed more thoroughly. The impact on resident education, especially in terms of operative experience is worrisome, but well-being appears to have improved. More work is needed to delineate the variability in the outcomes of patient complications and resident experience. Overall, the impact of the duty hour rules appears to have been positive.

Effect of Shift Length and Protected Sleep Time on Residents' Health, Education, and Patient Care: A Systematic Review

Darcy Reed, MD, MPH, Kathlyn Fletcher, MD, MA, Vineet Arora, MD, MA

BACKGROUND: A recent report by the Institute of Medicine on sleep and fatigue among resident physicians triggered resurgence in the national debate over residents' duty hours. Among the most controversial recommendations contained in the report is the suggestion that residents should work no more than 16 consecutive hours without rest. After 16 hours, residents must leave the hospital or be provided with 5 hours of protected sleep time (i.e. "nap"). If implemented, this policy would eliminate "overnight long call" shifts that have traditionally been a central component of residency training. Field studies examining shift length and protected sleep time among residents have not been comprehensively reviewed. Therefore, we systematically reviewed the published literature examining the effect of shift length and protected sleep time on residents 'health, education, and patient care.

METHODS: We searched the English literature in Medline, Pre-Medline, and Embase from 1989-2009, combining multiple Medical Subject Heading terms for work hours, works scheduling, sleep and fatigue with numerous terms for internship, residency and graduate medical education. Studies were included if they 1)reported a shift length in hours, 2) compared a longer shift length to a shorter shift length, 3) described at least one out come related to residents' health, education, or patient care, and 4)occurred in an actual practice setting such as an inpatient ward, operating room, or emergency room. All studies examining protected sleep time were also included. Disagreements regarding study inclusion were resolved by consensus. Study quality was assessed using the

validated Medical Education Research Quality Instrument (MERSQI, scorerange5-18). **RESULTS:** The search yielded 480 articles, of which 31 studies met inclusion criteria. Studies examined shifts ranging from 6 to 36 hours; just 3 unique studies described a 16-hourshift. The mean (SD) MERSQI score of studies was 13. 11 (2.60). Twenty-six (84%) studies were conducted at a single institution, 24 (77%) reported objective data, 10 (32%) described validity evidence for evaluation instruments. Sixteen studies reported a resident health outcome, with all but one of these studies favoring shorter shifts. Shorter shifts were associated with improvements in residents' mental health and decreased risk of percutaneous injuries and motor vehicle crashes. Of the 10 studies examining resident's education, 6 reported neutral findings and 4 favored shorter shifts. No study showed improved education with longer shifts. Eleven studies examined the impact of shift length on patient care; the highest quality studies showed reductions in medical errors with shorter shifts. Just 2 studies examined protected sleep time. These studies suggested that naps may improve sleep and fatigue, but residents' adherence to naps is limited. **CONCLUSIONS**: Few studies have examined the effect of shift length and protected sleep time on residents' health, education, and patient care in actual practice settings. However, the highest quality studies demonstrated that shorter shifts were associated with improved resident health and decreased medical errors. Although more research is needed, the results of this review support reducing shift length. Further studies examining the feasibility and acceptability of protected sleep time are needed before broad based policy changes are implemented.

Systematic Review of Resident Workload and Work Activity: Impact on Resident Education and Patient Care

Vineet Arora, MD, MA, Darcy Reed, MD, MPH, Kathlyn Fletcher, MD, MA

BACKGROUND: As further limits in resident duty hours are considered, anecdotes of detrimental effects of work intensification (same amount of work in less time) and the continued reliance on residents for tasks of limited educational value ("scut") are prominent. The aim of this study was to systematically review the literature to examine how residents spend their time, and assess the impact of workload and work solutions on resident education and patient care.

METHODS: In consultation with a biomedical librarian, we conducted an electronic search of the English literature in Medline and Embase from1989-2009. We exploded over 20 Medical Subject Heading terms related to workload, work, work environment, etc. Workload terms were combined with multiple terms for “graduate medical education” and “residency”. Each study was abstracted into an online Research Electronic Data Capture (REDCap) database. To assess study quality, the previously validated Medical Education Research Quality Index (MERSQI) was used (range 5-18, mean 10).

RESULTS: The search yielded 4805 articles of which 54 met inclusion criteria. Overall, the 21 studies examining resident time allocation suggest that at least one third of resident time is spent on activities of limited educational value. 8 of the 9 studies evaluating the impact of resident workload on patient care (mean MERSQI 12.5) showed a negative impact on outcomes including length of stay, mortality, patient satisfaction, medication errors, and lab utilization. All 8 studies (mean MERSQI 11.0) that examined the impact

of workload on resident health (sleep, fatigue, and markers of physiologic stress) or resident education (test scores, learning styles, participation in educational activities) were negative. 16 studies demonstrated successful off load of resident tasks to other staff (physician extenders, hospitalists, etc). Studies indicated that off setting workload may enable residents to take advantage of more educational opportunities (e.g. attending conferences). Drawbacks of offloading tasks to other staff included confusion about role of non resident staff, high turn over, and cost.

CONCLUSIONS: A significant fraction of resident time is of limited educational value. Excessive workload has a negative impact on resident education and patient care. Workload solutions, such as hospitalists and physician extenders, can improve resident learning without impacting patient care. As further limits in resident duty hours are debated, optimal workload and work activity for resident should be considered to maximize learning and patient outcomes.

Effect of Supervision on Residency Education and Patient Outcomes: Results of a Systematic Review

Lindsay Petty, Shannon Martin, Emily Georgitis, Meryl Prochaska , Jeanne M. Farnan, Vineet M. Arora

Background: The recent Institute of Medicine report on the residency duty hour regulations recommends trainee supervision by a qualified on-site faculty physician at all hours as a way to improve both housestaff education and patient safety. Trainees have identified inadequate supervision as a common cause of medical errors. The ACGME has called for comprehensive review of the literature in this area to inform future changes in GME. The aim of our review is to summarize the existing literature describing the effect of clinical supervision on residency education and patient outcomes.

Methods: A search was performed of the English-language literature from 1966 to present utilizing PubMed, hand-searching and review of the reference list of all articles included. Inclusion criteria for studies were those which described a controlled design with a supervision-related educational or patient outcome. For each study included, two authors abstracted data related to study design, type of supervision, clinical setting, supervisor and trainee role, specialty and supervision-related outcomes. Overall quality of the study was rated using the Medical Education Research Study Quality Instrument (MERQSI).

Results: 1, 427 citations were identified via our search-strategy, of those 1,197 were eliminated by title, wrong topic or non-English language. 230 articles underwent detailed review, 217 articles were excluded because of wrong topic, non-research report and observational study. Overall, 14 articles met inclusion criteria in the fields of psychiatry

(4), emergency medicine (3), surgery (3), anesthesiology (1) and internal medicine (3). Of included studies, six examined the impact of a direct supervision intervention, four evaluated participatory supervision and six evaluated indirect models of supervision. Two studies compared supervisory strategies, one comparing direct versus participatory attending supervision and the other comparing direct and indirect. Three studies were randomized controlled clinical trials. Five studies evaluated the impact of a supervision intervention on education-related outcomes and eleven evaluated the impact of a supervisory intervention on patient-related outcomes Overall, the majority of studies demonstrated that enhanced attending-level supervision resulted in improved resident or patient outcomes. Only one study examined the impact of enhanced nighttime supervision for psychiatry residents during emergency room shifts, which did not demonstrate any change in residents' rating of the educational value of the rotation and did not examine patient outcomes. The majority of the studies included were limited by small sample size, non-randomized designs, single institution, and lack of objective measure of clinical supervision.

Conclusions: Based on the results of this review, enhanced supervision of residents in a variety of clinical situations, including inpatient and ambulatory care, may result in improved education and patient-related outcomes. However, there is insufficient evidence to support enhanced continuous on-site attending supervision. Future work should focus on understanding the role of on-site supervisors, whether enhanced on-site supervision by attendings results in improved educational and patient outcomes and developing validated measures of clinical supervision.

Acknowledgements

There are numerous people we would like to thank who contributed to the data presented in this report. At the University of Chicago, we are grateful for the contributions of the following individuals: Meryl Prochaska, Emily Chiu, Diane Daviera, Jeanne Farnan, MD, Lindsay Petty, MD, Emily Georgitis, MD, and Shannon Martin, MD. From the Medical College of Wisconsin/VAMC, we are grateful to Andrea Bruckbauer, Katya Papatla, Alexis Dye, Mark Oium, Rita Sieracki and Jack Littrell. From the Mayo Clinic College of Medicine, we would like to thank Patricia Erwin and Kate Featherstone. Lastly, we would like to thank DeWitt Baldwin, John Nylen, Tom Nasca and ACGME Staff for their support.

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Bell BM. Resident duty hour reform and mortality in hospitalized patients. JAMA. 2007;298(24):2865-6.

Blanchard MS, Meltzer D, Polonsky KS. To nap or not to nap? Residents' work hours revisited. N Engl J Med 2009;360:2242-2244.

Fletcher KE, Underwood W 3rd, Davis SQ, Mangrulkar RS, McMahon LF Jr, Saint S. Effects of work hour reduction on residents' lives: a systematic review. JAMA. 2005;294(9):1088-100.

Fletcher KE, Davis SQ, Underwood W, Mangrulkar RS, McMahon LF Jr, Saint S. Systematic review: effects of resident work hours on patient safety. Ann Intern Med. 2004;141(11):851-7.

Harris PA, Taylor R, Thielke R, Payne J, Gonzalez N, Conde JG, Research electronic data capture (REDCap) - A metadata-driven methodology and workflow process for providing translational research informatics support, J Biomed Inform. 2009;42:377-81.

Information Related to the ACGME's Effort to Address Resident Duty Hours and Other Relevant Resource Materials. Available at: http://www.acgme.org/acWebsite/dutyHours/dh_index.asp. Accessed on May 17, 2009.

Philibert I, Friedmann P, Williams WT; ACGME Work Group on Resident Duty Hours. Accreditation Council for Graduate Medical Education. New requirements for resident duty hours. JAMA. 2002;288(9):1112-4.

Philibert I. Sleep loss and performance in residents and nonphysicians: a meta-analytic examination. Sleep. 2005;28(11):1392-402.

Reed DA, Cook DA, Beckman TJ, Levine RB, Kern DE, Wright SM. Association between Funding and Quality in Published Medical Education Research. JAMA. 2007;298(9):1002-1009.

Reed DA, Beckman TJ, Wright SM, Levine RB, Kern DE, Cook DA. Predictive Validity Evidence for Medical Education Research Study Quality Instrument Scores: Quality of Submissions to JGIM's Medical Education Special Issue. J Gen Intern Med 2008;23(7):903-907.

Resident Duty Hours: Enhancing Sleep, Supervision, and Safety. Released December 02, 2008. Available at: http://www.iom.edu/?ID=60449. Accessed on May 17, 2009.

Annotated Bibliography: Patient Safety, Resident Well Being, Resident Education

Abraham T, Freitas M, Frangos S, Frankel HL, Rabinovici R. Are resident work-hour limitations beneficial to the trauma profession?. American Surgeon 2006; 72(1):35-41.

MERSQI score=9

Cross-sectional study of the work hours of faculty trauma surgeons and general surgery residents. Also conducted a multi-site survey study of trauma program directors. Findings of the single site study show that trauma attendings work significantly more hours than do residents on the trauma service. They also take more overnight call and work more shifts of >30 hours in a row. In the PD survey, 40% reported working more than 80 hours per week.

Akl EA, Bais A, Rich E, Izzo J, Grant BJB, Schunemann HJ. Internal Medicine Residents', Attendings', and Nurses' Perceptions of the Night Float System. J Gen Intern Med 2006; 21:494-497.

MERSQI score=8.5

Single institutional cross-sectional survey study to assess perceptions of IM faculty, residents and nurses about night float system. Findings included that faculty were more negative than the residents about many aspects of patient care with respect to the night float: they thought that continuity, quality, involvement, communication and outcomes were all more negative than did the residents. Nurses were also more negative than the residents were.

Arnedt JT, Owens J, Crough M, et. al. Neurobehavioral Performance of Residents after Heavy Night Call vs. After Alcohol Ingestion. JAMA 2005; 294(9): 1025-1033.

MERSQI score=12

This study used a prospective within subjects design to test performance in 4 conditions: heavy call (also post call), heavy call (post-call) with placebo, light call and light call with alcohol. The real question here was the comparison of the light call with alcohol compared to heavy call with placebo. With respect to sleepiness, post-call was worse than alcohol consumption designed to get to a peak of 0.04 to 0.05 percentage. The vigilance tests showed that reaction time and commission errors were worse in the post-call group, but equivalent to the alcohol group for number of lapses and omission errors. In the simulated driving task, the post-call group performed worse than the alcohol group in speed and lane variability, but not in off road episodes.

Arora V, Dunphy C, Chang VY, Ahmad F, Humphrey HJ, Meltzer D. The Effects of On-Duty Napping on Intern Sleep Time and Fatigue. Ann Intern Med 2006; 144:792-798.

MERSQI score=14.4

Single institutional within subject controlled trial to look at the impact of having protected time for napping during long call nights. The study was conducted on general medicine services during which interns were assigned to a nap schedule for Â½ the month and to a traditional schedule for the other Â½ of the month. Signing over their pagers to the night float was not mandatory, and occurred only 22% of the time. When on the nap schedule, interns slept an average of 41 minutes more (p=0.001). Interns who actually forwarded their pagers to the night float slept significantly longer than interns on the standard schedule (68 minutes different, p=0.001). Interns who did not sign their pagers out to the night float still slept significantly more than interns on the traditional schedule (but only 31 minutes more). .The main reason for not signing the pager over to night float was wanting to cover oneâ€™s own patients.

Bailit JL, Blanchard MH. The Effect of House Staff Working Hours on the Quality of Obstetric and Gynecologic Care. Obstet Gynecol 2004; 103:613-616.

MERSQI score=13.8

This is a single institution pre-post design to assess the impact of reducing work hours of OB-gyn residents to comply with the ACGME rules. Findings included reduced neonatal resuscitation and maternal hemorrhage in the post duty hour period. Increased percentage of deliveries by c-section for chorioamnionitis occurred in the post period, and a trend toward increased c-sections overall occurred in the post-period.

Balmer D, Ruzek S, Ludwig S, Giardino A. Pediatric residents' and continuity clinic preceptors' perceptions of the effects of restricted work hours on their learning relationship. Ambulatory Pediatrics 2007; 7(5):348-53.

MERSQI score=9

Single institution cross-sectional qualitative study that included interviews and observation of interactions between residents and their continuity clinic preceptors. Main findings were referable to the elimination of post-call call clinics, which resulted in the following themes: 1) Improved fatigue; 2) disruption of preceptor-resident relationship, seemed worse to preceptors than to residents; and 3) opportunity to see different practice styles.

Barrack RL, Miller LS, Sotile WM, Sotile MO, Rubash HE. Effect of duty hour standards on burnout among orthopaedic surgery residents. Clinical Orthopaedics & Related Research 2006; 449:134-7.

MERSQI score=11.5

Single institution cross-sectional survey study with a pre-post component (compared to a previously published study from pre-work hour rules) of orthopedic residents and faculty to assess burnout. Findings include significant reduction in work hours in the post-duty hour group (88 per week versus 70). There were no significant differences in the rate of burnout in either residents or faculty, although the post-duty hours residents did have significantly higher personal accomplishment and a trend toward less emotional exhaustion. Higher work hours were associated with more burnout. There was no difference between the scores on the general health questionnaire and the marital distress survey between the two time periods. Faculty scores on the burnout, general health and marital distress surveys were also not different between the two time periods.

Baskies MA, Ruchelsman DE, Capeci CM, Zuckerman JD, Egol KA. Operative experience in an orthopedic surgery residency program: the effect of work-hour restrictions. Journal of Bone & Joint Surgery - American Volume 2008; 90(4):924-7.

MERSQI score=13.33333

Pre-post study of operative experience in an orthopedic surgery residency evaluating the impact of compliance with duty hour standards. It appears that there were few changes needed from the pre-duty hour period in order to achieve compliance, although junior residents did leave post-call in the post-period instead of scrubbing in to surgeries. The findings included increases in total number of cases in the post-duty hour period from 364 to 410. This appears to mostly be related to a significant increase in cases for the PGY5 residents, although all years saw an upward trend.

Basu CB, Chen L, Hollier LH, Shenaq SM. The effect of the Accreditation Council for Graduate Medical Education Duty Hours Policy on plastic surgery resident education and patient care: an outcomes study. Plastic and Reconstructive Surgery 2004; 114(7):1878-86.

MERSQI score=8

Cross-sectional survey study of plastic surgery residents' impression of the work hour policy at their institution. Findings were generally positive, in terms of feeling more alert, having better well-being/higher ratings of quality of life and their perceived impact on patient care. Senior residents were more negative than junior residents about some of these issues, but still positive overall.

Bhavsar J, Montgomery D, Li J, Kline-Rogers E, Saab F, Motivala A, Froehlich JB, Parekh V, Del Valle J, Eagle KA. Impact of duty hours restrictions on quality of care and clinical outcomes. American Journal of Medicine 2007; 120(11):968-74.

MERSQI score=14.66667

Single institution retrospective chart review to look at one year before and one year after duty hour rules were implemented. This essentially was a pre-post study. The authors demonstrated that in-hospital mortality and 6-month major adverse cardiovascular events did not change between time periods. However, 6-month mortality was significantly decreased (adjusted OR of 0.53). In addition, there was significantly increased 6-month adherence to aspirin, beta-blockers and statins in the patients admitted in the post-duty hour group. Patients in the post-duty hour group were significantly more likely to get beta-blockers, ACE-Is or ARBs and statins than were the patients admitted in the pre-group. A quality improvement initiative was introduced at the beginning of the pre-duty hour year, which used standardized order entry and patient discharge instructions among other things to improve the care of acute coronary syndrome patients. It is possible that this played a role in the results, but it was in place during both time periods. It would have been helpful to know what the trend was for the year prior to the 'pre' year.

Blanchard MH, Amini SB, Frank TM. Impact of work hour restrictions in resident case experience in an obstetrics and gynecology residency program. American Journal of Obstetrics and Gynecology 2004; 191:1746-1751.

MERSQI score=13.8

This is a single institution pre-post study of the impact of interventions to comply with the ACGME duty hour rules on 4th year Ob-Gyn operative experience. The findings included decrease in experience for PGY4 Ob-gyn residents after compliance with duty hours in terms of laparoscopy, primary c-section, VBAC, mulit-fetal vaginal deliveries and vacuum-assisted deliveries. Experience increased in c-section (overall) and sterilization procedures. Most of these remained when adjusted for institutional volume, although the raw numbers are probably more important.

Bland KI, Stoll DA, Richardson RD, Britt LD. Brief communication of the Residency Review Committee-Surgery (RRC-S) on residents' surgical volume in general surgery. The American Journal of Surgery 2005; 190:345-350.

MERSQI score=14.66667

Pre-post design comparing surgical volume for residents before and after duty hour rules was implemented. This study looked at all programs. Surgical experience did not appear to change in the two time periods in terms of mean total major surgical procedures per year per resident, mean number of major surgical procedures per resident per program per year, mean number of major surgical procedures per chief resident per program per year, or Mean number of major surgical procedures per resident per program per year.

Breen E, Irani JL, Mello MM, Whang EE, Zinner MJ, Ashley SW. The Future of Surgery: Today's Residents Speak. Curr Surg 2005; 62(5):543-6.

MERSQI score=9

This is a multi-site cross-sectional survey study of general surgery residents in the New England area to assess attitudes toward future practice after the ACGME duty hour rules were implemented. The main findings include that a majority of residents want to be in a practice with fewer than 60 hours/ week of work. In addition, a sizeable minority are interested in having a practice where colleagues sometimes assume care of their patients, including the need for re-operation in the setting of a complication.

Browne JA, Cook C, Olson SA, Bolognesi MP. Resident duty-hour reform associated with increased morbidity following hip fracture. J Bone Joint Surg Am 2009; 91:2079-2085.

MERSQI score=16.66667

Pre-post study with a concomitant control group of non-teaching hospitals in both the pre and post duty hour period. Used the Healthcare Cost and Utilization Project, which is a national sample of hospitals. Hospitals were classified as rural, urban non-teaching and urban teaching. Urban teaching hospitals were compared to rural and urban non-teaching hospitals. Findings included significant increases in teaching hospitals in the post-duty hour years for1) pneumonia, 2) hematoma, 3) transfusion, 4) renal complications and 5) cost.

Brunworth JD, Sindwani R. Impact of duty hour restrictions on otolaryngology training: divergent resident and faculty perspectives. Laryngoscope 2006; 116(7):1127-30.

MERSQI score=7

National cross-sectional survey study of ENT residents, faculty and program directors. No response rate was reported because the denominator for the residents and faculty were unknown. Strategies that had been implemented to reduce hours included electronic tracking of resident hours (36%), home call for interns (33%), and hiring of additional personnel (23%). Faculty were significantly more negative than residents about the impact of duty hour limits on their education, although over half of the residents had some concerns about quantity of operative experience. Approximately 2/3 of respondents reported improved resident mental health with the duty hour limits. Most respondents (61%) did not believe that there had been a negative impact on patient care, but a large minority (33%) did think so.

Byrnes MC, Narciso VC, Brantley L, Helmer SD, Smith RS. Impact of resident work-hour restrictions on trauma care. American Journal of Surgery 2006; 191(3):338-43.

MERSQI score=7

Cross-sectional multi-site survey study of members of AAST (appears to be all faculty, but not certain), which is made up of several different surgical specialties to assess the impact of duty hour rules on trauma experience and patient care. Respondents reported that more programs were using 12 hour shifts than before the duty hour rules (31% versus 2%), and many fewer were using every third night call rotations (57% before versus 15% after). Responses suggested that after the duty hour rules, residents were less likely to be viewed as 'very important' to the care of trauma patients then before the duty hour rules. Sixty-one percent of respondents reported that at least weekly patient care is compromised as a result of shift changes or discontinuity.

Carlin AM, Gasevic E, Shepard AD. Effect of the 80-hour workweek on resident operative experience in general surgery. The American Journal of Surgery 2007; 193:326-330.

MERSQI score=13.8

Pre-post study conducted over 4 years to determine the impact of resident work hour rules on operative experience. The findings included significant decrease in cases as a primary surgeon, total OR cases and cases during which the resident was the first or teaching assistant.

Carpenter RO, Austin MT, Tarpley JL, Griffin MR, Lomis KD. Work-hour restrictions as an ethical dilemma for residents. American Journal of Surgery 2006; 191(4):527-32.

MERSQI score=8

Single site (Multi-program) cross-sectional survey study of residents to assess the factors associated with resident work hours and how they report them. Programs included medicine, peds, med/peds and surgery. Eight percent of respondents reported exceeding work hours and 49% reported underreporting to their PDs for reasons such as patient care, education experience and faculty and senior residents expectations.

Chandra RK. The Resident 80-Hour Work Week: How Has It Affected Surgical Specialties? Laryngoscope 2004; 114:1394-1398.

MERSQI score=7

This was a multi-institutional cross-sectional survey study of residency program coordinators/administrators for surgical programs to assess their perceptions of resident and faculty perceptions of the rules. The authors report that the most common strategies to achieve compliance were hiring physician extenders, using software to track hours and having research residents take call. Senior residents and faculty were more like to be "in denial" than the junior residents and faculty.

Choby B, Passmore C. Faculty perceptions of the ACGME resident duty hour regulations in family medicine. Fam Med 2007; 39(6):392-8.

MERSQI score=9

Multi-site cross-sectional survey study of a sample of academic family medicine faculty to assess the impact of duty hour rules on faculty and residents. Faculty reported working a mean of 66 h/wk with a mean longest continuous duty period in the last month of 58 hours. Thirty-one percent agreed that they spent more time in the hospital while on call after duty hour rules (42% were neutral), and 37% percent agreed that they were doing work previously done by residents. Only 3% agreed that there were now more opportunities to teach, and only 18% felt that patient safety had improved (51% felt neutral). Twenty percent of faculty were considering leaving academics because of resident duty hour reform.

Choi D, Dickey J, Wessel K, Girard DE. The impact of the implementation of work hour requirements on residents' career satisfaction, attitudes and emotions. BMC Medical Education 2006; 6:53.

MERSQI score=9

Single site, multi-program pre-post survey study of the impact of the ACGME duty hour rules on resident well-being and education. Results suggest that many emotional states were not different in the two time periods, but post-duty hour residents were significantly more relieved and more bored than the residents in the pre-duty hour time period. In addition, significantly more residents in the post-duty hour time period reported feeling competent about patient care and more also reported being worried about not getting enough sleep.

Christmas AB, Reynolds J, Hodges S, Franklin GA, Miller FB, Richardson JD, Rodriguez JL. Physician Extenders Impact Trauma Systems. J Trauma 2005; 58:917-920.

MERSQI score=14.66667

Pre-post single site study to assess the impact of using 2 NPs on a trauma service. The authors demonstrated that the hospital, ICU and floor lengths of stay all decreased after the NPs were incorporated. Mortality was unchanged. Work hours also seemed to decrease for the residents, but the way that they reported them made it difficult to interpret with respect to the intervention.

Chudgar SM, Cox CE, Que LG, Andolsek K, Knudsen NW, Clay AS. Current teaching and evaluation methods in critical care medicine: Has the Accreditation Council for Graduate Medical Education affected how we practice and teach in the intensive care unit? Crit Care Med 2009; 37:49-60.

MERSQI score=9

Cross-sectional survey study of a convenience sample of critical care fellowship directors in the US. The ACGME regulations were considered as a whole and included the ACGME core competencies and the duty hour rules. These regulations were thought by a majority to worsen continuity of care, transitions in care, and resident familiarity with patients. From an educational standpoint, a majority thought that educational opportunities and resident autonomy were negatively impacted by the regulations. Sleep deprivation was thought to be improved.

Cockerham WT, Cofer JB, Lewis PL, Scroggins CM, Burns RP. Resident Work Hours: Can We Meet the ACGME Requirements? The American Surgeon 2004; 70:687-690.

MERSQI score=7.5

This single institution pre-post study evaluated the impact of changes designed to achieve compliance with the ACGME duty hour rules on a general surgery program. Changes involved increased cross-coverage, residents leaving earlier post-call and increased home call for chief residents, and a change in trauma chief schedule that went from 24 on/24 off to 12 on/12 off. The authors demonstrated that the residents' work hours decreased, as did their non-patient care time (suggesting an impact on non-clinical workload). No comparative statistics were performed, so cannot confirm if these changes were significant, but they appeared to be so,

Cohen-Gadol AA, Piepgras DG, Krishnamurthy S, Fessler RD. Resident Duty Hours Reform: Results of a National Survey of the Program Directors and Residents in Neurosurgery Training Programs. Neurosurgery 2005; 56:398-403.

MERSQI score=8

Multi-institutional cross-sectional survey of neurosurgery residents and program directors to assess impact of compliance with duty hour rules on resident education and patient care. A majority of institutions used physician extenders to come into compliance with the work hour rules. Program directors appeared to be more negative than the residents about the impact on complexity of surgery that chiefs were doing, trauma experience and overall impact. A majority of both PDs and residents thought that there was a negative impact on training and resident familiarity with patients. Overall, 95% of respondents thought that continuity of care had decreased.

Connors RC, Doty JR, Bull DA, May HT, Fullerton DA, Robbins RC. Effect of work-hour restriction on operative experience in cardiothoracic surgical residency training. Journal of Thoracic & Cardiovascular Surgery 2009; 137(3):710-3.

MERSQI score=14.66667

Pre-post study of the impact of duty hour reductions on operative experience in CT surgery residents from three programs. Findings include significant decreases in surgical experience for training years 1-2, but not year 3 in the time period after duty hour rules. Likewise, cardiac procedures decreased significantly for training years 2-3. Specifically, experience with CABG significantly decreased from 148 to 110 combining all years of residency. There was no significant change in the number of thoracic cases in any of the training years 1-3 residents.

Coverdill JE, Finlay W, Adrales GL, Mellinger JD, Anderson KD, Bonnell BW, Cofer JB, Dorner DB, Haisch C, Harold KL, Termuhlen PM, Webb AL. Duty-hour restrictions and the work of surgical faculty: results of a multi-institutional study. Academic Medicine 2006; 81(1):50-6.

MERSQI score=8.5

Multi-site cross-sectional survey study of general surgery faculty about the impact of duty hour rules. A random sample of responders also underwent interviews. Survey findings suggested an impact on the faculty such that 69% reported increased work load and 73% reported that they were handling problems now that had previously been handled by the residents. In addition, 55% reported decreased job satisfaction as a result of the duty hour rules. With respect to resident education, 75% reported that the duty hour rules had resulted in decreased faculty expectations for the residents and decrease time for teaching (67%). Two additional themes that came up during interviews were that of skills gaps at night and the need for attendings to finish tucking the patients in or following up on 'loose ends.'

Coverdill JE, Adrales GL, Finlay W, Mellinger JD, Anderson KD, Bonnell BW, Cofer JB, Dorner DB, Haisch C, Harold KL, Termuhlen PM, Webb AL. How surgical faculty and residents assess the first year of the Accreditation Council for Graduate Medical Education duty-hour restrictions: results of a multi-institutional study. American Journal of Surgery 2006; 191(1):11-6.

MERSQI score=9.5

Multi-site cross-sectional survey study of general surgery residents and faculty to assess the impact of duty hour rules on resident education and quality of patient care. Findings include that faculty were often significantly less positive about the impact of duty hour rules when compared to the residents. Overall, respondents agreed (mean of 1.8 on 1-4 likert scale) that lack of familiarity (as opposed to fatigue) is the major cause of errors.

Cull WL, Mulvey HJ, Jewett EA, Zalneraitis EL, Allen CE, Pan RJ. Pediatric residency duty hours before and after limitations. Pediatrics 2006; 118(6):e1805-11.

MERSQI score=9.5

National pre-post survey study of pediatric residents. Program directors were also surveyed. Program directors were also surveyed. Strategies to comply with duty hours as reported by program directors include having faculty work more hours (45%), implementing night float (42%), and hiring non-physician healthcare workers (38%). Residents estimated that they worked 70 hours per week after duty hour rules were implemented. More than half of the residents thought that well-being had improved. Residents were significantly more positive about the impact of duty hours than were the program directors. With respect to moonlighting, only 33% of residents and 68% of PDs reported that PD approval was needed for moonlighting. When comparing graduates from 2002 to those from 2004, there was no significant difference in the percentage reporting moonlighting at least once in the last year (41% versus 38%). However, significantly fewer reported moonlighting in 6 of the past 12 months (2002: 18% versus 2004: 10%). With respect to resident safety, significantly fewer 2004 graduates reported falling asleep while driving from work (20% versus 32% in 2002). With respect to patient safety, significantly fewer residents in 2004 reported clinically important errors when compared to 2002 graduates (8% versus 17%).

Damadi A, Davis AT, Saxe A, Apelgren K. ACGME duty-hour restrictions decrease resident operative volume: a 5-year comparison at an ACGME-accredited university general surgery residency. Journal of Surgical Education 2007; 64(5):256-9.

MERSQI score=12

Single institution pre-post study to assess the impact of duty hour rules on general surgery chief resident operative experience. The major finding was that major surgeries performed in chief year were reduced

post-work hours (255 versus 189). In the non-chief years, there was also a significant drop in number of cases (1033 versus 854). This was based on an n of 17.

DeLaRosa J, Thourani VH, Wheatley GH III, McMullan DM, Karamanoukian RL, Greene MG, Morales DL. Impact of Resident Duty Hour Standards on Cardiothoracic Residents and Program Directors. Ann Thorac Surg 2005; 80:1569-1571.

MERSQI score=7

This is a multi-institutional cross-sectional survey study of CT surgery residents and program directors about the impact of duty hour rules. 54% of residents reported working >80 h/week, while only 24% of PDs reported that. Most residents reported that global well-being was improved, but only about 1/3 thought that stress was reduced. Approximately 1/3 of residents thought that duty hour rules were beneficial for patient care. No analyses comparing PD and resident responses were done.

DeMaria EJ, McBride CL, Broderick TJ, Kaplan BJ. Night Call Does Not Impair Learning of Laparoscopic Skills. Surgical Innovation 2005; 12:145-149.

MERSQI score=10.8

This study evaluated the impact of sleep deprivation on performance on a laparoscopic simulator. The sleep deprivation setting was post-call, the rested condition was the day immediately prior to that. All subjects were tested in the rested condition first, making it harder to detect deterioration post-call, as learning would overcome some of the effects. Overall, there was significant improvement in 29% of the tasks post-call and significant deterioration in 1.7%.

Dola C, Nelson L, Lauterbach J, Degefu S, Pridjian G. Eighty-hour work reform: faculty and resident perceptions. American Journal of Obstetrics & Gynecology 2006; 195(5):1450-6.

MERSQI score=8

Single site (but multi-program) cross-sectional survey study of residents and faculty to assess the impact of duty hour rules. Findings include that faculty generally viewed the impact of the 80-hour workweek significantly more negatively than the residents did, although a majority of both groups agreed that residents were better rested and that quality of life had improved. More than half of the residents reported that there had been a positive impact on education and decision-making, which was significantly different that the faculty. Nearly twice the number of faculty (81%) thought that continuity of care was worse (44% of residents), and five-fold more faculty believed that quality of care had worsened (45% versus 9% of residents).

Durkin ET, McDonald R, Munoz A, Mahvi D. The impact of work hour restrictions on surgical resident education. Journal of Surgical Education 2008; 65(1):54-60.

MERSQI score=13.33333

Single institution pre-post study of surgical experience and test scores before and after duty hour rules were implemented. Findings included significant increases in ABSITE scores including increases in the total percent correct (+3.6%), and basic science percent correct (+4.7%) with corresponding increases in the percentile scores. The clinical management scores were unchanged. Operative experience did not significantly change (total of 1052 pre to 1011 post-duty hours). Of interest, total major cases were significantly positively correlated with ABSITE scores. The only caveat is that the operative log data only represents the experience of 2 years of reforms, so three of the years for some residents and four for others were still without duty hour rules.

Ellman PI, Kron IL, Alvis JS, Tache-Leon C, Maxey TS, Reece B, Peeler BB, Kern JA, Tribble CG. Acute Sleep Deprivation in the Thoracic Surgical Resident Does Not Affect Operative Outcomes. Ann Thorac Surg 2005; 80:60-65.

MERSQI score=15.33333

Retrospective cohort study of cardiac surgical cases that were performed by thoracic surgery residents over more than 10 years (including some that were done in the post-2003 time period. Compared those surgeries that were performed by "sleep-deprived" residents versus those that were performed by "non-sleep-deprived residents." There was no impact of sleep deprivation on mortality in univariate or multivariate models. In addition, there was not impact of sleep deprivation on surgical complications or timing (only univariate analyses were performed).

Espey E, Ogburn T, Puscheck E. Impact of duty hour limitations on resident and student education in obstetrics and gynecology. Journal of Reproductive Medicine 2007; 52(5):345-8.

MERSQI score=8

Multi-institutional cross-sectional survey study of Ob-gyn clerkship directors, residency program directors, clerkship or residency coordinators, chairs, other teaching faculty and some undetermined participants. More than half thought that residents' interest in and time for teaching had worsened with the duty hour limits. No one reported thinking that operative volume had improved while 63% reported worsening. Participants were evenly divided in their opinion as to whether the duty hour rules had improved patient safety, with 19% reporting that it was better and 19% reporting that it was worse. The remainder reported no change.

Everett CB, Helmler SD, Osland JS, Smith RS. General surgery resident attrition and the 80-hour workweek. The American Journal of Surgery 2007; 194:751-757.

MERSQI score=11

This cross-sectional survey study essentially accomplished a retrospective pre-post design by asking surgical program directors how many residents left their programs over the course of the academic years 2001-2004. After duty hour rules were implemented, attrition from surgical programs increased.

Feanny MA, Scott BG, Mattox KL, Hirshberg A. Impact of the 80-hour workweek on resident emergency operative experience. American Journal of Surgery 2005; 190(6):947-9.

MERSQI score=13.33333

Single institution pre-post study of general surgery residents' experience with emergency abdominal surgery before and after becoming compliant with the ACGME duty hour rules. Overall number of operative procedures per graduating resident in the last 2 years of their residency did not differ between the 2 time periods. However, there was a significant decrease in the number of advanced emergency abdominal cases and an increase in the number of basic abdominal cases in the post-duty hour time period. In addition, the mean number of cases as first assistant also significantly decreased in the post-duty hour time period (from 88 to 58 cases). The number of reoperations by the same resident also significantly decreased from 52 to 23.

Ferguson CM, Kellogg KC, Hutter MM, Warshaw AL. Effect of Work-hour Reforms on Operative Case Volume of Surgical Residents. Curr Surg 2005; 62:535-538.

MERSQI score=13.33333

This is single institution pre-post study of the impact of multiple changes including night float, physician extenders and home call to comply with the ACGME duty hour rules on operative experience. The authors

showed that PGY5 residents had a significant increase in volume and that the other years remained stable (although PGYs 1-2 trended towards decreased experience). Notably, the PGY4s were not included in this analysis. Work hours decreased for all PGY levels.

Fialho G, Cavichio L, Povoa R, Pimenta J. Effects of 24-h Shift Work in the Emergency Room on Ambulatory Blood Pressure Monitoring Values of Medical Residents. Am J Hypertens 2006; 19(10):1005-9.

MERSQI score=15.6

Within subjects design to test blood pressure in IM and surgery residents in two different conditions: during a 24-hour shift and during a normal workday. Findings included significantly more participants with abnormal BP readings in the 24-h group and significantly higher number of participant with abnormal mean diastolic BPs in the 24-h group. In addition, the 24-h group slept significantly less than the common workday group (252 versus 434 minutes). There were no significant differences in mean SBP and DBP overall between the two groups.

Fletcher KE, Parekh V, Halasyamani L, Kaufman SR, Schapira M, Ertl K, Saint S. Work hour rules and contributors to patient care mistakes: a focus group study with internal medicine residents. Journal of Hospital Medicine (Online) 2008; 3(3):228-37.

MERSQI score=8

Cross-sectional focus group study of internal medicine residents in the year following duty hour reform. Four focus groups conducted at 3 sites. The purpose of the study was to better understand how residents attribute patient care errors, especially with respect to fatigue and continuity of care. Contributors to errors identified during the sessions included fatigue, sign-outs, not knowing patients well enough, entropy, inexperience and workload. Many of these were attributable to changes made to accommodate the duty hour limits. Well-being was reported as improved.

Fletcher KE, Wiest FC, Halasyamani L, Lin J, Nelson V, Kaufman SR, Saint S, Schapira M. How Do Hospitalized Patients Feel About Resident Work Hours, Fatigue and Discontinuity of Care? J Gen Intern Med 2007; 23(5):623-628.

MERSQI score=7.5

Multi-institutional cross-sectional survey study of internal medicine inpatients and their perceptions about resident duty hours and the impact of fatigue and discontinuity on their care. Patients estimated that their residents worked 60 hours per week but thought they should only be working about 51 hours per week. Overall, patients were not very worried about either hand-offs of care or fatigue in their doctors. About 70% reported feeling safer when one of their doctors was in the hospital at night, though.

Foley PJ, Roses RE, Kelz RR, Resnick AS, Williams NN, Mullen JL, Kaiser LR, Morris JB. The state of general surgery training: a different perspective. Journal of Surgical Education 2008; 65(6):494-8.

MERSQI score=7

National cross-sectional survey study of general surgery residents to assess percecptions of training. With respect to duty hour rules, 80% thought that the duty hours had improved their quality of life. However, less than half agreed that the duty hour rules had improved training or patient care.

Fortuna RJ, Palfrey JS, Shelov SP, Samuels RC. Pediatric experiences with work-hour limitations. Journal of Evaluation in Clinical Practice 2009; 15(1):116-20.

MERSQI score=9

National cross-sectional survey study of pediatrics program directors. Commonly used strategies to comply with the duty hour rules on ward teams included night float (30%), leaving post-call (66%), cross-coverage (51%). Other findings include a perceived decrease in patient continuity in both the outpatient and inpatient settings and a decrease in the flexibility of residents' schedules. Faculty satisfaction was noted to have declined as well.

Frankel HL, Foley A, Norway C, Kaplan L. Amelioration of increased intensive care unit service readmission rate after implementation of work-hour restrictions. Journal of Trauma-Injury Infection & Critical Care 2006; 61(1):116-21.

MERSQI score=14.666667

Single institutional pre-post study of the impact of duty hour rules on patients being transferred from SICU to the wards. Also assessed a post-duty hour innovation to improve communication between the SICU and the ward teams. Between the pre-intervention year and the 1st post-intervention year, SICU readmissions increased significantly from 1.4% to 3%, and the proportion attributable to ward provider care increased from 16.7% to 41.2%. An intervention was designed to increase communication between the SICU and ward teams including a phone call to the accepting resident and a discharge checklist to summarize ICU care. In the year following this intervention, the rate of transfers appears to have gone back to baseline (1.2%), although the stats were not reported.

Froelich J, Milbrandt JC, Allan DG. Impact of the 80-hour Workweek on Surgical Exposure and National In-Training Examination Scores in an Orthopedic Residency Program. Journal of Surgical Education 2009; 66(2):85-88.

MERSQI score=13.33333

Single institutional retrospective pre-post study of the operative experience and in-training examination scores of orthopedic residents for 3 years before and 5 years after the duty hour rules were in place. No significant differences in operative experience in any of the PGY 2-5 years occurred, although the trend was for an increase post-duty hours. There was likewise no significant difference in the in-training examination scores between the two time periods.

Gelfand DV, Podnos YD, Carmichael JC, Saltzman DJ, Wilson SE, Williams RA. Effect of the 80-Hour Workweek on Resident Burnout. Arch Surg 2004; 139:933-940.

MERSQI score=12.5

This pre-post study looked at burnout in surgical residents before and after compliance with the ACGME duty hour rules. No significant differences in the subscale scores or the percentage that scored low, med or high on the subset scores. Work hours did decrease. The authors had the subject record their daily activities as well, and the amount of floor work did not change, but home call and educational time significantly decreased in the post-duty hour time period.

Girard DE, Choi D, Dickey J, Wessel K, Austin D. A mid year comparison study of career satisfaction and emotional states between residents and faculty at one academic medical center. BMC Medical Education 2006; 6:36.

MERSQI score=7.5

Single site (but multiple program) cross-sectional survey study of residents and faculty about the impact of duty hour rules. On average, faculty and residents were neutral to whether they felt more stress than expected, but the mean faculty score was significantly greater than the resident score indicating more stress. Faculty were significantly less fatigued than the residents, but again, these scores were close to neutral.

Only 13% of residents and 14% of faculty reported working >80 hours/week, but 60% of faculty reported working for stretches longer than 30 hours (as opposed to only 14% of residents).

Goitein L, Shanafelt TD, Nathens AB, Curtis JR. Effects of Resident Work Hour Limitations on Faculty Professional Lives. J Gen Intern Med 2008; 23(7):1077-1083.

MERSQI score=10

Multi-institutional cross-sectional survey study to assess internal medicine and surgical faculty perceptions of the impact of duty hour rules on their professional lives. Faculty reported a median increase in their own work hours of 5-8/week. About half thought that clinical time increased and that research/academic time had decreased. 72% reported that time teaching residents decreased. In MV models, long hours, impact on research time and impact on patient care supervision were associated with being at risk for leaving academics.

Goitein L, Shanafelt TD, Wipf JE, Slatore CG, Back AL. The effects of work-hour limitations on resident well-being, patient care, and education in an internal medicine residency program. Archives of Internal Medicine 2005; 165(22):2601-6.
MERSQI score=13

Single institution study of internal medicine residents. Cross-sectional, but compared burnout scores to previous study conducted by their group in the pre-duty hour rules time period. Results indicate a trend toward less emotional exhaustion in the post-group, but overall burnout rates did not change. Residents (51%) perceived that they are less likely to make medical errors now (compared to 18% who disagreed), Most residents (64%) did not believe that their commitment to patients was diminished, and only 39% agreed that residents don't know as much detail about their patients. Many residents report missing or cutting short educational events such as conferences (81% have done so at least twice monthly).

Goldstein MJ, Samstein B, Ude A, Widmann WD, Hardy MA. Work Hours Assessment and Monitoring Initiative (WHAMI) Under Resident Direction: A Strategy for Working Within Limitations. Curr Surg 2005; 62:132-137.

MERSQI score=11.4

This single institution pre-post study assessed as system for aggressively monitoring resident work hours and actually taking steps to relieve them of patient care duties if they were approaching non-compliance with the ACGME/NY rules. The authors demonstrated decreased work hours and significantly improved compliance.

Goldstein MJ, Kim E, Widmann WD, Hardy MA. A 360-degree Evaluation of a Night-float System for General Surgery: A Response to Mandated Work-hours Reduction. Current Surgery 2004; 61:445-451.

MERSQI score=11.5

Single institutional study using a cross-sectional retrospective pre-post survey design as well as some actual pre-post data. Goal was to assess intervention designed to decreased resident work hours. Significant findings included reduced work hours after the intervention, improved availability for family events from spouses' perspective, improved subjective ratings of sleep and fatigue, reduced operative experience in PGY4 only and improved patient care from the nursing perspective.

Gopal R, Glasheen JJ, Miyoshi TJ, Prochazka AV. Burnout and internal medicine resident work-hour restrictions. [see comment]. Archives of Internal Medicine 2005; 165(22):2595-600.

MERSQI score=12.5

Single institution pre-post survey study of internal medicine residents to assess the impact of duty hour rules on resident burnout, depression and education. There was no overall change in the rate of burnout between pre and post duty hour rules, although the percentage of residents meeting burnout criteria for emotional exhaustion declined significantly (42% versus 29%). Residents reported attending fewer lectures and worked fewer hours in the post-duty hour period. No significant differences were reported for suboptimal patient care practices between pre and post periods.

Gopal RK, Carreira F, Baker WA, Glasheen JJ, Crane LA, Miyoshi TJ, Prochazka AV. Internal Medicine Residents Reject 'Longer and Gentler' Training. JGIM 2007; 22:102-106.

MERSQI score=12.5

Single institution cross-sectional survey study of internal medicine residents to assess burnout after the implementation of duty hour rules. They also assessed the residents'€™ interest in prolonging training in order to further reduce weekly hours. Results indicate that 55% of residents met criteria for burnout, and those that were burned out were more likely to accept the idea of prolonging training to reduce work hours. Overall, however, 85% of the residents disagreed with prolonging training. 42% felt that their personal life had improved with the duty hour rules and 45% believed that patient safety had improved.

Harrison R, Allen E. Teaching Internal Medicine Residents in the New Ear: Inpatient Attending with Duty-Hour Regulations. J Gen Intern Med 2006; 21:447-452.

MERSQI score=6.5

This is a focus group study with internal medicine faculty to assess the impact of the ACGME duty hour rules on their roles as educators. The study included a survey, which residents filled out about their perception of the impact on faculty teaching. Both faculty and residents perceived that faculty now had an increased clinical role. Other themes from both faculty and residents include altered time management and change in the expectation of presentations. In addition, both groups felt that there was less time for teaching and that the teaching had become more focused. Both groups perceived that resident autonomy had also decreased. Faculty also discussed rounding alone and less time spent as a team. Resident reported that some faculty had failed to adapt to the changes.

Henry MCW, Silverman BL, Moss RL. The impact of the 80-hour workweek on pediatric surgical training: an Association of Pediatric Surgery Program Directors-sponsored study. Journal of Pediatric Surgery 2005; 40:60-68.

MERSQI score=8

Multi-institutional cross-sectional survey study of pediatric surgery program directors and fellows to assess how programs were meeting the duty hour requirements and what the impact was. Finding include that call frequency has decreased in many programs and that adding fellows and physician extenders are the most popular mechanism by which this occurred. In addition, the respondents reported decreased quality and continuity of care. About 1/4 of fellows and 1/2 of the PDs perceived that the quality of training had also decreased.

Horwitz LI, Krumholz HM, Huot SJ, Green ML. Internal Medicine Residents' Clinical and Didactic Experiences After Work Hour Regulation. J Gen Intern Med 2006; 21:961-965.

MERSQI score=9.5

Multi-institutional survey study of internal medicine chief residents to assess the impact of duty hour rules on resident education and workload. The majority (72%) of programs reported that they had experienced no change in average census for interns, and 20% reported a decreased in census. Most programs (56%) reported no increase in ward coverage on non-call rotations with the duty hour rules, but 36% reported an increase. Time on wards and float increased significantly for PGY2 and three residents. Elective time also

decreased significantly for PGY2/3 residents, even though most programs reported no change in elective time. There was no change in the overall time devoted to formal teaching, but intern and resident attendance at conferences decreased significantly, by 5% for interns and 4% for residents.

Horwitz LI, Kosiborod M, Lin Z, Krumholz HM. Changes in outcomes for internal medicine inpatients after work-hour regulations. [see comment][summary for patients in Ann Intern Med. 2007; 147(2):97-103.

MERSQI score=15.33333

Single institution retrospective pre-post study of the impact of duty hours on patient outcomes with a concomitant non-teaching control group. The teaching service showed improvements in multiple parameters in the post duty hour time period. The following 3 were improved in the post-time compared to the non-teaching service: 1) ICU admission, 2) discharge to home/rehab, and 3) pharmacist errors to prevent errors. The only important drawback to this study is that the overnight resident on the resident teams was replaced by an attending or fellow and that the census on the hospitalist service overall greatly increased during the post-period (2954 to 3710) while the teaching services increased only slightly (7018 to 7242).

Hutter MM, Kellogg KC, Ferguson CM, Abbott WM, Warshaw AL. The impact of the 80-hour resident workweek on surgical residents and attending surgeons. Annals of Surgery 2006; 243(6):864-71.

MERSQI score=15

This was a single institution pre-post study of the impact of changes to comply with the duty hour rules in a general surgery residency program. Multiple methods were used including, time cards, survey, test scores and interviews. Work hours significantly declined, patient mortality and complications as recorded in the NSQIP did not change. ABSITE scores did not change. Faculty work motivation and burnout did not change, and resident burnout as measured by the emotional exhaustion component of the MBI decreased from high to medium levels.

Immerman I, Kubiak EN, Zuckerman JD. Resident work-hour rules: a survey of residents' and program directors' opinions and attitudes. [see comment]. American Journal of Orthopedics (Chatham, Nj) 2007; 36(12):E172-9; discussion E179.

MERSQI score=9

Cross-sectional survey nationally conducted of orthopedic surgery residents and program directors about the impact of duty hour rules on patient care, education and well-being. It is difficult to interpret the meaning of the means reported because the authors discuss the results as thought the likert scale were reversed from how they reported it. If we go with the authors' interpretation of the numbers, overall, senior residents were more negative than junior residents, and senior residents often did not significantly differ from the program directors.

Irani JL, Mello MM, Ashley SW, Whang EE, Zinner MJ, Breen MD. Surgical residents' perceptions of the effects of the ACGME duty hour requirements 1 year after implementation. Surgery 2005; 138: 246-253.

MERSQI score=9

Multi-institutional cross-sectional survey study of general surgery residents about the impact of the duty hour rules. The findings included no change/worsening in perceived quality of care. The majority felt that continuity of care had worsened. Likelihood that errors in management would increase or not change was reported by the majority. A majority felt that the number of operations they participated in had decreased, although the time for reading/studying was reported as increased by the majority.

Izu BS, Johnson RM, Termuhlen PM, Little AG. Effect of the 30-hour work limit on resident experience and education. Journal of Surgical Education 2007; 64(6):361-4.

MERSQI score=9.5

Single institution pre-post study of a general surgery program to assess the impact of duty hour restrictions on operative experience. The study assessed 1 month during the pre-duty hour period and 1 month in the post-duty hour period, but this represented the experience of a single 4th year resident each year. They also conducted a cross-sectional survey during the post-duty hour period. No difference in the proportion of surgeries covered by the resident was found between the two time periods (35% pre and 45% post-duty hours). The survey results suggested that residents were neutral about the 30-hour rule for the most part, , but did feel that they learned more in surgeries when they had been a part of the pre-op work-up and also that they preferred to participate in rather than sign-out surgeries in which they had been involved in the pre-op management.

Jagannathan J, Vates GE, Pouratian N, Sheehan JP, Patrie J, Grady S, Jane JA. Impact of the Accreditation Council for Graduate Medical Education work-hour regulations on neurosurgical resident education and productivity. J Neurosurg. 2009;110:820-827.

MERSQI score=12.5

Multi-institutional pre-post study of the impact of the duty hour rules on neurosurgical education in terms of ABNS scores and presentations at national meetings. Scores for 2nd and 3rd year residents decreased by 16% overall (pre 310 versus post 259) although the scores for all applicants taking the exam for credit did not change. The % of resident attendees presenting research decreased significantly too (85% versus 75%) There was also a multi-institutional survey that was sent to all chief residents and program directors. The vast majority of both groups felt that the duty hour rules were detrimental to patient safety and resident operative experience. There was also an embedded single institution study of breakdown of time spent by residents pre-post. Work hours, required conference hours, and time in OR (64 hour/week versus 41 hours/week) all decreased in the post-duty hour period, while the on-call time per week increased.

Jagsi R, Shapiro J, Weinstein DF. Perceived Impact of Resident Work Hour Limitations on Medical Student Clerkships: A Survey Study. Academic Medicine 2005; 80:752-757.

MERSQI score=10

This survey study used a pre-post design to assess the students' perspectives on the decrease in duty hour rules across specialties. For those most part, there was little impact. However, they did think that the 1-2 residents with whom they most closely worked were more interested and available after the rules went into effect. Of those who had witnessed suboptimal patient care, significantly more thought it was due to trying to limit hours in the post-2003 period.

Jagsi R, Shapiro J, Weissman JS, Dorer DJ, Weinstein DF. The educational impact of ACGME limits on resident and fellow duty hours: a pre-post survey study. [see comment]. Academic Medicine 2006; 81(12):1059-68.

MERSQI=9.5

Pre-post survey study of residents conducted in multiple residency programs at two sites to assess the impact of the duty hour rules on resident education. Compared 'reduced hours programs' with other programs. Reduced hours programs were those that started out with more than 65 hours per week and decreased them by at least 5 hours per week in the post-duty hour period. The reduced hours programs had a significantly greater drop in the % of residents working >80 hours/week compared to the other programs (from 43% to 17%). The percent of respondents reporting working >30 hours in the post-duty hour time

period was 12% in the reduced hours group and 5% in the other group. The amount of time spent on scut work changed from 23% to 20% in the reduced hours group and from 25% to 14% in the other group.

Jagsi R, Buck DA, Singh AK, Engleman M, Thakkar V, Frank SJ, Flynn D. Results of the 2003 Association of Residents in Radiation Oncology (ARRO) Surveys of Residents and Chief Residents in the United States. Int J Radiat Oncol Biol Phys 2005; 61(3):642-8.

MERSQI score=8

Cross-sectional multi-institutional survey study that is part of a yearly survey conducted by the Association of Residents in Radiation Oncology. Findings include median hours per week of approximately 50. Most programs required "scut" work of approximately 10 hours per week.

Jagsi R, Weinstein DF, Shapiro J, Kitch BT, Dorer D, Weissman JS. The Accreditation Council for Graduate Medical Education's limits on residents' work hours and patient safety. A study of resident experiences and perceptions before and after hours reductions. Archives of Internal Medicine 2008; 168(5):493-500.

MERSQI score=10

Survey study of multiple programs within a single institution to assess the impact of duty hour rules on workload and patient safety. Compared 'reduced hours programs' with other programs. Reduced hours programs were those that started out with more than 65 hours per week and decreased them by at least 5 hours per week in the post-duty hour period. The reduced hour programs had a significantly greater change in the proportion of residents reporting working over 80 hours per week when compared with other programs, but both program types had a minority of respondents report working >80 hours in the post period (17% and 10%). Fatigue decreased to a significantly greater extent in the reduced hours programs, but still did not reach the levels of the post-duty hour other programs. Workload in terms of numbers of patients admitted, their own patients covered, and patients cross-covered did not change to a different extent in the reduced hours programs versus the others. In the 2 time periods the number of patients cross-covered stayed at 17 for the reduced hours group and decreased from 20 to 15 in the other programs, but significance levels for these changes was not reported. Hours spent in direct patient care decreased to a significantly greater extent in the reduced hours programs (from 48 h/week to 42 h/week) when compared to the change in the other programs (39 h/week to 40 h/week).

Jarman BT, Miller MR, Brown RS, Armen SB, Bozaan AG, Ho GT, Hartranft TH. The 8-hour Work Week: Will We Have Less-Experienced Graduating Surgeons? Current Surgery 2004; 61:612-615.

MERSQI score=9

Pre-post study of a night rotation to measure the number of operations that were likely missed by residents who had to leave early post-call. Notably, this program reported achieving compliance with the ACGME duty hour rules prior to the onset of this study, so technically, both pre and post periods are 'post-ACGME rules.' The results showed that overall approximately 154 surgeries would have been missed by the group of residents each year after duty hour compliance. Using 9 residents in the post group and 10 in the pre-group, this average 16 missed surgeries per year.

Jones AM, Jones KB. The 88-hour family: effects of the 80-hour work week on marriage and childbirth in a surgical residency. Iowa Orthopedic Journal 2007; 27:128-33.

MERSQI score=12

Single institution retrospective pre-post study to determine the number of married orthopedic residents who had children during their residency. The authors compared the 4 years before and the 4 years after duty hour rules were implemented. A total of 24 babies were born to residents in the post-duty hour period

compared to 15 in the pre-duty hour period (but the number of residents in the program also increased). There was a 40% increase in the number of births per married resident per year in the post-duty hour time period.

Joyner BD, Siedel K, Stoll D, Mitchell M. Report of the National Survey of Urology Program Directors: Attitudes and Actions Regarding the Accreditation Council for Graduate Medical Education Regulations. The Journal of Urology 2005; 174: 1961-1968.

MERSQI score=9

This cross-sectional multi-institutional survey study assessed perceptions of urology program directors about the impact of the ACGME duty hour rules. Findings of interest include that most PDs felt that their faculty were working about the same amount after duty hour rules as before. In addition, very few felt that the duty hour rules had positively impacted either patient care or resident education.

Kaafarani HMA, Itani KMF, Petersen LA, Thornby J, Berger DH. Does Resident Hours Reduction Have an Impact on Surgical Outcomes? Journal of Surgical Research 2005; 126:167-171.

MERSQI score=14.66667

This is a pre-post single institution study of the impact of the ACGME duty hour rules on surgical patient outcomes. No differences in mortality in general or vascular surgery patients. Two complications were more likely in the pre than the post time (deep surgical site infection and bleeding requiring >4 units) ARF was more common in the intervention.

Kairys JC, McGuire K, Crawford AG, Yeo CJ. Cumulative Operative Experience is Decreasing During General Surgery Residency: A Worrisome Trend for Surgical Trainees? J Am Coll Surg 2008; 206:804-813.

MERSQI score=14.66667

This retrospective pre-post study used ACGME data on major operative experience to compare the year 2001-2002 ('pre' duty hour rules) to the year 2005-2006 ('post' duty hour rules). They demonstrated a significant decline in the number of cases as total surgeon and surgeon chief in the post-duty hour year. In addition, they demonstrated differences in the number of times that residents were first assistant and teaching assistant. These were not checked for significance. It is not clear why the authors only looked at 2 years, but it is interesting that the graduating chief residents would have trained for 3/5 years under the new rules.

Karamanoukian RL, Ku JK, DeLaRosa J, Karamanoukian HL, Evans GR. The effects of restricted work hours on clinical training. American Surgeon 2006; 72(1):19-21.

MERSQI score=7

Multi-site cross-sectional survey study of residents in general surgery programs to assess the impact of duty hour rules on resident education and well-being. Well-being appeared to improve, but 84% of residents expected a decrease in clinical exposure due to the duty hour rules. However, only 4% were amenable to adding on additional year of training to make of for the decreased exposure.

Kerfoot BP, Nabha KS, Hafler JP. The impact of duty hour restrictions on teaching by surgical residents. Med Educ 2005; 39:505-533.

MERSQI score=7.5

Multi-institution cross-sectional survey study of the impact of the duty hour rules on surgical residents' experience educating students. 35% of residents thought that the duty hour rules had been detrimental for

student teaching (44% were neutral and 21% thought the rules had been beneficial). Reasons cited for the detriment in teaching were decreased time available to teach and fewer interactions between residents and students. Twenty-six percent of residents reported that decreased fatigue made them better teachers.

Kiernan M, Civetta J, Bartus C, Walsh S. 24 hours on-call and acute fatigue no longer worsen resident mood under the 80-hour workweek regulations. Current Surgery 2006; 63(3):237-41.

MERSQI score=13.5

Single site repeated measures test using the Profile of Mood States (POMS) to assess mood disturbances at 9 AM 4 times for each resident. Residents kept sleep logs, and their scores were compared based on being sleep deprived (<4 h sleep) or not (>4 hours sleep) and between post-call and not post-call residents. There were no significant differences on any subscale scores when the post-call group was compared with the not-post-call group. There were no significant differences when comparing scores between fatigued versus not fatigued either, but there was a trend toward higher depression scores in the fatigued group.

Klingensmith ME, Winslow ER, Hamilton BH, Hall BL. Impact of resident duty-hour reform on faculty clinical productivity. Current Surgery 2006; 63(1):74-9.

MERSQI score=11

Single site (including multiple specialties) pre-post study of the impact of the duty hour rules on clinical productivity of surgical faculty. There was also a cross-sectional survey component of this study. Data suggests that faculty productivity as measured by RVUs has either increased or stayed the same for this hospital's surgical programs. Work hours for faculty have likewise remained unchanged. Approximately half of the respondents felt that academic productivity had not been negatively impacted, but 60% reported that they now were doing the work of the residents.

Kogan JR, Pinto-Powell R, Brown LA, Hemmer P, Bellini LM, Peltier D. The impact of resident duty hour's reform on the internal medicine core clerkship: results from the clerkship directors in internal medicine survey. Academic Medicine 2006; 81(12):1038-44.

MERSQI score=10

Multi-site cross-sectional survey study of IM clerkship directors to assess the impact of changes to comply with the duty hour rules on student clerkship experience. Findings include that the proportion of students who take overnight call declined from 56% to 41% between the pre and post duty hour rules. Overall, the clerkship directors were negative about residents and attendings having time to teach students. They also disagreed that there was more time for bedside teaching. The clerkship directors did not think that students had more continuity with their team. Sixty-three percent believe that students are learning that hours worked takes precedence over patient care.

Kogan JR, Bellini LM, Shea JA. The Impact of Resident Duty Hour Reform in Medicine Core Clerkship. Academic Medicine 2004; 79(10 Suppl):S58-61.

MERSQI score=9.5

Pre-post survey study of the impact of the duty hour rules on medical students. Conducted at the four hospitals that host the core IM clerkship for one medical school. The proportion of student time in various activities did not change much from pre to post, although the educational value of time spent walking and in indirect patient care was rated as less educationally valuable post-reform. Time spent with the team attending and resident did not significantly change, but time with the consulting attendings, team intern and nurses increased post-reform. Educational value of the time spent with members of consulting teams was rated as more educational post-reform.

Kort KC, Pavone LA, Jensen E, Haque E, Newman N, Kittur D. Resident perceptions of the impact of work-hour restrictions on health care delivery and surgical education: Time for transformational change. Surgery 2004; 136:861-871.

MERSQI score=10.5

Multi-institutional cross-sectional survey to assess impact of ACGME work hour rules on general surgery residents. Findings included worse perceptions of patient care following the duty hour rules, although rates of medical errors were perceived to have declined. Operative experience in terms of caseload and skill acquisition was thought to have declined, although the ability to study when not at work and to pursue research were improved after the duty hour rules. Resident quality of life was also improved. PGY 4-5 residents were more negative about the impact on patient care and some aspects of education.

Kupferman TA, Lian TS. Implementation of duty hour standards in otolaryngology-head and neck surgery residency training. Otolaryngology Head Neck Surg 2005; 132:819-822.

MERSQI score=7

Cross-sectional survey study of ENT program directors post-duty hour rules. The results suggest that most program directors did not see a positive impact on patient care and they saw a negative impact on resident education. They also believed that faculty had increased their clinical time because of the duty hour rules.

Kusuma SK, Mehta S, Sirkin M, Yates AJ, Miclau T, Templeton KJ, Friedlaender GE. Measuring the attitudes and impact of the eighty-hour workweek rules on orthopaedic surgery residents. Journal of Bone & Joint Surgery - American Volume 2007; 89(3):679-85.

MERSQI score=8

National cross-sectional survey study of orthopedic surgery residents to assess the impact of the duty hour rules on multiple areas of interest. This study was limited by a response rate of only 13%. Findings of interest include 85% consistently working within the 80-hour limit with averaging, but 33% underreporting their hours at least one time. Forty percent of residents felt that the impact on their program had been positive. With respect to patient care, only 16% perceived decreased continuity, although 38% felt that quality of care had deteriorated (51% perceived no change). A minority (10%) felt that residents had developed a shift-worker mentality. As far as workload, respondents felt that 70% of their time was educationally valuable, but 24% was still 'scut' work. Strategies that respondents reported had been undertaken by their institutions included home call (28%) physician extenders (25%) and night float (22%).

Ladd AP. Pediatric surgery fellowship compliance to the 80-hour work week. Journal of Pediatric Surgery 2006; 41(4):687-92.

MERSQI score=7.5

Multi-site cross-sectional survey study of the impact of duty hour rules on pediatric surgery fellows and their opinions about the impact on residents and themselves. Sixty-nine percentage reported that resident compliance with duty hours increased their clinical work, and more than half reported that time for teaching residents and students was reduced.

Landrigan CP, Rothschild JM, Cronin JW, Kaushal R, Burdick E, Katz JT, Lilly CM, Stone PH, Lockley SW, Bates DW, Czeisler CA. Effect of Reducing Interns' Work Hours on Serious Medical Errors in Intensive Care Units. N Engl J Med 2004; 351(18):1838-48.

MERSQI score=16.2

This prospective randomized crossover study studied the impact of an intervention schedule to eliminate extended shifts in the ICU setting. The main outcomes were patient safety outcomes such as errors and

adverse events. Findings included significant decreases in problems with the intervention schedule. Specifically, serious medical errors by interns and overall were reduced as were intercepted serious errors (for interns and unit-wide) and non-intercepted serious errors by interns. Medication and diagnostic errors by interns and unit-wide also decreased with the intervention. Of note, the number of procedures performed by interns per patient day was significantly higher when following the intervention schedule.

Landrigan CP, Barger LK, Cade BE, Ayas NT, Czeisler CA. Interns' compliance with accreditation council for graduate medical education work-hour limits. JAMA 2006; 296(9):1063-70.

MERSQI score=16.5

National pre-post survey study conducted monthly with interns in 2002-2003 and 2003-2004 to assess compliance with the duty hour rules and sleep. Important findings include 44% of intern-months had some duty hour violation reported in the post-duty hour time period. The 30-hour rule was violated in 32% of the intern months in the post-duty hour time period, and 67% of interns reported at least on violation of the 30-hour rule. Mean weekly hours significantly decreased from pre to post periods from 70.7 hours to 66.6 hours. Likewise, the longest shift duration significantly decreased from a mean of 32.1 to 29.9 hours. Sleep also significantly increased in the post-duty hour time period by 21 minutes per night (which translates into 2.5 extra hours per week). This study had quite low response rates (6.8% and 14.8% for the 2 years).

Landrigan CP, Fahrenkopf AM, Lewin D, Sharek PJ, Barger LK, Eisner M, Edwards S, Chiang VW, Wiedermann BL, Sectish TC. Effects of the Accreditation Council for Graduate Medical Education Duty Hour Limits on Sleep, Work Hours, and Safety. Pediatrics 2008; 122:250-258.

MERSQI score=7.5

This multicenter pre-post study demonstrated that the implementation of changes to comply with the ACGME duty hour rules did not confer a significant benefit in terms of sleep amount, patient safety, or education. In fact patient safety in terms of resident ordering errors trended toward being worse post implementation. Duration of extended shifts, % of residents reporting extended shifts and burnout all improved in the post-implementation period. Compliance to duty hour rules was not measured in this study, although >50% reported working more than 30 hours in a row in the post-duty hour rules group.

Lefrak S, Miller S, Schirmer B, Sanfey H. The night float system: ensuring educational benefit. Am J Surg 2005; 189:639-642.

MERSQI score=7.5

Prospective time-series survey study to assess impact on education of a night float system in a general surgery program. No statistical analyses were performed, but it appeared that on night float, for PGY3's especially, the NF residents got less operative experience.

Leibrandt TJ, Pezzi CM, Fassler SA, Reilly EF, Morris JB. Has the 80-hour work week had an impact on voluntary attrition in general surgery residency programs?. Journal of the American College of Surgeons 2006; 202(2):340-4.

MERSQI score=12.5

Multi-site pre-post survey study of general surgery residency program directors about the attrition of residents before and after duty hour rules were implemented. This is the report of the post-test, but they compare it with the pre-test as well. Attrition did not change between pre-duty hour rules and post-duty hour rules time periods.

Lin GA, Beck DC, Garbutt JM. Residents' perceptions of the effects of work hour limitations at a large teaching hospital. Academic Medicine 2006; 81(1):63-7.

MERSQI score=6

Single site focus group study of internal medicine residents to assess the impact of the work hour limits on internal medicine residents. Findings included improved well-being and an opportunity to learn about different approaches to patient care due to the increased number of residents involved in patient care. Many disadvantageous aspects of the duty hour rules were discussed including incomplete patient evaluations, delayed treatment decisions and discontinuity of care with missed information. With respect to education, residents perceived that there were fewer opportunities to follow patients longitudinally and less time for conference attendance. Overall, there was some frustration at the inflexibility of the rules, especially when it came to specific patient situations.

Lin GA, Beck DC, Stewart AL, Garbutt JM. Resident Perceptions of the Impact of Work Hour Limitations. J Gen Intern Med 2007; 22:969-975.

MERSQI score=10

Single institution cross-sectional survey study of internal medicine residents' perceptions of the impact of the duty hour rules. The survey was analyzed according to scales determined by factor analysis. The results included a negative perception of the duty hour rules on patient care and clinical experience. The impact on work-rest balance was close to neutral. The residents felt more negatively than the interns about the impact of duty hour rules. There were high rates of reporting at least one episode of non-compliance with one of the duty hour rules during the last call month.

Lockley SW, Cronin JW, Evans EE, Cade BE, Lee CJ, Landrigan CP, Rothschild JM, Katz JT, Lilly CM, Stone PH, Aeschbach D, Czeisler CA. Effect of Reducing Interns' Weekly Work Hours on Sleep and Attentional Failures. N Engl J Med 2004; 351:1829-1837.

MERSQI score=8

This within subject randomized study tested interns in one of two ICU settings with one of two schedules. The intervention schedule was marked by no shifts longer than 16 hours and fewer hours overall. Of note, the intervention schedule required an extra intern be allotted to the rotation. The findings included significantly fewer hours for the intervention setting as well as more sleep per week for the interns in the intervention setting. Attentional failures overnight were significantly more common in the traditionally scheduled interns.

Lund KJ, Teal SB, Alvero R. Resident job satisfaction: One year of duty hours. American Journal of Obstetrics and Gynecology 2005; 193: 1823-1826.

MERSQI score=8.5

This is a single institution pre-post survey study of the impact of a night float and other changes to comply with the ACGME duty hour rules in an Ob-Gyn program. The findings included no change in global satisfaction, but statistically significant improvements in several aspects of education/training as well as improved satisfaction with amount of leisure time.

Lundberg S, Wali S, Thomas P, Cope D. Attaining resident duty hours compliance: the acute care nurse practitioners program at Olive View-UCLA Medical Center. Academic Medicine 2006; 81(12):1021-5.

MERSQI score=9

Cross-sectional study of an intervention to help ensure compliance with the 24+6 rule. Intervention was to use NPs on post-call medicine services to help with the team's work that day. They worked under the supervision of the attending from 2-5PM. The interns signed out directly to the cross-cover intern. This

study was really more of an evaluation of an innovation. They do not report much about their assessment methods, but do report a decrease in weekly hours from 86 to 76 and an approximately 99% compliance with the 24+6 rule since implementation.

Malangoni MA, Como JJ, Mancuso C, Yowler CJ. Life after 80 Hours: The Impact of Resident Work Hours Mandates on Trauma and Emergency Experience and Work Effort for Senior Residents and Faculty. J Trauma 2005; 58:758-762.

MERSQI score=12

This single institution pre-post study evaluated the impact of combining trauma and emergency surgery call and compliance with work hours rules. They found that work hours were significantly reduced for residents but not faculty. There appeared to be a decrease in the number emergency surgeries performed by PGY4s. No statistical analyses were performed however. Overall, the number of surgeries for the combined PGY4+5 seemed to decrease as well.

Martini S, Arfken CL, Balon R. Comparison of burnout among medical residents before and after the implementation of work hours limits. Academic Psychiatry 2006; 30(4):352-5.

MERSQI score=12.5

Single site (but multiple program) pre-post study of the impact of changes to comply with duty hour rules on resident burnout. Burnout was statistically unchanged in the post-duty hour period overall (incidence of 41% compared to 49% before duty hours). There was a significant decline in burnout among PGY1s: (77% pre-duty hours to 43% post). Those who reported working more than 80 hours per week were more likely to experience burnout (69%) versus those who worked less than 80 hours (38.5%).

Mathis BR, Diers T, Hornung R, Ho M, Rouan GW. Implementing duty-hour restrictions without diminishing patient care or education: can it be done?. Academic Medicine 2006; 81(1):68-75.

MERSQI score=9

Single site cross-sectional survey study to assess the impact of an intervention to decrease duty hours. The intervention was the creation of 'superteams' with 2 senior residents, 4 intern equivalents and one attending. The superteams were divided into 2 half-teams that took call separately. Findings include a significant decrease in the number of patients admitted per call for the senior residents (from 8 to 6). Residents were mostly neutral about the impact of the intervention/duty hour rules on meeting ACGME requirements, patient care, fatigue and education. Faculty were significantly more positive about the impact on meeting ACGME requirements and on education.

McBurney PG, Gustafson KK, Darden PM. Effect of 80-hour workweek on continuity of care. Clinical Pediatrics 2008; 47(8):803-8.

MERSQI score=13.33333

Single institution pre-post study of the impact of the duty hour rules on the continuity experienced by residents in their clinic. That is, continuity was assessed from the resident's perspective as the proportion of their own patients that they saw. Findings included significantly decreased continuity in well-child visits in the overall means, but not in the means for individual resident years. In addition, average number of visits per year were significantly lower for the PGY3's in the post-year data.

McElearney ST, Saalwachter AR, Hedrick TL, Pruett TL, Sanfey HA, Sawyer RG. Effect of the 80-Hour Work Week on Cases Performed by General Surgery Residents. The American Surgeon 2005; 71:552-556.

MERSQI score=13.33333

This single institution pre-post study evaluated the implementation of a night float and other changes in order to comply with the ACGME duty hour rules. They specifically evaluated surgical experience by looking at OR cases for residents across PGY levels and in total for 1 year before and 1 year after these changes. The only significant difference was a decrease in cases for PGY5 residents. There was a trend toward increased cases for PGY4s. Overall, there was no difference in cases for all classes combined.

Mendoza KA, Britt LD. Resident Operative Experience During the Transition to Work-Hour Reform. Arch Surg 2005; 140:137-145.

MERSQI score=13

Multi-institutional look at operative cases and also a survey study to assess programmatic changes. Employed both a pre-post assessment and also a non-randomized observational comparison between programs that did and did not experiment with changes to comply with the ACGME duty hour rules. Operative cases were measured by the defined category reports. For the pre-post study, the "pre" period is 2001-2002. The "post" period is 2002-2003 when many programs were working on changes. The non-randomized observational study is what we focused on and is the comparison of operative experience in the programs that did and did not experiment with change in 2002-2003. According to the analyses conducted by the authors, there was no effect of experimenting with work hour rules on the operative experience of chief residents. When we conducted separate analyses, we found that university and university/community programs that experimented with change had a significant decrease in operative experience for the chief residents. The authors also found that adherence to an 80-hour rule did not relate to operative experience. The most common strategies used by the programs to comply with duty hour rules included: residents home early post call (30%), night float (30%), decreased frequency of call (18%), strict monitoring of work hours (12%), and NPs/PAs added (12%).

Moelam J, Salzman P, Ruan DT, Cherr GS, Freiburg CB, Farkas RL, Brewster L, James TA. Should all duty hours be the same? Results of a national survey of surgical trainees. J Am Coll Surg 2009; 209:47-54.

MERSQI score=9

National cross-sectional study of surgical residents and fellows with a response rate of only 7.3%. Findings included that 41% of residents reported that duty hour rules were a moderate or considerable barrier to education. The senior residents were more likely to report the duty hour rules as a significant barrier. 52% reported that 6-80 hours per week was idea, with an additional 43% reporting that 80-100 hours per week would be ideal.

Morrison CA, Wyatt MM, Carrick MM. Impact of the 80-hour workweek on mortality and morbidity in trauma patients: an analysis of the National Trauma Data Bank. Journal of Surgical Research 2009; 154(1):157-62.

MERSQI score=16

Multi-institution pre-post study using a national database to assess the morbidity and mortality of patient who were admitted in the two years before duty hour rules to the patients admitted during the 2 years post-duty hour rules. Findings included that the overall mortality for trauma patients decreased in the post-duty hour time period (4.64% to 4.46%). When comparing time periods for university hospitals, the significant decrease persists, but when mortality rates for nonteaching hospitals were analyzed, there was a significant increase in the post-duty hour time period. Overall, hospital and ICU length of stay decreased in the post-duty hour time period as did number of days on mechanical ventilation. Hospital LOS significantly increased in the nonteaching hospitals and did not change in the university hospitals. Days on mechanical ventilation and ICU LOS decreased significantly in both nonteaching and university hospitals.

Mycyk MB, McDaniel MR, Fotis MA, Regalado J. Hospital wide adverse drug events before and after limiting weekly work hours of medical residents to 80. Am J Health-Syst Pharm 2005; 62:1592-1595.

MERSQI score=14.66667

Pre-post single institution study to assess adverse drug events pre and post ACGME duty hour rules. The findings were that there were no differences between the pre and post period in terms of rates of ADEs or preventable ADEs.

Myers JS, Bellini LM, Morris JB, Graham D, Katz J, Potts JR, Weiner C, Volpp KG. Internal medicine and general surgery residents' attitudes about the ACGME duty hours regulations: a multicenter study.[see comment]. Academic Medicine 2006; 81(12):1052-8.

MERSQI=10

Multi-site cross-sectional survey study of general surgery and internal medicine residents to assess the impact of the duty hour rules. With respect to patient safety, the mean score on the item assessing errors due to discontinuity indicated an increase (score=3.6, 1-5 scale with 5=increased a lot). Errors due to fatigue seemed to decrease by about the same amount (mean score of 2.5). Bedside learning was rated as having decreased. The mean response on the item assessing shirt-work mentality indicated agreement that it was occurring (3.7, 1-5 scale with 1=strongly disagree). Resident burnout (as measured by a single item) was slightly decreased (2.7, 1-5 scale with 1=decreased a lot).

Naylor RA, Rege RV, Valentine RJ. Do Resident Duty Hour Restrictions Reduce Technical Complications of Emergency Laparoscopic Cholecystectomy? J Am Coll Surg 2005; 201: 724-731.

MERSQI score=14.66667

This pre-post study evaluated the impact of an intervention to reduce resident work hours on surgical complications in patients undergoing emergent cholecystectomy. No significant difference in complication rates occurred between the 2 study periods.

Nixon LJ, Benson BJ, Rogers TB, Sick BT, Miller WJ. Effects of Accreditation Council for Graduate Medical Education Work Hour Restrictions on Medical Student Experience. J Gen Intern Med 2007; 22:937-941.

MERSQI score=8.5

This is a single institution pre-post survey study of medical students while on their required medicine, pediatrics and surgery clerkships and their medicine sub-internship rotation. They survey had been in place prior to the conception of the study. The findings include significantly increased time spent teaching by the residents after the duty hour rules when all rotations were combined and no difference in the time teaching by attendings. Work hours for students significantly declined in the post-duty hour time period.

Nuckols TK, Bhattacharya J, Wolman DM, Ulmer C, Escarce JJ. Cost implications of reduced work hours and workloads for resident physicians. [see comment]. New England Journal of Medicine 2009; 360(21):2202-15.

MERSQI score=NA

This study developed a probability model based on published data to estimate the annual cost of implementing the IOM recommendations. The authors suggest that it would cost approximately $1.6 billion dollars annually to implement the IOM recommendations if non-residents were used to absorb the extra work. If additional residents were used the cost could be up to $1.7 billion. In order for this to be a

cost-neutral intervention to society, an annual decrease in preventable adverse events of 11.3% would need to occur,

Nuckols TK, Escarce JJ. Residency Work-Hours Reform: A Cost Analysis Including Preventable Adverse Events. J Gen Intern Med 2005; 20:873-878.

MERSQI score=NA

Cost analysis of four different methods for achieving success at duty hour rule compliance. Findings included needing a 16.9% reduction in AEs with attendings as substitutes in order to get to cost neutrality.

Nuthalapaty FS, Carver AR, Nuthalapaty ES, Ramsey PS. The scope of duty hour-associated residency structure modifications. American Journal of Obstetrics & Gynecology 2006; 194(1):282-8.

MERSQI score=8.5

Multi-site cross-sectional survey study of Ob/Gyne program directors to assess the methods used to comply with the resident duty hour rules. Ninety-four percent reported changing their call structure. Seventy-six percent were using night float systems. Sixty-three percent decreased elective time, and 48% hired physician extenders. The most difficult part of the rules to comply with was the 10 hours off between shifts.

Nuthalapaty FS, Carver AR, Nuthalapaty ES, Ramsey PS. The perceived impact of duty hour restrictions on the residency environment: a survey of residency program directors. American Journal of Obstetrics & Gynecology 2006; 194(6):1556-62.

MERSQI score=9.5

Multi-site national cross-sectional survey study of Ob/gyn program directors (not including those from NY state). Study was to assess the impact of the duty hour rules. Seventy-two percent pf respondents reported an improvement in resident well-being. A predominantly negative impact was seen on resident education, resident surgical skills and resident work ethic. Overall, a minority felt that quality of patient care had improved.

Pappas AJ, Teague DC. The impact of the accreditation council for graduate medical education work-hour regulations on the surgical experience of orthopedic surgery residents. Journal of Bone & Joint Surgery - American Volume 2007; 89(4):904-9.

MERSQI score=13.8

Single institution pre-post study using retrospective data to assess the impact of changes to comply with the duty hour rules on resident operative experience. There were no significant differences in operative experience between the two time periods, either overall or per PG year.

Parthasarathy S, Hettiger K, Budhiraja R, Sullivan B. Sleep and well-being of ICU housestaff. Chest 2007; 131(6):1685-93.

MERSQI score=13

Single site pre-post study to assess the impact of interventions to comply with duty hour rules on residents and fellows working in an ICU setting. Interventions for the residents included, leaving by noon post call, cancelling post-call clinics, and tracking of their hours. Intercepted medication ordering errors significantly decreased in the post-duty hour period for the combined group of residents/fellows. Amount of sleep for residents increased significantly and mean sleepiness scores improved in the post-duty hour time period.

For residents/fellows combined, 3 domains of the SF-36 improved post-duty hours: vitality, social functioning and general health. There was also a significant decrease in the number of residents reporting that they were sleepy while driving in the post-duty hour period compared to the pre-duty hour period.

Peabody T. The effect of work hour restrictions on the education of orthopaedic surgery residents. Clinical Orthopaedics & Related Research 2006; 449:128-33.

MERSQI score=7

National cross-sectional survey study of orthopedic surgery residents, program directors and chairs. This was conducted 2 years after the duty hour rules and was very similar to a survey published by the same author that was conducted only a few months after the duty hour rules had been put into place. Strategies used to comply with the duty hour limits included physician extenders (76%), home call (37%) and night float (34%). More than half of the PDs/chairs reported increased faculty workload as a result of the duty hour limits. With respect to the impact on the programs, 61% of PDs and chairs and 50% of residents reported negative impact of the duty hour rules while 24% and 38% reported a positive impact, respectively. With respect to patient safety, just over half of residents and PDs/chairs reported problems with hand-offs and only 9% of PDs/chairs reported improvement in errors with the duty hour limits (31% of residents reported improvement).

Pellegrini VD Jr, Peabody T, Dinges DF, Moody J, Fabri PJ. Symposium resident work-hour guidelines. A sentence or an opportunity for orthopaedic education?[see comment]. Journal of Bone & Joint Surgery - American Volume 2005; 87(11):2576-86.

MERSQI score=7

National cross-sectional survey of orthopedics residents and program directors to assess the impact of the duty hour rules on education and patient care. Strategies undertaken to reduce hours include the use of physician extenders (51%), float rotations (31%) and home call (39%). Over 40% of both residents and PDs reported inadequate operative volume for the residents. Forty percent of residents, but only 6% of PDs thought that the duty hour limits had resulted in fewer errors. Most PDs (74%) felt that they duty hour rules had had a negative impact on their residency program.

Peterson CM, Gerstle R, Bhalla S, Menias CO, Jost RG. Results of the 2004 Survey of the American Association of Academic Chief Residents in Radiology. Acad Radiol 2005; 12:373-378.

MERSQI score=7.5

Cross-sectional survey study of radiology chief residents. Covered several issues pertinent to the duty hour rules. Most chief residents reported that they were able to achieve compliance with duty hour regulations with little or no changes in their programs. They also reported improved educational and call experiences post-duty hour rules. Some workload issues were addressed as well, with 39% of chiefs reporting that the residents covered 3 or more hospitals. Attendings were not universally available even by pager to residents when they were on-call.

Peterson LE, Johnson H, Pugno PA, Bazemore A, Phillips RL Jr. Training on the clock: family medicine residency directors' responses to resident duty hours reform. [see comment]. Academic Medicine 2006; 81(12):1032-7.

MERSQI score=8.5

National cross-sectional survey study of family medicine program directors to assess the impact of the duty hour rules on several outcomes. Strategies used to comply with duty hour rules include elimination of post call clinics (54%), adjusting work schedules (33%), caps on new admits: (18%), non-housestaff services run by PA/NP (8%), resident day/night float (35%). Half of the program directors reported increased patient care duties for faculty, while 42% reported no change. More than half of PDs reported no change in

formal resident educational activities and elective time, but nearly half reported decreases in both of those (47% and 41% respectively). Fifty-eight percent reported a decrease in residents caring for their patients in continuity clinics (41% said no change).

Privette AR, Shackford SR, Osler T, Ratliff J, Sartorelli K, Hebert JC. Implementation of resident work hour restrictions is associated with a reduction in mortality and provider-related complications on the surgical service: A concurrent analysis of 14,610 patients. Ann Surg 2009; 250:316-321.

MERSQI score=14.66667

Pre-post study at a single institution to assess the impact of resident duty hour rules on patient safety and faculty time. Mortality significantly decreased despite an increase in Charlson scores in the post-duty hour time period (1.96% to 1.1%). Complication rates did not significantly change, but the proportion of complications that were attributable to provider-related issues decreased in the post-duty hour time period. Attending involvement in care significantly increased in the post-duty hour period, measured by Medicare time records and the use of the RVU -82 modifiers, 'no qualified resident available.'

Ratanawongsa N, Bolen S, Howell EE, Kern DE, Sisson SD, Larriviere D. Residents' Perceptions of Professionalism in Training and Practice: Barriers, Promoters, and Duty Hour Requirements. J Gen Intern Med 2006; 21:758-763.

MERSQI score=9.5

Multi-institutional cross-sectional survey study of IM, neurology and FP residents to assess the impact on professionalism. 45% of residents reported a decrease in professionalism because of the duty hour rules, while only 19% reported a net improvement. Reasons they listed for the reduction in professionalism were less time with patients/families, general time pressure, decreased continuity and decreased sense of accountability. On the other hand, less fatigue and teamwork were cited as most common reason why the duty hour rules improved professionalism.

Reed DA, Levine RB, Miller RG, Ashar BH, Bass EB, Rice T, Cofrancesco J Jr. Impact of Duty Hour Regulations on Medical Students' Education: Views of Key Clinical Faculty. J Gen Intern Med 2008; 23(7):1084-1089.

MERSQI score=9.5

This multi-institution cross-sectional survey study of key clinical faculty from a random sample of academic internal medicine residency programs assessed the faculty-perceived impact of the duty hour rules on students. These faculty members were more likely to say that education on the IM wards had worsened (52% reported worsening) as had continuity of patient care (30%), the responsibility of the student on the team (app 30%) and the ability to form working relationships with the residents (56%). In addition, faculty members who reported teaching more than 15 hours per week viewed the changes more negatively than those who taught < 15 hours/week.

Reed DA, Levine RB, Miller RG, Ashar BH, Bass EB, Rice TN, Cofrancesco J Jr. Effect of residency duty-hour limits: views of key clinical faculty. [see comment]. Archives of Internal Medicine 2007; 167(14):1487-92.

MERSQI score=9.5

Multi-institutional cross-section survey study of key clinical faculty from a random sample of internal medicine residency programs to assess the impact of duty hour rules on resident education, patient care and professionalism. Findings include significantly more faculty than not perceived decline in professionalism and accountability to the patients. The faculty also reported declines in continuity of care and overall quality of care. They also felt that resident autonomy has decreased and that there were fewer opportunities for bedside and didactic teaching. Significantly more faculty reported increased time on wards directly

supervising residents or providing care without residents when compared to faculty who did not believe these things had increased.

Reiter ER, Wong DR. Impact of Duty Hour Limits on Resident Training in Otolaryngology. Laryngoscope 2005; 115:773-779.

MERSQI score=9.6

This is a multi-institutional cross-sectional survey study of ENT program directors' and residents' perception of the impact of the ACGME duty hour rules. Overall, the PDs were less positive about of the impact of duty hour rules on patient safety and resident education, although fewer than half the residents reported agreeing that education and safety had improved. Only 27% of residents reported getting consistently more sleep now than before the duty hour rules.
Sorokin R, Riggio JM, Hwang C. Attitudes About Patient Safety: A Survey of Physicians-in-Training. American Journal of Medical Quality 2005; 20:70-77.

Roey S. Medical education and the ACGME duty hour requirements: assessing the effect of a day float system on educational activities. Teaching & Learning in Medicine 2006; 18(1):28-34.

MERSQI score=8.5

Pre-post survey study of a single institution's changes to comply with duty hour rules. The main change was the implementation of a day float system which admitted patients from 8AM-2PM and allowed the on call team to stagger their arrival times. After the interventions were implemented, residents viewed their autonomy in decision-making significantly more positively. Attendance at teaching conferences and peer-to-peer teaching did not significantly change in the two time periods however. After the interventions, frequency of working fewer than 30 hours in a row for interns was significantly decreased (from 58% of the time before to 7% of the time after).

Rosen AK, Loveland SA, Romano PS, Itani KMF, Silber JH, Even-Shoshan OO, Halenar MJ, Teng Y, Zhu J, Volpp KG. Effects of resident duty hour reform on surgical and procedural patient safety indicators among hospitalist veterans health administration and Medicare patients. Med Care 2009; 47:723-731.

MERSQI score=16.66667

Pre-post study comparing teaching intensive and non-teaching intensive hospitals with respect to the July 1, 2003 start date of the ACGME duty hour rules. This study was conducted for all patients admitted to VA hospitals for acute care and for Medicare patients admitted to other acute care hospitals. The authors combined the patient safety indicators into three groupings according to factor analysis and other criteria. In the 1st post-reform year, there was a significant increase in the odds of having a psi related to technical skills (1.12)/ In post-reform year #2, there was a significant increase in 'other' PSIs. These both refer to changes relative to the pre-duty hour rules for teaching intensive versus not teaching intensive hospitals.

Schenarts P, Bowen J, Bard M, Sagraves S, Toschlog E, Goettler C, Cromwell S, Rotondo M. The effect of a rotating night-float coverage scheme on preventable and potentially preventable morbidity at a level 1 trauma center. Am J Surg 2005; 190:147-152.

MERSQI score=14.66667

Pre-post study of the impact of a night coverage system on patient outcomes. They found no impact on patients with respect to a number of potential complications. None were significant differences between the two time periods.

Schneider JR, Coyle JJ, Ryan ER, Bell RH Jr, DaRosa DA. Implementation and evaluation of a new surgical residency model. J Am Coll Surg 2007; 205(3):393-404.

MERSQI score=12.5

Single institution pre-post study of the impact of an intervention to comply with duty hour standards in a general surgery program. Operative experience appeared to increase but this was not checked for significance (average yearly cases over the 5 PGYs: pre-1112 and post (2004-05)-1277). ABSITE scores significantly improved for the PGY1-2 in the post-reform period. Two-thirds of the faculty reported that their hours had changed not changed with the reforms, but 35% reported an increase in hours.

Schuh LA, Adair JC, Drogan O, Kissela BM, Morgenlander JC, Corboy JR. Education research: neurology residency training in the new millennium. [see comment]. Neurology 2009;.72(4):e15-20.

MERSQI score=

Cross-sectional survey study of all adult neurology program directors in the US to assess several aspects of their jobs including their impressions of the impact of the duty hour rules. Rearranging schedules was the most common method for addressing duty hour rules. Only 8% thought that patient care had improved, 15% thought that resident education had improved and 62% thought that faculty workload had improved.

Shetty KD, Bhattacharya J. Changes in hospital mortality associated with residency work-hour regulations. [see comment][summary for patients in Ann Intern Med. 2007 Jul 17;147(2):I16; PMID: 17548402]. Annals of Internal Medicine 2007; 147(2):73-80.

MERSQI score=15.33333

Multi-institution retrospective pre-post study to assess the impact of duty hour rules on patient outcomes with a concomitant non-teaching control group, so essentially this was a combination of pre-post and cohort designs, resulting in a 'difference-in-differences' analysis. The main finding was a significant absolute decline in mortality among medical but not surgical patients admitted to teaching hospitals in the post-duty hour period (-0.25%).

Shin S, Britt R, Britt LD. Effect of the 80-Hour Work Week on Resident Case Coverage: Corrected Article. J Am Coll Surg 2008; 207:148-150.

MERSQI score=12

This retrospective pre-post study used medical record review to ascertain the percentage of cases covered by residents in a single practice before and after duty hour rules were implemented. No significant differences emerged in terms of percentage of cases covered by resident level. The absolute numbers seemed to increase or stay stable from pre to post duty hour rules. The only procedure that saw significant change in coverage was simple breast surgery by junior residents, which decreased in the post-duty hour rule period.

Shonka DC Jr., Ghanem TA, Hubbard MA, Barker DA, Kesser BW. Four years of accreditation council of graduate medical education duty hour regulations: have they made a difference?. Laryngoscope 2009; 119(4):635-9.

MERSQI score=13.8

Single institution pre-post study to assess the impact of duty hour rules on patient care benchmarks, operative experience and In-training examination scores. Also assessed duty hour violations. Patient care benchmarks were largely unchanged, except for an increase in the post-duty hour period of the LOS index, which is a measure of LOS that is standardized against other hospitals. LOS itself did not change significantly. In-training examinations and operative experience of graduating residents did not change during the two periods. Of the approximately 1400 duty hour violations in the post-duty hour period, >90% were violations of the 10-hour rule.

Short AC, Rogers SJ, Magann EF, Rieg TS, Shapiro A, Morrison JC. The 80-hour workweek restriction: How are OB/GYN resident procedure numbers affected?. Journal of Maternal-Fetal & Neonatal Medicine 2006; 19(12):801-6.

MERSQI score=12.6

Single site pre-post study to assess the impact of interventions to comply with duty hour rules in resident operative experience in an Ob/Gyn program. There was no significant difference in overall operative experience, but there was a significant decline in the number or obstetrical cases after the changes to comply with the duty hours were implemented.

Sorokin R, Riggio JM, Hwang C. Attitudes About Patient Safety: A Survey of Physicians-in-Training. American Journal of Medical Quality 2005; 20:70-77.

MERSQI score=8

Cross-sectional survey study conducted at a single institution but across a wide range of specialties to assess resident attitudes toward causes of adverse events, including questions on supervision, duty hour rules and sign-outs. 59% of PGY1-2 versus 37% of PGY 3-4 felt that the 80-hour work week would decrease AEs. A majority agreed that better attending supervision and improving sign-outs would reduce AEs.

Spencer AU, Teitelbaum DH. Impact of Work-Hour Restrictions on Residents' Operative Volume on a Subspecialty Surgical Service. J Am Coll Surg 2005; 200:670-676.

MERSQI score=9

Pre-post single institutional study of the impact of duty hour rules compliance on the operative experience of residents on pediatric surgery service. No significant differences were found in operative experience before and after duty hour rules except that senior residents performed more endoscopy/vascular access procedures in the post period than in the pre period.

Stamp T, Termuhlen P, Miller S, Nolan D, Hutzel P, Gilchrist J, Johnson RM. Before and After Resident Work Hour Limitations: An Objective Assessment of the Well-being of Surgical Residents. Curr Surg 2005; 62:117-121.

MERSQI score=13.5

Single institution pre-post survey study of surgical residents to assess the impact of changes made to comply with duty hour rules. The Beck Depression Inventory and the SF-36 did not change between the 2 study periods. Most questions about resident quality of life improved significantly after the duty hour rules, but no questions relating to patient safety changed. In terms of education, only having enough time to read changed significantly, and that was in the positive direction for the duty hour rules.

Surani S, Subramaniam S, Aguillar R, Ahmed M, Varoon J. Sleepiness in medical residents: Impact of mandated reduction in work hours. Sleep Medicine 2007; 8:90-93.

MERSQI score=11.5

This single institutional study used a non-random simultaneous control group of residents on daytime rotations to compare with residents on night float (shift length =14 hours). The testing occurred in the morning following at least 3 nights of night float or 3 mornings since the last call for the control group. Based on sleep diaries, both groups had similar amounts of sleep in the week prior to the testing. The findings included more normal sleep latency in the night float group, and similar subjective sleepiness scores between the two groups.

Tendulkar AP, Victorino GP, Chong TJ, Bullard MK, Liu TH, Harken AH. Quantification of Surgical Resident Stress "On Call." J Am Coll Surg 2005; 201: 560-564.

MERSQI score=14.4

This study used a control group and compared residents on call to those without clinical responsibility in terms of heart rate average and maximum. For all training levels, the residents had higher mean HRs on call. For the interns, the max heart rate was significantly higher on call compared to not, but this was not true of the junior and senior residents. In a within subject subset, WBC count was shown to be higher post call for the interns, but not the junior residents.

Tran J, Lewis R, de Virgilio C. The effect of the 80-hour workweek on general surgery resident operative case volume. American Surgeon 2006; 72(10):924-8.

MERSQI score=13.33333

Single site pre-post study to assess the impact of changes to comply with duty hour rules on operative experience of general surgery residents. Number of call nights decreased in the post-duty hour period. No significant difference in median number of procedures overall, although there was a significant increase for the PGY2s. Interestingly, in the 2 post-reform years the numbers were very different. In 2003, the median number of cases per quarter was 20.5, but the following year it was only 7, so it is not clear that this was a sustained increase.

Vallier HA, Prokuski LJ, Nash Jr. CL, Patterson BM. Effects of resident work-hour restrictions on orthopedic education and patient care. Current Orthopedic Practice 2009; 20(1):77-86.

MERSQI score=10

This multi-institutional time series study had a pre-post component to assess the impact of duty hour rules on orthopedic residents. In the 2 years post-duty hour rules, 93% of residents reported working <80 hours/week, compared with before when only 43% worked fewer than 80 hours. In the post-time period, only 55% of faculty reported working fewer than 80 hours/week. Compared to recent graduates, the residents in 2005 rated their time spent on non-educational patient care as closer to â€œtoo much.â€ Faculty perceptions of graduate competence significantly decreased when post-duty hours was compared to pre-duty hours. The major drawback to this study was that very little of the pre-data was actually reported and no response rate data was reported for the â€œpreâ€ time period either.

Vanderveen K, Chen M, Scherer L. Effects of Resident Duty-Hours Restrictions on Surgical and Nonsurgical Teaching Faculty. Arch Surg 2007; 142(8); 759-766.

MERSQI score=8

Single institution cross-sectional survey study of faculty from various departments about the impact of duty hour rules on their lives. Forty-two percent reported that their own work hours had increased as a result of the 80-h work week for residents, while 56% reported no change. Decreased time for teaching was reported by 56%, and 43% reported a decrease in their job satisfaction. In terms of patient care, 33% reported a decrease in quality of care, but 64% reported no change. Fifty-eight percent reported a decline in continuity for their patients, but 80% reported no change in medical errors.

Vaughn DM, Stout CL, McCampbell BL, Groves JR, Richardson AI, Thompson WK, Dalton ML, Nakayama DK. Three-year results of mandated work hour restrictions: attending and resident perspectives and effects in a community hospital. American Surgeon 2008; 74(6):542-6.

MERSQI score=7

Single institution survey study that assessed opinions about the impact of duty hour rules at two time points: 1-year post-implementation and 3 years post-implementation. The main intervention was a night float system. Results include majority of attendings feeling that the work ethic had deteriorated by 2006 and no attendings believing that the training prepared residents for the 'real world.' All residents and attendings agreed that resident quality of life had improved. No residents thought that night float had a negative impact on patient care. Most attendings thought that continuity of care had deteriorated, but only a minority of residents thought so. A majority of residents and a minority of attendings thought that the duty hour rules were beneficial to patient care. Significantly more residents than attendings thought that the duty hour rules had been beneficial for education.

Vetto JT, Robbins D. Impact of the recent reduction in working hours (The 80 hour workweek) on surgical resident cancer education. J Cancer Ed 2005; 20:23-27.

MERSQI score=9

Pre-post study of the same residents in a single general surgery program to test the impact of the ACGME duty hour rules on surgical cancer education. Used a survey and cancer-specific ABSITE performance. It appears that no statistical analysis was performed of the ABSITE data, but the mean scores increased by 7% and the cancer-specific scores decreased by 3%. The survey data suggests that clinical exposure to cancer cases is virtually unchanged, while most residents reported increased or no change in cancer-related reading.

Vidyarthi AR, Katz PP, Wall SD, Wachter RM, Auerbach AD. Impact of reduced duty hours on residents' educational satisfaction at the University of California, San Francisco. Academic Medicine 2006; 81(1):76-81.

MERSQI score=10

Single institution cross-sectional survey study of internal medicine residents to assess the impact of duty hour rules on resident education and subjective workload. Results include most r(57%) reporting no change in workload with 39% reporting improvements in workload. Time spent on non-MD tasks was reported as unchanged by 72%, but 22% reporting improvements. Forty-five percent of residents reported no change in time to teach (with a slight preponderance of the others reporting increased time for teaching), and 47% reported no change in time in teaching conferences, with roughly equal numbers reporting increased and decreased time.

Vidyarthi AR, Auerbach AD, Wachter RM, Katz PP. The Impact of Duty Hours on Resident Self Reports of Errors. J Gen Intern Med 2007; 22:205-209.

MERSQI score=10

This single institution cross-sectional survey addressed the question of how work hours impacted patient safety at an internal medicine residency program. They found that 18% of residents still worked more than 80 hours/week, but that working >80 h/wk did not predict poor patient care practices or medical errors. Contributors to errors were identified as workload, inadequate time, fatigue and inadequate supervision. In addition, 18% of residents reported spending > 50% of their time on non-physician related tasks.

Volpp KG, Rosen AK, Rosenbaum PR, Romano PS, Itani KMF, Bellini L, Even-Shoshan O, Cen L, Wang Y, Halenar MJ, Silber JH. Did duty hour reform lead to better outcomes among the highest risk patients? J Gen Intern Med 2009.

MERSQI score=16.66667

National study of VA hospitals using a multiple time-series design to look at whether the change in duty hour rules was associated with a change in an underlying trend. this approach compares each hospital to itself in the pre and post periods, adjusting for patient factors and comparing the changes in hospitals with

more residents to hospitals with fewer residents. In this study, the outcome of interest was mortality in high risk patients and failure to rescue in patients with post-operative complications. The patients were Medicare or VA patients. In post-reform year 1, there was a significant increase in mortality among high risk VA patients and a significant decrease in mortality in the surgical patients. By post-reform year 2, there were no differences between teaching intensive and non-teaching intensive hospitals.

Volpp KG, Rosen AK, Rosenbaum PR, Romano PS, Even-Shoshan O, Wang Y, Bellini L, Behringer T, Silber JH. Mortality among hospitalized Medicare beneficiaries in the first 2 years following ACGME resident duty hour reform.[see comment]. JAMA 2007; 298(9):975-83.

MERSQI score=16.66667

National study of medicare beneficiaries admitted to non-federal acute care hospitals using a multiple time-series design to look at whether the change in duty hour rules was associated with a change in an underlying trend. This approach compares each hospital to itself in the pre and post periods, adjusting for patient factors and comparing the changes in hospitals with more residents to hospitals with fewer residents. There were no significant differences in adjusted odds of 30-day mortality in either the surgical or medical medicare patients when that could be attributed to the reform. However, the 30-day mortality in the subgroup of patients admitted for CVA in post-reform years 1 and 2 was significantly increased at 1.08.

Volpp KG, Rosen AK, Rosenbaum PR, Romano PS, Even-Shoshan O, Canamucio A, Bellini L, Behringer T, Silber JH. Mortality among patients in VA hospitals in the first 2 years following ACGME resident duty hour reform. [see comment]. JAMA 2007; 298(9):984-92.

MERSQI score=16.66667

National study of VA hospitals using a multiple time-series design to look at whether the change in duty hour rules was associated with a change in an underlying trend. the authors found that adjusted risk of mortality was significantly decreased in the second year after duty hour rules were implemented for the patients in the medical group, but not in the surgical group when compared to patients who were admitted to less teaching intensive hospitals (OR=0.74).

Watson JC. Impact of the ACGME Work Hour Requirements: A neurology resident and program director survey. Neurology 2005; 64:E11-E15.

MERSQI score=7

Multi-institutional cross-sectional survey study of neurology program directors and residents about the impact of the ACGME duty hour rules on neurology programs. The most commonly used strategies were reforming structure of hospital teams, rescheduling educational activities, eliminating standing or elective rotations and adding more residents to rotations. Overall, program directors appeared to be more negative about the impact than were residents, although the responses were not compared statistically. This was especially true for the impact on patient care and the impact on training. Both agreed that residents were less fatigued and that continuity of care had suffered.

Weatherby BA, Rudd JN, Ervin TB, Stafford PR, Norris BL. The effect of resident work hour regulations on orthopedic surgical education. Journal of Surgical Orthopaedic Advances 2007; 16(1):19-22.

MERSQI score=12.6

Single institution pre-post design to assess the impact of duty hour rules on operative experience on PGY2-3 orthopedic residents (n=8). Findings include a significant decline in operative experience in the post-duty hour period (79.5 cases/year to 63.3 cases/year). In addition, residents kept logs to record the number of cases they missed by leaving post-call, and found that they missed on average 7.75 over 3 months.

West CP, Tan AD, Habermann TM, Sloan JA, Shanafelt TD. Association of resident fatigue and distress with perceived medical errors. JAMA 2009; 302: 1294-1300.

MERSQI score=

Single institution time series study of internal medicine residents to assess prospectively the relationship between burnout, depression, fatigue and sleepiness on self-perceived major medical errors. Residents received surveys quarterly to assess demographics, rotation characteristics, self-reported medical errors, quality of life, and fatigue. Burnout and depression were assessed every 6 months. Data collected before the self-report of a medical error were used to predict likelihood of committing a medical error. In models containing fatigue, quality of life, burnout on all 3 dimensions, and depression were all statistically significantly associated. For the studies that included sleepiness, sleepiness often dropped out of the model. Quality of life, burnout, especially the emotional exhaustion and depression were all significantly associated with self-report of a medical error, but sleepiness remained significant only in the model containing quality of life.

West CP, Cook RJ, Popkave C, Kolars JC. Perceived impact of duty hours regulations: a survey of residents and program directors. American Journal of Medicine 2007; 120(7):644-8.

MERSQI score=9

National cross-sectional survey study of internal medicine residents and program directors. This was in the form of a question added to the end of the in-training exam and a separate survey sent to the PDs. Results indicated that 30% of residents reported an increase in learning (as opposed to 11.7% who reported a decrease). In terms of clinical skills, 15.6% reported an increase in clinical skills versus 14% who reported a decrease. Finally, 40% reported an increase on the overall ability to provide patient care, as opposed to 12.3% who reported a decrease. 51% of program directors reported that the duty hour rules made it harder for them to educate residents, with the 24+6 rules providing difficulty for the most programs.

White CB, Haftel HM, Purkiss JA, Schigelone AS, Hammoud MM. Multidimensional Effects of the 80-Hour Work Week at the University of Michigan Medical School. Academic Medicine 2006; 81:57-62.

MERSQI score=7.5

Single institution pre-post survey study to assess the impact of duty hour rules on 3rd year clerks. The authors used a system of clerkship evaluation that was already in place and assessed the impact on medicine, peds, surgery and ob-gyne experiences. The experience of students during pediatrics significantly improved in two domains, faculty availability and teaching. In surgery, however, it was a different story with significant worsening in multiple domains. Specifically, quality of feedback, clarity of expectations, ability to manage patient problems and amount of scutwork all significantly worsened in the post-duty hour period. Ob-gyne also showed significant worsening in accessibility of faculty and house staff, quality of house staff teaching/feedback and overall clerkship as well as a detriment in observation of clinical skills and ability to manage problems. Medicine changed in only one domain: time spent in scutwork, which significantly worsened.

Winslow ER, Berger L, Klingensmith ME. Has the 80-hour Work Week Increased Faculty Hours? Current Surgery 2004; 61(6):602-8.

MERSQI score=8

Pre-post Survey study of a single institution over 6 months before and 6 months after institution of resident 80-hour workweek). Faculty work hours did not change. Patient care was thought to stay neutral of worsen.

Wong JG, Holmboe ES, Huot SJ. Teaching and learning in an 80-hour work week: A novel day-float rotation for medical residents. J Gen Intern Med. 2004;19:519-523.

MERSQI score=10.93

This was a cross-sectional evaluation of a single site innovation involving the implementation of a day-float system to assist the post-call team complete their work. Residents rated the program using a 1-5 scale with 1=almost never. Findings include a score of 4.38 on having time to read about patient problems, and a score of 3.84 on their role making the team more efficient.

Woods SE, Zabat E, Talen MR, Bishop S, Stephens L, Engel A. Residents' perspective on the impact of the 80-hour workweek policy. Teaching & Learning in Medicine 2008; 20(2):131-5.

MERSQI score=10

Multi-site cross-sectional survey study of the impact of duty hour rules on a broad range of issues using a likert-type scale of 1-5 (1=very little impact, 5=high impact). Self-care and sleep hygiene were the highest impact outcomes, both scoring over 4. Medical competency and quality of patient care score in the mid-3's. Least impacted were depth of knowledge, continuity of care, quantity of experiences and variety of training experiences (all scoring between 2.85 and 3.01).

Yaghoubian A, Saltmarsh G, Rosing DK, Lewis RJ, Stabile BE, de Virgilio C. Decreased bile duct injury rate during laparoscopic cholecystectomy in the era of the 80-hour resident workweek. Archives of Surgery 2008; 143(9):847-51.

MERSQI score=14.66667

Single site pre-post study of the impact of the duty hour rules on patient outcomes in a general surgery program, specifically looking at complications and bile duct injuries of patients undergoing laparoscopic cholecystectomy. Important findings include a significant increase in the number of surgeries that were converted to open procedures in the post-duty hour period (13% to 16%). Total bile duct injuries and complications were significantly reduced in the post-duty hour period (1.1% to 0.4% and 5% to 2%, respectively). These differences were confirmed in multivariable modeling accounting for patient characteristics.

Zahn CM, Dunlow SG, Alvero R, Parker JD, Nace C, Armstrong AY. Too little time to teach? Medical student education and the resident work-hour restriction. Military Medicine 2007; 172(10):1053-7.

MERSQI score=8

This was a cross-section survey study that asked respondents to consider pre-and post-duty hour time periods (so essentially a retrospective pre-post design) in order to study the impact of the duty hour restrictions on student education on ob-gyn rotations. No comparisons were made, but in general the faculty reported that they spent roughly the same amount of time teaching students before and after duty hours (before 44% reported <5 hour and 53% reported 5-10 hours as compared to after (53% spent <5 hours and 41% spent 5-10 hours). As for resident teaching, 33% reported teaching < 5 hours/week prior to duty hours while 42% reported <5 after. However, 25% reported 5-10 prior and 33% reported 5-10 after. 70% of faculty felt neutral to the impact of duty hours on their ability to be involved in student teaching, while residents were more evenly divided about the perceived impact with 25% feeling neutral, 25% agreeing that there had been a positive impact and 50% disagreeing that there had been a positive impact on teaching.

Zaré SM, Galanko JA, Behrns KE, Sieff EM, Boyle LM, Farley DR, Evans SRT, Meyer AA, Farrell TM. Psychological well-being of surgery residents after inception of the 80-hour workweek: A multi-institutional study. Surgery 2005; 138:150-157.

MERSQI score=12

This multi-institutional pre-post study of general surgery residents assessed the psychological and educational impact of the duty hour rules on residents. Psychological distress in general and on specific dimensions decreased in the post-intervention period, but personal stress did not change significantly. ABSITE scores did not change either, but residents scored more poorly on the basic science section in the post-intervention period.

Zonia SC, LaBaere RJ II, Stommel M, Tomaszewski DD. Resident Attitudes Regarding the Impact of the 80-Duty-Hours Work Standards. JAOA 2005; 105:307-313.

MERSQI score=9.5

Multi-institutional, multi-specialty cross-sectional survey of the perceived impact of the duty hour rules on patient safety and resident education. Findings include belief that patient safety would be increased and that resident quality of life would improve. Residents were more neutral about impact on training and student debt. There were some differences by specialties with surgeons and ob-gyns believing that continuity was more important than having providers that were not fatigued, while the opposite was true for IM and family medicine.

de Virgilio C, Yaghoubian A, Lewis RJ, Stabile BE, Putnam BA. The 80-hour resident workweek does not adversely affect patient outcomes or resident education. Current Surgery 2006; 63(6):435-9.

MERSQI score=14.66667

Single site pre-post study to evaluate the impact of changes to comply with the duty hour rules on general surgery resident education and trauma patient outcomes. Of note, there were some possibly influential educational innovations using this time as well. Mean number of calls decreased in the post-duty hour period. With respect to patient safety, overall complications, pneumonia and intra-abdominal abscesses decreased in the post-period, but PE, sepsis and DIC increased. Several other complications did not change. Total number of cases for graduating chief residents increased significantly (831 to 1156), but there was no significant difference between the ABSITE percentile scores or the rates of passing the qualifying and certifying examinations.

Extra Citations

Fletcher KE, Underwood W 3rd, Davis SQ, Mangrulkar RS, McMahon LF Jr, Saint S.
Effects of work hour reduction on residents' lives: a systematic review. JAMA. 2005;294(9):1088-100.

Fletcher KE, Davis SQ, Underwood W, Mangrulkar RS, McMahon LF Jr, Saint S.
Systematic review: effects of resident work hours on patient safety. Ann Intern Med. 2004;141(11):851-7.

Reed DA, Beckman TJ, Wright SM, Levine RB, Kern DE, Cook DA. Predictive Validity Evidence for Medical Education Research Study Quality Instrument Scores: Quality of Submissions to JGIM's Medical Education Special Issue. J Gen Intern Med 2008;23(7):903-907.

Masclach c, Johnson SE. Maslach burnout survey. 3rd edition. Palo, Alto, CA: Consulting Psychologist Press Inc:

Annotated Bibliography: Shift Night and Protected Sleep Time

Afessa B, Kennedy CC, Klarich KW, Aksamit TR, Kolars JC, Hubmayr RD. Introduction of a 14-hour work shift model for housestaff in the medical ICU. Chest 2005; 128(6):3910-5.

MERSQI score = 13.00

This is a study of the effect of a 14-hour ICU shift (compared to a traditional every fourth night call) for residents on patient care and residents' education. No changes were found in adjusted mortality, length of stay, or residents' performance on a standardized knowledge assessment. Residents worked fewer total hours after implementation of the 14-hour shift model.

Akl EA, Bais A, Rich E, Izzo J, Grant BJ, Schunemann HJ. Brief report: Internal medicine residents', attendings', and nurses' perceptions of the night float system. Journal of General Internal Medicine 2006; 21(5):494-7.

MERSQI score = 8.50

This study is a cross-sectional survey of IM residents, attendings, and nurses at a single institution on their perceptions of a residents' night float rotation on residents' education and patient care. Self-perceptions of multiple aspects of education and patient care were reported. Comparisons of perceptions among residents, attendings, and nurses revealed that residents viewed most aspects of the night float rotation (and the effects of the night float on education and patient care) more positively than did attendings and residents.

Amir O, Alroy S, Schliamser JE, Asmir I, Shiran A, Flugelman MY, Halon DA, Lewis BS. Brachial artery endothelial function in residents and fellows working night shifts. American Journal of Cardiology 2004; 93(7):947-9.

MERSQI score = 13.50

Single group pre-post test of endothelial function among 30 IM and surgery residents and IM subspecialty fellows at a single institution in Israel. Subjects were tested at 2 time points: after 24 hour overnight shift and after a regular work day (length not specified). Flow mediated dilation of the brachial artery was significantly decreased after the night shift compared to after a regular day shift. The authors suggest that this finding may increase the risk of a future acute vascular event.

Arora V, Dunphy C, Chang VY, Fawaz A, Humphrey HJ, Meltzer D. The effects of on-duty napping on intern sleep time and fatigue. Ann Intern Med 2006; 144:792-798.

MERSQI score = 16.00

This study examined the effect of providing internal medicine interns at a single center with 7 hours of protected sleep time during a 30-hour overnight call shift on sleep and fatigue. This intervention increased total sleep time by 41 minutes and reduced fatigue among on-call interns. However, adherence to the intervention among interns was low (22% of interns chose to use coverage for protected sleep time) due to interns' desires to care for their patients and concerns about discontinuity of care.

Ayas NT, Barger LK, Cade BE, Hashimoto DM, Rosner B, Cronin JW, Speizer FE, Czeisler CA. Extended work duration and the risk of self-reported percutaneous injuries in interns. JAMA 2006; 296(9):1055-62.

MERSQI score = 12.50

This study is a national survey of interns conducted monthly over 12 months regarding hours worked and percutaneous injuries experienced (needle stick, sharps injury). The results demonstrate that residents working extended shifts (>=20 hours, i.e. after overnight call) experienced more percutaneous injuries than

residents working a shift of 12 or fewer hours. Additionally, residents were more likely to experience injuries during night hours compared to day hours.

Barger LK, Ayas NT, Cade BE, Cronin JW, Rosner B, Speizer FE, Czeisler CA. Impact of extended-duration shifts on medical errors, adverse events, and attentional failures. PLoS Medicine / Public Library of Science 2006; 3(12):e487.

MERSQI score = 12.50

This study reports the findings of a national survey of US interns conducted monthly over 1 year. Interns working between 1 and 4 or 5 or more extended work shifts (>=24 hours overnight) report involvement in more medical errors and more preventable adverse events. These residents also report more attentional failures (nodding off or falling asleep during surgery, when with patients, on rounds, and during lectures and seminars).

Barger LK, Cade BE, Ayas NT, Cronin JW, Rosner B, Speizer FE, Czeisler CA, Harvard Work Hours, Health, and Safety Group. Extended work shifts and the risk of motor vehicle crashes among interns. New England Journal of Medicine 2005; 352(2):125-34.

MERSQI score = 12.00

National cross-sectional survey of all interns registered with the NRMP conducted monthly over 12 months. Analyses examined relationships between extended work shifts (defined as >=24 hours, with a sample average was 32 hours) and motor vehicle crashes, near miss incidents, and involuntary sleep. Motor vehicle crashes and near miss incidents were more likely to occur after extended work shifts compared to non-extended shifts. The risk of falling asleep while driving or while stopped in traffic was increased among interns working 5 or more extended shifts per month. Every extended shift scheduled in a month increased the monthly risk of a crash by 9.1% and the monthly risk of a crash on the commute from work by 16.2%.

Benbarka MM, Wong GA. Effect of the stress of medical residency training on the overnight dexamethasone suppression test. Hormone & Metabolic Research 1995; 27(7):332-4.

MERSQI score = 14.40

Forty-two IM residents at a single center underwent dexamethoasone suppression tests twice: once on-call (24 hour overnight shift) residents were given dexamethasone at 11 pm and then plasma cortisol was measured between 8-9 am the next morning, and once off-call (residents were given dexamethasone at 11 pm, slept at home, and then plasma cortisol was measured between 8-9 am the next morning). There was no difference in suppression of plasma cortisol at the 2 time points (off-call vs. after an extended overnight shift).

Berkoff K, Rusin W. Pediatric house staff's psychological response to call duty. Journal of Developmental & Behavioral Pediatrics. 1991; 12(1):6-10.

MERSQI score = 17.50

Random allocation of first and second year residents to on-call (24 hour overnight call) and not on-call (regular work day). Both groups were tested before and after their work shifts (24 hour or regular day) using 3 validated measures of well-being: POMS, State Trait Anxiety Inventory A-Trait Scale, and Perceived Stress Scale. Residents who worked 24 hour overnight shifts demonstrated more negative mood and higher anxiety than those who were tested after a regular work day. There was no difference in perceived stress between groups.

Busowski JD, Chez RA, Goldfain VM. The effect of a resident night team on cesarean delivery. American Journal of Perinatology. 1997; 14(4):177-80.

MERSQI = 10.80

This is a single institution study that examined the rate of cesarean deliveries after implementation of a 14-hour night shift model. The investigators found no change in the rate of cesarean deliveries with implementation of the night shift system.

Cao CG, Weinger MB, Slagle J, Zhou C, Ou J, Gillin S, Sheh B, Mazzei W. Differences in day and night shift clinical performance in anesthesiology. Human Factors 2008; 50(2):276-90.

MERSQI score = 14.50

The aim of this study was to determine whether anesthesia residents' duties in the operating room differed during the day versus at night. Thirteen anesthesia residents at one academic program were each tested during 2 operative cases (one occurring during the night and one during the day). The day and night cases were matched based on type of operative case and patient complexity. The independent variable in the study was the time the case occurred (night vs. day). The outcomes were residents' mood, behavioral task analysis, response to an alarm latency task, and workload during the OR case (self-reported workload, observer rated workload, and workload density during the operative case). The study found that anesthesia residents spent less time on manual tasks (actively conducting procedures, etc in the OR) and more time on observing task (monitoring patients' vital signs, etc in the OR) during cases that occurred at night compared to day cases. Residents' also reported more negative mood at night time compared to day time. The authors concluded that since residents were working extended shifts at night (21-24.5 hours in this study vs. 11.5 hours during the day), the changes in task distribution and mood at night may be due to fatigue. They hypothesized that residents' may compensate for fatigue at night by shifting to observing/monitoring type tasks instead of manual tasks to maintain patient care quality and keep workload during cases at a manageable level.

Carey JC Fishburne JA. A method to limit working hours and reduce sleep deprivation in an obstetrics and gynecology residency program. Obstetrics and Gynecology. 1989;74(4):668-672.

MERSQI score = 6.50

This is a pre-post study using historical controls (different groups at time 1 and time 2) of an unknown number of obstetrics and gynecology residents (but presumably less than 18 residents, as program enrolls 18 residents total). The investigators examined residents' self-reported stress levels using a non-validated instrument and found no difference in stress scores after implementing a 13-hour night float system (residents work 13 hours of 5 consecutive nights to provide night coverage for long-call teams). The program experienced an upward trend in ITE scores (statistical significance not tested) after implementation of the night shift system.

Cavallo A, Ris MD, Succop P. The night float paradigm to decrease sleep deprivation: good solution or a new problem? Ergonomics 2003; 46(7):653-63.

MERSQI score = 14.50

This was a single-group pre-post test intervention of 38 pediatric residents at a single institution. The investigators found no difference in residents' mood (as measured by POMS scores) at the end of an 8-hour night shift vs. at the end of a regular day shift without night duty.

Chatterton RT Jr, Dooley SL. Reversal of diurnal cortisol rhythm and suppression of plasma testosterone in obstetric residents on call.[see comment]. Journal of the Society for Gynecologic Investigation 1999; 6(1):50-4.

MERSQI score = 14.00

Four male OB/Gyn residents underwent psychological tests of stress, anxiety, and affect as well as serum measurements of testosterone, LH, cortisol and prolactin during 4 time points: during the first 2 weeks of residency, after an extended 36 hour overnight call shift, during a regular work day in the gynecology clinic, and the day after a one week vacation. Following a 36 hour extended overnight call shift, residents reported higher levels of stress, and anxiety, and possibly increased depression on validated scales. Residents' plasma testosterone and LH were suppressed following night call compared to after vacation. Cortisol levels demonstrated a reversal of the normal diurnal variation post-call.

Chow KM, Szeto CC, Chan MHM, Lui SF. Near-miss errors in laboratory blood test requests by interns. Q J Med. 2005; 98:753-756.

MERSQI score = 10.36

Fifty-three near miss errors in laboratory blood test requests (test ordered for the wrong patient, mislabeled specimen, blood sample taken from the wrong patient) among patients cared for by IM interns in a residency program in Hong Kong over a 2 year period were retrospectively analyzed. Half of near miss errors occurred when interns were on-call and half occurred when residents were working an extended shift (30 hours). No near miss events occurred during the regular working day.

Eastridge BJ, Hamilton EC, O'Keefe GE, Rege RV, Valentine RJ, Jones DJ, Tesfay S, Thal ER. Effect of sleep deprivation on the performance of simulated laparoscopic surgical skill. American Journal of Surgery 2003; 186(2):169-74.

MERSQI score = 12.00

Thirty-five surgery residents at a single institution were tested using a surgical virtual reality simulator at 3 time points: pre-long call, on overnight 24 hour call, the morning after 24-hour overnight call shift. Residents served as their own controls (repeated measures within residents). The number of errors made per segment on the simulator was greater in the post-call group (after 24-hour shift) than the pre-call group. There was no difference between groups in the mean time to perform tasks on the surgical simulator.

Fialho G, Cavichio L, Povoa R, Pimenta J. Effects of 24-h shift work in the emergency room on ambulatory blood pressure monitoring values of medical residents. American Journal of Hypertension 2006; 19(10):1005-9.

MERSQI score = 15.00

This study compares awake and sleep ambulatory blood pressure readings among 56 internal medicine and surgery residents working a 24-hour shift versus an 8-hour normal work day in an emergency department in an academic hospital in Brazil. Residents served as their own controls. The study shows increased 24-h ambulatory systolic and diastolic blood pressure among residents working a 24-hour shift compared to the same residents working a normal 8-hour work day. Mean diastolic blood pressure during sleep was also increased in residents during the 24-hour shift compared to the 8-hour shift, but there was no difference in mean systolic blood pressure during sleep. The authors conclude that extended work shifts may increase cardiovascular risks among residents.

Friesen LD, Vidyarthi AR, Baron RB, Katz PP. Factors associated with intern fatigue. Journal of General Internal Medicine 2008. 23(12):1981-6.

MERSQI score = 11.50

This study is a cross-sectional survey of internal medicine interns at a single institution regarding factors associated with fatigue, sleep, stress, and teamwork. Interns in the study were working 30-hour shifts, however comparisons based on shift length were not performed.

Gottlieb DJ, Parenti CM, Peterson CA, Lofgren RP. Effect of a change in house staff work schedule on resource utilization and patient care. Archives of Internal Medicine. 1991; 151(10):2065-70.

MERSQI score = 15.00

Thirty-two IM residents at one VA medical center participated in a baseline call schedule of 32-hour shifts overnight 'long call' every 4th night over 4 weeks compared to a new schedule including a night float system (16 hour shifts over night once per week). Resident and patient outcomes were measured in the pre-intervention and post-intervention period. Patient outcomes were collected on 520 patients admitted to the medicine floor or ICU in the pre-intervention period and 583 patients in the post-intervention period. After the introduction of the 16-hour night shift, residents slept more hours in the hospital when on-call, and spent fewer hours per week in the hospital overall. The number of admissions to resident services and the average service census did not change. Residents ordered fewer laboratory tests on patients, but numbers of radiology tests and consults remained the same. Patient length of stay and medication errors made by physicians decreased. No change was seen in patient deaths, nosocomial fevers, readmission rates, or number of discharges to nursing homes.

Gottlieb DJ, Pereson CA, Parenti CM, Lofgren RP. Effects of a night float system on housestaff neuropsychologic function. Journal of General Internal Medicine. 1993; 8(3):146-8.

MERSQI score = 16.00

This is a randomized 2-group intervention examining the effect of a night float system on residents' neuropsychiatric test scores. The night float rotation consisted of a 16 hour night shift once per week and one 30-hur shift once in 7 weeks, and was compared to a traditional overnight call system of 32 hour shifts every fourth night. The study found no difference in 4 validated measures of neuropsychiatric performance between residents on night float versus traditional overnight call. Night float residents had statistically lower depression scores than traditional call residents, but thins finding may be confounded by time of year (March through May for night float versus January through February for traditional call).

Griffith 3rd CH, Wilson JF, Rich EC. Intern call structure and patient satisfaction. Journal of General Internal Medicine. 1997; 12(5):308-310.

MERSQI score = 10.00

This is a cross-sectional survey of hospitalized patients' satisfaction with their primary internal medicine intern. Comparisons in satisfaction were conducted based on whether patients were admitted by a resident on traditional long call, new short call, or a new night float assignment. Mean patient satisfaction ratings were lower for patients admitted by night float and short call residents compared to traditional long call residents in multivariate linear regression adjusted for resident gender, patient age, and patient illness severity. The authors speculate that differences may be due to discontinuity of care and interns spending less time with patients when they are on night float or short call assignments.

Haynes DF, Schwedler M, Dyslin DC, Rice JC, Kerstein MD. Are postoperative complications related to resident sleep deprivation? Southern Medical Journal 1995; 88(3):283-9.

MERSQI score = 14.00

Retrospective review of all 6371 emergency and elective surgeries performed by general surgery and surgical subspecialty residents at a single academic center over a period of 40 months. Surgical complications among these surgeries were recorded. Complication rate was compared among cases where the resident surgeon was operating the day after being on-call for a 24-hour overnight shift versus operating during a call shift or during a shift when not on-call (regular day shift). No change in frequency of surgical complications occurred when the surgical resident was post-call (after a 24-hour overnight shift) vs. all other time points (on-call and regular day).

Hendey GW, Barth BE, Soliz T. Overnight and post-call errors in medication orders. Academic Emergency Medicine 2005; 12(7):629-34.

MERSQI score = 12.67

This a retrospective review of 8195 medication orders written by residents in internal medicine, family medicine, emergency medicine, obstetrics, pediatrics, and surgery at an academic medical center in April 2000. There were 177 errors (2.16% overall error rate). The error rate was increased for overnight and post-call (following a 32 hour extended overnight shift) orders compared to off-call orders (2.71%, OR 1.44, 95% CI 1.06-1.95). PGY-1 residents had a higher overnight error rate (4.23%, OR 2.28, 95% CI 1.44-3.61) compared to residents at higher training levels.

Jakubowicz DM, Price EM, Glassman HJ, Gallagher AJG, Mandava N, Ralph WP, Fried MP. Effects of a Twenty-Four Hour Call Period on Resident Performance during Simulated Endoscopic Sinus Surgery in an Accreditation Council for Graduate Medical Education-Compliant Training Program. Laryngoscope. 2005; 115:143-146.

MERSQI score = 12.00

Eight surgery residents at a single center were tested using an endoscopic sinus surgery simulator pre-call and post a 24-hour overnight call shift. There was no difference in residents' overall time to completion, mean dissection time, or hazard scores on the simulator between pre-call and post 24-hour call residents. However, this was a very small study that may not have bee adequately powered to detect differences between groups.

Jeanmonod R, Jeanmonod D, Ngiam R. Resident productivity: does shift length matter? American Journal of Emergency Medicine 2008; 26(7):789-91.

MERSQI score = 11.33

This is a retrospective analysis of the number of patients seen by PGY-2 residents in an ED working 9 hour shifts vs. 12 hour shifts (regardless of night or day time of shift). Residents working 9 hour shifts saw more patients per hour than those working 12 hour shifts (1.15 patients vs. 1.06 patients, 95% CI .031-.15). In this ED, this results in 180 additional patient encounters per residents per year.

Landrigan CP, Rothschild JM, Cronin JW, Kaushal R, Burdick E, Katz JT, Lilly CM, Stone PH, Lockley SW, Bates DW, Czeisler CA. Effect of Reducing Interns' Work Hours on Serious Medical Errors in Intensive Care Units. N Engl J Med. 2004; 351:1838-1848.

MERSQI score = 16.20

This prospective randomized cross-over study studied the impact of an intervention schedule to eliminate extended shifts in the ICU setting. The main outcomes were patient safety outcomes such as errors and adverse events. Findings included significant decreases in problems with the intervention schedule. Specifically, serious medical errors by interns and overall were reduced as were intercepted serious errors (for interns and unit-wide) and non-intercepted serious errors by interns. Medication and diagnostic errors by interns and unit-wide also decreased with the intervention. Of note, the number of procedures performed by interns per patient day was significantly higher when following the intervention schedule.

Leff DR, Aggarwal R, Rana M, Nakhjavani B, Purkayastha S, Khullar V, Darzi AW. Laparoscopic skills suffer on the first shift of sequential night shifts: program directors beware and residents prepare. Annals of Surgery 2008; 247(3):530-9.

MERSQI score = 13.00

Twenty-one surgery, OB, orthopedics, and EM residents at a single center in the UK who were working 11-12 hour night shifts for 7 consecutive nights were tested on a virtual reality surgical simulator the morning after each night shift (7 tests on each of 7 consecutive post-shift mornings). Residents took longer to complete the tasks and had higher error scores on the simulator after the first night shift compared to baseline. Time to task completion and error scores improved after nights 2-7 such that scores after these consecutive nights were not significantly different from baseline.

Lieu TA, Forrest CB, Blum NJ, Cornfeld D, Polin RA. Effects of a night-float system on resident activities and parent satisfaction. American Journal of Diseases of Children. 1992; 146(3):307-10.

MERSQI score = 12.00

This study compares educational outcomes and parents' satisfaction with patient care delivered by pediatric residents admitting patients on an 8 hour night shift versus residents on a traditions overnight long-call. The design is a non-randomized 2-group post-test only with multiple methodological concerns related to incomplete reporting. Results suggest no difference in educational outcomes (residents' ratings of time available to talk with patents and their familiarity with admission diagnoses) and parents' satisfaction with the hospitalization between night shift and long-call groups. Just six (8%) of parents surveyed felt that the change of physicians in the morning (from night float to regular team) affected their child's care.

Lockley SW, Cronin JW, Evans EE, Cade BE, Lee CJ, Landrigan CP, Rothschild JM, Katz JT, Lilly CM, Stone PH, Aeschbach D, Czeisler CA. Effect of Reducting Interns' Weekly Work Hours on Sleep and Attentional Failures. N Engl J Med. 2004; 351:1829-1837.

MERSQI score = 15.00

This within subject randomized study tested interns in one of two ICU settings with one of two schedules. The intervention schedule was marked by no shifts longer than 16 hours and fewer hours overall. Of note, the intervention schedule required an extra intern be allotted to the rotation. The findings included significantly fewer hours for the intervention setting as well as more sleep per week for the interns in the intervention setting. Attentional failures overnight were significantly more common in the traditionally scheduled interns.

Mann FA, Danz PL. The night stalker effect: quality improvements with a dedicated night-call rotation. Investigative Radiology. 1993; 28(1):92-6.

MERSQI score = 15.33

This study measured the effect of a night float (9 hour night shift for 5 consecutive nights) versus traditional overnight call (15-23 hour shifts every 9-10th night) on missed radiologic diagnoses and associated patient morbidity and attending rework. The study showed fewer missed diagnoses by radiology residents on the night float rotation, and no difference in patient mortality or rework required by attendings. Residents and attendings believed the level of patient service was unchanged or improved with implementation of the night float system.

Marcus, CL, Loughlin GM. Effect of sleep deprivation on driving safety in housestaff. Sleep 2006; 19(10):763-6.

MERSQI score = 10.00

This is a cross-sectional survey of 70 pediatric residents working 33 hour extended overnight shifts every 4 nights throughout residency and 85 pediatric faulty without night work regarding motor vehicle related sleepiness, citations, and accidents. The survey was conducted at one academic center. Compared to faculty, a greater proportion of residents reported falling asleep at the wheel while stopped at traffic lights, traffic citation for moving violations, and motor vehicle accidents.

Parks DK, Yetman RJ, McNeese MC, Burau K, Smolensky MH. Day-night pattern in accidental exposures to blood-borne pathogens among medical students and residents. Chronobiology International 2000; 17(1):61-70.

MERSQI score = 10.00

Retrospective analysis of accidental exposure to blood-borne pathogens (e.g. needle sticks) among medical students and residents at one institution over a 5 year period. Events reported to a telephone hotline were reviewed. Event rates were compared at night (among students and residents on 24-36 hour overnight call shifts) vs. during the day. 9.27

Reader DW, Spigos DG, Bennett WF, Mueller CF, Vaswani KK. The graveyard shift: experience with a night float system. Emergency Radiology 2002; 9(2):82-7.

MERSQI score = 7.00

This study is a cross-sectional survey of the perceptions of 20 radiology residents at a single hospital of a night float rotation compared to traditional 24-hour call. The night float rotation consisted on 11 hour night shifts for 6 consecutive nights. Residents reported that it took an average of 2 days to acclimate to night work and 2.3 days to re-acclimate to a regular day work routine after completing the 6 day night float experience. Residents believe 10.5 hours is the optimal length for a night shift, and an average of 6.8 days is the optimal number of consecutive nights for night work. Residents in this study reported either no change or improvement in their clinical judgment with the night float rotation as compared to traditional 24-hour call.

Richardson GS, Wyatt JK, Sullivan JP, Orav EJ, Ward AE, Wolf MA, Czeisler CA. Objective assessment of sleep and alertness in medical house staff and the impact of protected sleep time. Sleep 1996;19 (9): 718-726.

MERSQI score = 15.00

In this single institution study, internal medicine interns were provided 4 hours of protected sleep time (night float) during a 36-hour overnight call shift. The effects of this intervention on sleep time were compared with interns on a traditional call rotation with a similar workload. The investigators found that provision of protected sleep time did not increase total sleep time, but did increase sleep efficiency.

Rose M, Manser T, Ware JC. Effects of call on sleep and mood in internal medicine residents. Behavioral Sleep Medicine 2008; 6(2):75-88.

MERSQI score = 15.50

Thirty-one internal medicine residents at two medical schools were tested using POMS (mood) and STAXI (anger) measures at 4 time points: morning after a 24-hour overnight on-call shift, 1 full work day after call, 2 days after call, 3 days after call. Analyses within subjects were conducted. POMS and STAXI scores were significantly higher the morning after a 24-hour night shift compared to the other time points, and the scores decreased with each of 3 subsequent work days following call.

Stamler JS, Goldman ME, Gomes J, Matza D, Horowitz SF. The effect of stress and fatigue on cardiac rhythm in medical interns. Journal of Electrocardiology. 1992; 25(4):333-8.

MERSQI score = 12.00

Twenty-four IM interns at a single academic institution underwent Holter monitoring during a 24-hour overnight call shift. Atrial and ventricular premature beats were recorded. Residents also subjectively rated their level of stress and fatigue on a non-validated numeric scale. Relationships between stress and fatigue level and Holter readings were examined. APB occurred in 95% of interns and VPB in 60%.

Interns with higher levels of stress and fatigue experienced more frequent APB and VPB. The authors state that further study is needed to determine the significance of these findings.

Storer JA, Hugh F, Gill WL, Giusti CW, Ginsberg H. Effects of sleep deprivation on cognitive ability and skills of pediatrics residents. Acad Med 1989; 64:29-32.

MERSQI Score = 15.60

This study compared the time it took pediatric residents to perform simulated umbilical artery catholicization and vein cannulation after 24-hoour and 34-hour overnight extended shifts. The study found no differences between groups.

Ware JC, Risser MR, Manser T, Karlson KH Jr. Medical resident driving simulator performance following a night on call. Behavioral Sleep Medicine 2006; 4(1):1-12.

MERSQI score = 12.00

Nineteen internal medicine residents were tested using a driving simulator under 2 conditions: after a 15 hour overnight on-call shift and after a normal work day (shift length not specified). Residents served as their own controls (cross-over). Lane position variance and speed variance on the driving simulator did not change based on shift status (overnight vs. day). Frequency of crashes on the driving simulator increased in men after 15 hour call shift compared to after regular day, but women showed no change in simulated crash frequency by call status.

Wong JG, Holmboe ES, Huot SJ. Teaching and learning in an 80-hour work week: a novel day-float rotation for medical residents. Journal of General Internal Medicine. 2004; 19(5 Pt 2):519-23

MERSQI score = 7.00

Single group cross-sectional post-test only evaluation of 13 PGY-3 IM residents who participated in a day float rotation over for 4 weeks once during the year. The intervention consisted of adding a PGY-3 day float resident to the existing IM resident long-call ward teams. Educational outcomes of the day float were measured by cross-sectional survey of the 13 residents who participated as day float residents over a 1 year period. Residents reported adequate time to read on the day float rotation, and they indicated that their presence made the long-call ward teams more efficient, and the day float residents were able to provide articles or answer clinical questions for the long-call ward teams daily.

Yetman RJ, West MS, Portman RJ. Changes in circadian rhythm of blood pressure in on-call pediatric residents. Chronobiology International 1994; 11(1):54-61.

MERSQI score = 15.00

Thirty-seven pediatric and medicine/pediatrics residents at single center underwent 24-hour ambulatory blood pressure monitoring during two conditions: during a 24-hour overnight shift and during a regular work day with 4 or fewer hours spent in the hospital. Residents' mean BP was higher during the 24-hour call than during the regular work day.

Zheng H, Patel M, Hryniewicz K, Katz SD. Association of extended work shifts, vascular function, and inflammatory markers in internal medicine residents: a randomized crossover trial. JAMA 2006; 296(9):1049-50.

MERSQI score = 15.00

This study was a single-group pre-post test of 22 IM residents in an ICU working a 30 hour extended work shift including overnight call compared to a 6 hour day shift. The study demonstrated lower levels of brachial artery flow-mediate dilatation, higher levels of IL-6, norephinephrine, and hs-CRP in residents

when working the 30 hour overnight shift. The authors suggest that these findings could indicate increased long-term atherosclerosis risk.

Other Citations:

Institute of Medicine. *Resident duty hours: enhancing sleep, supervision, and safety*. Washington, DC: The National Academies Press; 2008.

Philibert I. Sleep loss and performance in residents and nonphysicians: A meta-analytic examination. Sleep 2005;28(11):1392-1402.

Reed DA, Cook DA, Beckman TJ, Levine RB, Kern DE, Wright SM. Association between Funding and Quality in Published Medical Education Research. JAMA. 2007;298(9):1002-1009.

Van Dongen HPA, Dinges DF. Circadian rhythm in sleepiness, alertness and performance. In: Kryger MH, Roth T, Dement WC, eds, *Principles and practice of sleep medicine, 4th ed*. Philadelphia, PA: W. B. Saunders; 2005:435-443.

Annotated Bibliography: Night Work

Akl EA, Bais A, Rich E, Izzo J, Grant BJ, Schunemann HJ. Brief report: Internal medicine residents', attendings', and nurses' perceptions of the night float system. Journal of General Internal Medicine 2006; 21(5):494-7.

MERSQI score = 8.50

This study is a cross-sectional survey of IM residents, attendings, and nurses at a single institution on their perceptions of a residents' night float rotation on residents' education and patient care. Self-perceptions of multiple aspects of education and patient care were reported. Comparisons of perceptions among residents, attendings, and nurses revealed that residents viewed most aspects of the night float rotation (and the effects of the night float on education and patient care) more positively than did attendings and residents.

Buff DD, Shabti R. The night float system of resident on call: what do the nurses think? Journal of General Internal Medicine. 1995; 10(7):400-2.

MERSQI score = 6.50

Cross-sectional survey of nurses' perceptions of the impact of a night float system on their interactions with residents and residents' performance at one community teaching hospital. Nurses generally favored the night float system.

Busowski JD, Chez RA, Goldfain VM. The effect of a resident night team on cesarean delivery. American Journal of Perinatology. 1997; 14(4):177-80.

MERSQI = 10.80

A retrospective chart review was performed on patients who underwent cesarean birth during two time periods - before the implementation of a resident night team and after. The investigators found o change in the rate of cesarean deliveries with implementation of the night float system.

Carey JC Fishburne JA. A method to limit working hours and reduce sleep deprivation in an obstetrics and gynecology residency program. Obstetrics and Gynecology. 1989;74(4):668-672.

MERSQI score = 6.50

This is a pre-post study using historical controls (different groups at time 1 and time 2) of an unknown number of OB/Gyn residents (but presumably less than 18 residents, as program enrolls 18 residents total). The investigators examined residents' self-reported stress levels using a non-validated instrument and found no difference in stress scores after implementing a 13-hour night float system (residents work 13 hours of 5 consecutive nights to provide night coverage for long-call teams). The program experienced an upward trend in ITE scores (statistical significance not tested) after implementation of the night shift system.

Cavallo A, Ris MD, Succop P. The night float paradigm to decrease sleep deprivation: good solution or a new problem?. Ergonomics 2003; 46(7):653-63.

MERSQI score = 14.50

This was a single-group pre-post test intervention of 38 pediatric residents at a single institution. The investigators found no difference in residents' mood (as measured by POMS scores) at the end of an 8-hour night shift vs. at the end of a regular day shift without night duty.

Druss BG, Pelton G, Lyons L, Sledge WH. Resident and faculty evaluations of a psychiatry night-float system. Academic Psychiatry. 1996; 20:26-34.

MERSQI score = 7.80

Single institution study examining psychiatry residents' and faculty perceptions of a new night float system for coverage of psychiatry emergency room. Residents reported improved well-being and educational experience with the night float system.

Gottlieb DJ, Pereson CA, Parenti CM, Lofgren RP. Effects of a night float system on housestaff neuropsychologic function. Journal of General Internal Medicine. 1993; 8(3):146-8.

MERSQI score = 16.00

This is a randomized 2-group intervention examining the effect of a night float system on residents' neuropsychiatric test scores. The night float rotation consisted of a 16 hour night shift once per week and one 30-hur shift once in 7 weeks, and was compared to a traditional overnight call system of 32 hour shifts every fourth night. The study found no difference in 4 validated measures of neuropsychiatric performance between residents on night float versus traditional overnight call. Night float residents had statistically lower depression scores than traditional call residents, but thins finding may be confounded by time of year (March thru May for night float versus January through Feb. for traditional call).

Gottlieb DJ, Parenti CM, Peterson CA, Lofgren RP. Effect of a change in house staff work schedule on resource utilization and patient care. Archives of Internal Medicine. 1991; 151(10):2065-70.

MERSQI score = 15.00

Thirty-two IM residents at one VA medical center participated in a baseline call schedule of 32-hour shifts overnight 'long call' every 4th night over 4 weeks compared to a new schedule including a night float system (16 hour shifts over night once per week). Resident and patient outcomes were measured in the pre-intervention and post-intervention period. Patient outcomes were collected on 520 patients admitted to the medicine floor or ICU in the pre-intervention period and 583 patients in the post-intervention period. After the introduction of the 16-hour night shift, residents slept more hours in the hospital when on-call, and spent fewer hours per week in the hospital overall. The number of admissions to resident services and the

average service census did not change. Residents ordered fewer laboratory tests on patients, but numbers of radiology tests and consults remained the same. Patient length of stay and medication errors made by physicians decreased. No change was seen in patient deaths, nosocomial fevers, readmission rates, or number of discharges to nursing homes.

Griffith 3rd CH, Wilson JF, Rich EC. Intern call structure and patient satisfaction. Journal of General Internal Medicine. 1997; 12(5):308-310.

MERSQI score = 10.00

This is a cross-sectional survey of hospitalized patients' satisfaction with their primary internal medicine intern. Comparisons in satisfaction were conducted based on whether patients were admitted by a resident on traditional long call, new short call, or a new night float assignment. Mean patient satisfaction ratings were lower for patients admitted by night float and short call residents compared to traditional long call residents in multivariate linear regression adjusted for resident gender, patient age, and patient illness severity. The authors speculate that differences may be due to discontinuity of care and interns spending less time with patients when they are on night float or short call assignments.

Leff DR, Aggarwal R, Rana M, Nakhjavani B, Purkayastha S, Khullar V, Darzi AW. Laparoscopic skills suffer on the first shift of sequential night shifts: program directors beware and residents prepare. Annals of Surgery 2008; 247(3):530-9.

MERSQI score = 13.00

Twenty-one surgery, obstetrics, orthopedics, and emergency medicine residents at a single center in the UK who were working 11-12 hour night shifts for 7 consecutive nights were tested on a virtual reality surgical simulator the morning after each night shift (7 tests on each of 7 consecutive post-shift mornings). Residents took longer to complete the tasks and had higher error scores on the simulator after the first night shift compared to baseline. Time to task completion and error scores improved after nights 2-7 such that scores after these consecutive nights were not significantly different from baseline.

Lieu TA, Forrest CB, Blum NJ, Cornfeld D, Polin RA. Effects of a night-float system on resident activities and parent satisfaction. American Journal of Diseases of Children. 1992; 146(3):307-10.

MERSQI score = 12.00

This study compares educational outcomes and parents' satisfaction with patient care delivered by pediatric residents admitting patients on an 8 hour night shift versus residents on a traditions overnight long-call. The design is a non-randomized 2-group post-test only with multiple methodological concerns related to incomplete reporting. Results suggest no difference in educational outcomes (residents' ratings of time available to talk with patents and their familiarity with admission diagnoses) and parents' satisfaction with the hospitalization between night shift and long-call groups. Just six (8%) of parents surveyed felt that the change of physicians in the morning (from night float to regular team) affected their child's care.

Mann FA, Danz PL. The night stalker effect: quality improvements with a dedicated night-call rotation. Investigative Radiology. 1993; 28(1):92-6.

MERSQI score = 13.80

This study measured the effect of a night float (9 hour night shift for 5 consecutive nights) versus traditional overnight call (15-23 hour shifts every 9-10th night) on missed radiologic diagnoses and associated patient morbidity and attending rework . The study showed fewer missed diagnoses by radiology residents on the night float rotation, and no difference in patient mortality or rework required by attendings. Residents and attendings believed the level of patient service was unchanged or improved with implementation of the night float system.

Reader DW, Spigos DG, Bennett WF, Mueller CF, Vaswani KK. The graveyard shift: experience with a night float system. Emergency Radiology 2002; 9(2):82-7.

MERSQI score = 7.00

This study is a cross-sectional survey of the perceptions of 20 radiology residents at a single hospital of a night float rotation compared to traditional 24-hour call. The night float rotation consisted on 11 hour night shifts for 6 consecutive nights. Residents reported that it took an average of 2 days to acclimate to night work and 2.3 days to re-acclimate to a regular day work routine after completing the 6 day night float experience. Residents believe 10.5 hours is the optimal length for a night shift, and an average of 6.8 days is the optimal number of consecutive nights for night work. Residents in this study reported either no change or improvement in their clinical judgment with the night float rotation as compared to traditional 24-hour call.

Seelig CB. Quantitating qualitative issues in residency training: development and testing of a scaled program evaluation questionnaire. Journal of General Internal Medicine. 1993; 8(11):610-3.

MERSQI score = 7.50

Pre-post study measuring residents' response to a validated questionnaire about a new night float system. Residents experienced increased stress and dissatisfaction with the faculty and learning environment with implementation of a night float system.

Seelig CB. Changes in residents' attitudes in response to residence program modifications: a prospective study. Southern Medical Journal. 1992; 85(10):972-5.

MERSQI score = 8.50

This is a pre-post survey of residents' satisfaction before and after implementation of a night float system at one internal medicine residency program. The night float rotation was associated with improved ratings of time demands and workload among residents. No change was noted in ratings of time to read and stress or depression.

Seltzer V, Foster Jr. HW, Gordon M. Resident scheduling: night float programs. Obstetrics & Gynecology. 1991; 77(6):940-3.

MERSQI score = 8.50

This study is a cross-sectional survey of 295 OBGYN residency program directors in the US and Canada in 1989 regarding whether their schedules included night floats, and if so, to rate several characteristics that may have been affected as a result of the night float system. The study showed that the majority of programs in NY had implemented night float systems while fewer programs in other states had done so. Program directors from NY programs felt the night float system worsened all outcomes measured including residents' education, residents' personal life, and patient care. However, program directors from states other than New York felt that night float systems improved all of these same outcomes.

Suryadevara AC, Zandifar H, Guyer M, Kellman RM. Day float: an alternative to the night float coverage system for residency programs. Laryngoscope 2008; 118(7):1257-9.

MERSQI score = 6.00

This study reports a cross-sectional survey of 17 otolaryngology residents at one hospital regarding their preferences for a day float versus a night float rotation. All responses to the 9 question survey showed that residents preferred the day float rotation over the night float rotation. The authors conclude that residents believe a day float rotation allows for better attendance at educational activities, more time with families, and better continuity of care.

Townsend RR, Manco-Johnson ML. Night call in US radiology residency programs. Academic Radiology. 1995; 2(9):810-5.

MERSQI score = 8.00

National survey of 166 (81%) of radiology residency program directors, of which 18% programs had night float systems in place. In 1995, radiology residents were working an average of 15 hours on night shifts during the week and 22 hours on weekends.

Trontell MC, Carson JL, Taragin MI, Duff A. The impact of the night float system on internal medicine residency programs. Journal of General Internal Medicine. 1991; 6(5):445-9.

MERSQI score = 8.00

This study is a national survey of 442 IM program directors at ACGME accredited programs. The survey assessed use, organization, and perceived impact of night float systems. Approximately 30% of IM programs had night float systems in place in 1989 when this survey was conducted. Program directors believed night float systems improved residents' morale, decreased, residents' fatigue and did not worsen quality of care. Some program directors believed implementation of night float systems increased miscommunication problems between residents and a small proportion believed night float systems decreased continuity of care.

Wallach SL, Alam K, Diaz N, Shine D. How do internal medicine residency programs evaluate their resident float experiences? Southern Medical Journal 2006; 99(9):919-23.

MERSQI score = 7.00

National survey of 139 (39%) internal medicine residency program directors regarding float experiences and how these experiences are evaluated. In 2006, 76% of internal medicine programs had a night float system.

Other Citations:

Institute of Medicine. *Resident duty hours: enhancing sleep, supervision, and safety*. Washington, DC: The National Academies Press; 2008.

Reed DA, Cook DA, Beckman TJ, Levine RB, Kern DE, Wright SM. Association between Funding and Quality in Published Medical Education Research. JAMA. 2007;298(9):1002-1009.

Bibliography: Activities of Residents

Boex JR. Leahy PJ. Understanding residents' work: moving beyond counting hours to assessing educational value. Academic Medicine. 2003; 78(9):939-44.

Brasel KJ, Pierre AL, Weigelt JA. Resident work hours: what they are really doing. Archives of Surgery. 2004;139(5):490-3.

Gabow PA, Karkhanis A, Knight A, Dixon P, Eisert S, Albert RK. Observations of residents' work activities for 24 consecutive hours: Implications for workflow redesign. Academic Medicine. 2006; 81(8):766-775.

Morton JM, Baker CC, Farrell TM, Yohe ME, Kimple RJ, Herman DC, Udekwu P, Galanko JA, Behrns KE, Meyer AA. What do surgery residents do on their call nights? The American Journal of Surgery. 2004; 188:225-229.

Scher KS, Peoples JB. A study of the on-duty hours of surgical residents. Surgery. 1990; 108(2):393-7.

Schwartz RJ, Dubrow TJ, Rosso RF, Williams RA, Butler JA, Wilson SE. Guidelines for Surgical Residents' Working Hours. Intent vs Reality 1992;127:778-783.

Annotated Bibliography: Work Intensity

Niederee MJ, Knudtson JL, Byrnes MC, Helmer SD, Smith RS. A survey of residents and faculty regarding work hour limitations in surgical training programs. Archives of Surgery 2003; 138(6):663-9.

MERSQI score=8

National survey of general surgery PD and residents prior to 2003 demonstrating that 43% of residents felt that their workload was excessive.

Ozuah PO, Neuspiel DR, Shelov SP. The pediatric forum: trends in residents' perceptions of working conditions: 1989-1999. Archives of Pediatrics & Adolescent Medicine 2001; 155(9):1073-4.

MERSQI score=9

Prospective study of pediatric residents over 10 years (1989-1999) in New York demonstrating that although interns worked fewer hours, a greater fraction of time was spent in handoffs (signing in and signing out). Only 20% had sufficient time for ongoing reading in 1999 (compared to 15% in 1989).

Zelenock GB, Holmes MM, Campell DA Jr., Stanley JC, Greenfield LJ. Quantitative increases in surgical house officer clinical activity as the basis for increased workloads in a university hospital. Surgery 1992; 112(2):235-42.

MERSQI score=12.6

Single institution study of surgical residency between 1981 to 1991 demonstrating that amount of work as measured by # operations, admissions, discharges, op hours, patient acuity increased while # surgical residents remained constant.

Annotated Bibliography: Workload (Patient Care)

Dellit TH, Armas-Loughran B, Bosl GJ, Sepkowitz KA, Thaler H, Blaskovich J. A method for assessing house staff workload as a function of length of stay. JAMA 2001 286(9):1023-4.

MERSQI score=10.8

Single institution study demonstrating that although traditional workload measures (LOS, daily census) were decreasing over a 3 year period, the number of admissions and discharges were increasing which led to an increase in overall activity index, a new measure of workload that takes into account the time to admit and discharge patients. This study demonstrates that traditional measures of workload may not be effective for residents that have a high number of admissions and discharges.

Feddock CA, Hoellein AR, Griffith CH, Wilson JF, Becker NS, Bowerman JL, Caudill TS. Are continuity clinic patients less satisfied when residents have a heavy inpatient workload?. Evaluation & the Health Professions 2005; 28(4):390-9.

MERSQI score=9.5

Prospective cohort study of IM interns demonstrating that self-reported greater level of workload was associated with reduced satisfaction among clinic patients. The impact of heavy workload on patient satisfaction is reportedly similar to that of increased waiting time. The authors hypothesize that busy residents may act more distracted or seem less attentive.

Griffith 3rd CH, Desai NS, Wilson JF, Griffith EA, Powell KJ, Rich EC. Housestaff experience, workload, and test ordering in a neonatal intensive care unit. Academic Medicine 1996; 71(10):1106-8.

MERSQI score=13.2

As workload increased, interns ordered more ABG tests per infant than residents. This effect was also significant on the weekends, when supervision is less. This study highlights that utilization / test ordering increases with higher workload and worse supervision.

Griffith CH 3r, Wilson JF, Rich EC. The effect at one teaching hospital of interns' workloads on the satisfaction of their patients. Academic Medicine 1998; 73(4):427-9.

MERSQI score=13.2

Prospective cohort study that demonstrates that increased admission workload, as measured by intern log of patients admitted, is associated with worse patient satisfaction for COPD patients on the day of discharge.

Hillson SD, Rich EC, Dowd B, Luxenberg MG. Call nights and patients care: effects on inpatients at one teaching hospital. Journal of General Internal Medicine 1992; 7(4):405-10.

MERSQI score=14.4

Retrospective cohort study of patients demonstrating that nighttime admissions are associated with shorter LOS, higher costs, and higher risk of inpatient mortality. While this could simply reflect the fact that patients admitted at night are sicker, no evidence of this could be found.

Hilson SD, Rich EC, Dowd BE, Luxenberg MG. The Impact of Intern Workload on Length of Hospital Stay for Elderly Patients. Gerontology and Geriatrics Education 1993; 14(2):33-40.

MERSQI score=14.4

Single institution study that demonstrates that with increasing patient admissions, older patients were selectively discharged earlier than younger patients. As intern workload increased, younger patients had longer hospital stays and older patients had shorter hospital stays. Workload had no effect on mortality or early hospital readmission.

Liu CC, Wissow LS. Residents who stay late at hospital and how they perform the following day. Medical Education 2008; 42(1):74-81.

MERSQI score=12

Pediatric residents who stayed late the night before demonstrated worse communication skills in clinic on the next day - specifically less patient centeredness, more dominating of conversation, and less social talk.

Morales IJ, Peters SG, Afessa B. Hospital mortality rate and length of stay in patients admitted at night to the intensive care unit. Critical Care Medicine 2003; 31(3):858-63.

MERSQI score=14.4

Large single institution retrospective cohort study demonstrating that heavy workload call nights (greater than 3 admissions) were not associated with worse patient outcomes (LOS, ICU LOS, mortality).

Ong M, Bostrom A, Vidyarthi A, McCulloch C, Auerbach A. House staff team workload and organization effects on patient outcomes in an academic general internal medicine inpatient service. Archives of internal medicine 2007; 167(1):47-52.

MERSQI score=13.2

Retrospective cohort analysis of 5742 patients demonstrating that higher admission workload is associated with increased LOS and higher inpatient mortality. Conversely, higher total census is associated with shortened LOS.

Sheen SS, Choi JE, Park RW, Kim EY, Lee YH, Kang UG. Overdose rate of drugs requiring renal dose adjustment: data analysis of 4 years prescriptions at a tertiary teaching hospital. Journal of General Internal Medicine 2007; 23(4):423-8.

MERSQI score=14.4

Large study of Korean hospitalized patients demonstrating that less clinical experience, higher workload (as measured by # of prescriptions), and patient's renal function were associated with a higher risk of overdose rate of drugs requiring renal dose adjustment.

Annotated Bibliography: Workload (Resident Outcomes)

Arora VM, Georgitis E, Siddique J, Vekhter B, Woodruff J, Humphrey H, Meltzer D. Association of on-call workload of medical interns with sleep duration, shift duration, and participation in educational activities. JAMA 2008; 300(10):1146-53.

MERSQI score=12.6

Single institution prospective study demonstrating that increased on-call admissions is associated with more sleep loss and longer shift durations in a traditional coverage model. A higher number of previously admitted patients on the census was associated with lower odds of participating in educational activities.

Bertram DA, Hershey CO, Opila DA, Quirin O. A measure of physician mental work load in internal medicine ambulatory care clinics. Medical Care 1990; 28(5):458-67.

MERSQI score=10

Study of internal medicine ambulatory practice, which demonstrates that mental workload is associated with increased number of patients seen, and a lower physician satisfaction with care provided and self-rated quality of care.

Bertram DA, Opila DA, Brown JL, Gallagher SJ, Schifeling RW, Snow IS, Hershey CO. Measuring physician mental workload: reliability and validity assessment of a brief instrument. Medical Care 1992; 30(2):95-104.

MERSQI score=10

Study of mental workload survey in IM clinic demonstrating that mental workload score is inversely correlated with self-rated quality of care, residents' experience, faculty ratings of technical performance and positively correlated with fatigue. Mental workload was not associated with number of patients seen, proportion of new patients, patient complexity, or faculty physicians overall quality of care.

Brennan DF, Silvestri S, Sun JY, Papa L. Progression of emergency medicine resident productivity. Academic Emergency Medicine 2007; 14(9):790-794.

MERSQI score=13.8

Single institution study demonstrating that work productivity - as measured by mean RVU per hour - increased with increasing PGY experience in an EM residency. Likewise, patient acuity also increased from PGY2 to PGY3 year. This reflects the graduated level of responsibility desired in an EM program.

Delva MD, Kirby J, Schultz K, Godwin M. Assessing the Relationship of Learning Approaches to Workplace Climate in Clerkship and Residency. Academic Medicine 2004; 79:1120-1126.

MERSQI score=10

In this mail survey of Canadian residents and students, perceptions of workplace climate were associated with approaches to learning. Specifically, perception of heavy workload was associated with a surface-disorganized approach to learning (feeling overwhelmed at work).

Deveau JP, Lorenz JE, Hughes MJ. Emergency medicine resident work productivity and procedural accomplishment. Journal of the American Osteopathic Association 2003; 103(6):291-6.

MERSQI score=13.2

Retrospective analysis of patient-encounter data over 8 years in an EM program demonstrating that more senior EM residents are more productive - seeing more patients per hour. This study is consistent with other studies showing graduated level of work intensity.

Gaba DM, Lee T. Measuring the workload of the anesthesiologist. Anesthesia & Analgesia 1990; 71(4):354-61.

MERSQI score=12

Could be a potential 'teaching in progress' effect that distracts from patient care. Induction and emergence were periods of peak workload, but there were long period of high spare capacity during other phases of anesthesia. The spare capacity to attend to the secondary task was often compromised. Anesthesiologists

are so loaded with tasks that their ability to attend to additional activities is reduced. Has implications for the # of tasks /monitors that one anesthesiologist should be following.

Haney EM, Nicolaidis C, Hunter A, Chan BKS, Cooney TG, Bowen JL. Relationship between resident workload and self-perceived learning on inpatient medicine wards: a longitudinal study. BMC Medical Education 2006; 6:35.

MERSQI score=8

Prospective study demonstrating that resident self-perceived learning is associated with higher acuity and greater heterogeneity of case variety. A parabolic relationship for # total patients and resident learning existed for interns and for senior residents with respect to new admissions.

Hoffman KG, Donaldson JF. Contextual tensions of the clinical environment and their influence on teaching and learning. Medical Education 2004; 38(4):448-54.

MERSQI score=10

Small observational qualitative study demonstrating that patient census provides learning opportunities and catalyzes teaching. However, with increasing patient acuity and census, learning is deprioritized due to the need to focus on patient care. Teaching was often interrupted due to patient care activities demanding urgent action. Seems similar to the parabolic curve seen in other workload studies.

Niederee MJ, Knudtson JL, Byrnes MC, Helmer SD, Smith RS. A survey of residents and faculty regarding work hour limitations in surgical training programs. Archives of Surgery 2003; 138(6):663-9.

MERSQI score=8

National survey of general surgery PD and residents prior to 2003 demonstrating that 43% of residents felt that their workload was excessive.

Ozuah PO, Neuspiel DR, Shelov SP. The pediatric forum: trends in residents' perceptions of working conditions: 1989-1999. Archives of Pediatrics & Adolescent Medicine 2001; 155(9):1073-4.

MERSQI score=9

Prospective study of pediatric residents over 10 years (1989-1999) in New York demonstrating that although interns worked fewer hours, a greater fraction of time was spent in handoffs (signing in and signing out). Only 20% had sufficient time for ongoing reading in 1999 (compared to 15% in 1989).

Parshuram CS, Dhanani S, Kirsh JA, Cox PN. Fellowship training, workload, fatigue and physical stress: A prospective observational study. Canadian Medical Association Journal 2004; 170(6):965-970.

MERSQI score=13.2

Prospective small study of Canadian pediatric fellows demonstrating that the work is physically demanding and associated with objective measures of physiologic stress (ketonuria and arrhythmia).

Tanz RR, Charrow J. Black Clouds: Work load, sleep, and resident reputation. American Journal of Diseases of Children 1993; 147(5):579-84.

MERSQI score=15

This prospective cohort study examining the relationship between reputation 'black cloud', perceived and actual workload, and sleep demonstrates that there are significant differences among pediatric interns in their perceived workload. This differences is largely driven by sleep loss on-call and not actual workload (measured by # of patients) highlighting that some interns may be more inefficient, sleep less, and have higher perceived work-loads.

Tov N, Rubin AH, Lavie P. Effects of workload on residents' sleep duration: objective documentation. Israel Journal of Medical Sciences 1995; 31(7):417-23.

MERSQI score=14.4

This small study of Israeli residents demonstrated that increased admissions on call was associated with less sleep on call.

Walling HW. Actual versus perceived workload for house officers: black cloud looming?. Annals of Internal Medicine 2004; 140(10):847-8.

MERSQI score=9

Brief report of a single institution study demonstrating that self-reported or general consensus of 'black cloud' designation is associated with interns admitting more patients on call. Consistent with another study on black clouds, it demonstrates that workload by interns vary.

Zelenock GB, Holmes MM, Campell DA Jr., Stanley JC, Greenfield LJ. Quantitative increases in surgical house officer clinical activity as the basis for increased workloads in a university hospital. Surgery 1992; 112(2):235-42.

MERSQI score=12.6

Single institution study of surgical residency between 1981 to 1991 demonstrating that amount of work as measured by # operations, admissions, discharges, op hours, patient acuity increased while # surgical residents remained constant.

Annotated Bibliography: Work Solution/Substitutions

Bellini LM, Shea JA. Improvement of resident perceptions of nurse practitioners after the introduction of a collaborative care model: a benefit of work hour reform? Teaching and Learning in Medicine 2006; 18(3):233 - 236.

MERSQI score=12.5

Pre-post study shows that residents felt that NPs reduced their workload (p=.0001) and felt that they should have a more expanded role, and viewed them as colleagues.

Block AE, Norton DM. Nurse labor effects of residency work hour limits. Nursing Economic$ 2008; 26(6):368-73.

MERSQI score=15.6

Nationally representative study of hospitals demonstrating that teaching intensive hospitals hired more nurses (RN, NP, etc.) after the 2003 ACGME duty hour limits.

Buch KE, Genovese MY, Conigliaro JL, Nguyen SQ, Byrn JC, Novembre CL, Divino CM. Non-physician practitioners' overall enhancement to a surgical resident's experience. Journal of Surgical Education 2008; 65(1):50-53.

MERSQI score=7.5

Single institution surgical study demonstrating that residents and NPPs agree that that they work well together and that NPPs contribute positively to resident education. Most NPPs and residents believe that having an NPP on service decreases their workload.

Chung RS, Ahmed N. How surgical residents spend their training time: the effect of a goal-oriented work style on efficiency and work satisfaction. Archives of Surgery 2007; 142(3):249-52.

MERSQI score=8.5

Pre-post single institution study demonstrating improved work efficiency, clinical productivity, and greater educational time after switching to a "goal-oriented" rounding style in a general surgical program. An important study that suggests that wasted time can be eliminated.

Feinland JB, Sankey HZ. The obstetrics team: midwives teaching residents and medical students on the labor and delivery unit. Journal of Midwifery and Women's Health 2008; 53(4):376-380.

MERSQI score=6

Single institution study describing the implementation of a midwifery program in an Ob/gyne residency with generally positive reviews by residents.

Gallagher SF, Ross SB, Haines K, Shalhub S, Fabri PJ, Karl RC, Murr MM. Journal of Surgical Research 2005; 126(2):137-44.

MERSQI score=14.6

Pre and post study of trauma service admission intervention; implemented in an effort to reduce resident work hours

Gordon CR, Axelrad A, Alexander JB, Dellinger RP, Ross SE. Care of critically ill surgical patients using the 80-hour Accreditation Council of Graduate Medical Education work-week guidelines: a survey of current strategies. The American Surgeon 2006; 72(6):497-499

MERSQI score=8

National survey of surgical program directors demonstrating that many programs are using other residents or physician extenders to help alleviate workload in few months prior to implementation of the 2003 duty hour restrictions.

Green BA, Johnson T. Replacing residents with midlevel practitioners: a New York City-area analysis. Health Affairs 1995; 14(2):192-8

MERSQI score=10.2

Hypothetical analysis of cost of substituting resident work with NPs in New York under different assumptions of shorter work hours. Demonstrates that thousands of midlevels at a cost of 242 million annually would be needed.

Henderson NC, Cookson DT, Plumley R, Cairns M, Paterson-Brown S. The influence of a nurse practitioner on out of hours work intensity for surgical house officers. Scottish Medical Journal 1999; 44(2):52-3.

MERSQI score=10.8

Single institution study of UK demonstrating that NPs resulted in reduced number of calls to house officers.

Holzman MS, Elkins CC, Neuzil DF, Williams Jr. LF. Expanding the physician care team: its effect on patient care, resident function, and education. Journal of Surgical Research 1994; 56(6):636-40.

MERSQI score=13.2

Single institution surgical study, which demonstrated that implementation of a night nurse (physician extenders - RN with critical care certificates), resulted in increased self-reported resident sleep, patient evaluation, and time for education.

Jack B, Prescott T. Staffing. Nightie-knights. Health Service Journal 1999; 109(5636):24.

MERSQI score=6.5

Study of UK single hospital implementing night nurses with pending duty hour limitations demonstrating night nurses gave junior doctors more time for patient review, the ability to prioritize care for sick patients, and more sleep.

Kendrick AS, Ciraulo DL, Radeker TS, Lewis PL, Richart CM, Maxwell R, Barker DE, Smith PW. Trauma nurse specialists' performance of advanced skills positively impacts surgical residency time constraints. American Surgeon 2006; 72(3):224-227.

MERSQI score=15.6

Single institution study demonstrating that by using trauma nurse specialists for invasive procedures, work hours for surgery residents with no change in procedural complications.

Mathur M, Rampersad A, Howard K, Goldman GM. Physician assistants as physician extenders in the pediatric intensive care unit setting-A 5-year experience. Pediatric Critical Care Medicine 2005; 6(1):14-9.

MERSQI score=6

Descriptive single institution study discussing the experience with PA's as physician extenders in the PICU over a 5 year experience. Overall, the PAs were a positive addition in that they helped comply with the ACGME work hour regulations. They performed similar tasks as the peds residents and integrated well with residents and attendings on their respective patient care teams. In addition, over time, PAs provided additional help with their knowledge and familiarity with unit practice patterns. Limitations included high job turnover rates and confusion between their role as shift workers or professional employees. Lastly, there are problems with inexperienced residents supervising PA's who are often more experienced than they are.

Nuckols TK, Bhattacharya J, Wolman DM, Ulmer C, Escarce JJ. Cost implications of reduced work hours and workloads for resident physicians.[see comment]. New England Journal of Medicine 2009; 360(21):2202-15.

MERSQI score=NA

This study developed a probability model based on published data to estimate the annual cost of implementing the IOM recommendations. The authors suggest that it would cost approximately $1.6 billion dollars annually to implement the IOM recommendations if non-resients were used to absorb the extra work. If additional residents were used the cost could be up to $1.7 billion. In order for this to be a cost-neutral intervention to society, an annual decrease in preventable adverse events of 11.3% would need to occur,

Peckett WR, Hicks JS, Williamson DM. The effect of junior doctors' assistants on SHO workload. Ann R Coll Surg Eng 1999; 81(2 Suppl):89-92.

MERSQI score=11.5

Single institution UK surgical study demonstrating that junior doctor assistants helped decrease time spent drawing blood and improved opportunities for education.

Podnos YD, Williams RA, Jimenez JC, Stemmer EA, Gordon IL, Wilson SE. Reducing the noneducational and nonclinical workload of the surgical resident: defining the role of the health technician. Current Surgery 2003; 60(5):529-532.

MERSQI score=14.4

In this single institution surgical study, the addition of a health technical (college graduate) resulted in reductions in hours and workloads of surgical residents and increased time in the OR.

Resnick AS, Todd BA, Mullen JL, Morris JB. How do surgical residents and non-physician practitioners play together in the sandbox? Current Surgery 2006; 63(2):155-164.

MERSQI score=7

Although most residents view the addition of NPP to the clinical services as positive in this single institution surgery study, there were concerns about the program. NPPs do not have the same goals as surgery residents and there is confusion about how to fit NPPs into the hierarchy of the traditional surgical team.

Riportella-Muller R, Libby D, Kindig D. The substitution of physician assistants and nurse practitioners for physician residents in teaching hospitals. Health Affairs 1995; 14(2):181-91.

MERSQI score=8.5

More than 60 percent of teaching hospital medical directors reported using PAs or NPs as a resident replacement/substitution.

Rogers F, Shackford S, Daniel S, Crookes B, Sartorelli K, Charash W, Igneri P. Workload Redistribution: A New Approach to the 80-hour Workweek. J Trauma 2005; 58: 911-916.

MERSQI score=13.8

Single institution study demonstrating that direct admission of neurosurgical and orthopedic trauma to subspecialty services can reduce admissions to the general trauma service, without any differences in patient outcomes (complications, etc.). This approach resulted in a 9.7% reduction in resident work hours, which enabled compliance with the ACGME duty hour rules.

Rosner F, Krinsky JE, Spiegel K, Dolan KL. Journal of the National Medical Association. Successful introduction of an intravenous line insertion team at a municipal hospital 1991; 83(10):913-5.

MERSQI score=9

Single institution study describing implementation of an IV team, which was well received by residents as a way to assist in reducing their workload

Roy CL, Liang CL, Lund M, Boyd C, Katz JT, McKean S, Schnipper JL. Implementation of a physician assistant/hospitalist service in an academic medical center: impact on efficiency and patient outcomes. Journal of Hospital Medicine 2008; 3(5):361-8.

MERSQI score=15.6

Single institution study demonstrating that implementation of a hospitalist/NP service resulted in no differences in patient care compared to an academic teaching service. Total costs were lower but not significant.

Simmer TL, Nerenz DR, Rutt WM, Newcomb CS, Benfer DW. A randomized, controlled trial of an attending staff service in general internal medicine. Medical Care 1991; 29(7 Suppl):JS31-40.

MERSQI score=15.6

Single institution RCT demonstrating that a staff service (physician with NP) can result in shorter LOS and lower total costs than a traditional resident teaching service. No changes in mortality or readmission were observed.

Stahlfeld KR, Robinson JM, Burton EC. What do physician extenders in a general surgery residency really do? Journal of Surgical Education 2008; 65(5):354-358.

MERSQI score=8.4

Single institution surgical study of physician extenders that demonstrates that physician extenders wrote appropriate orders and reduced resident workload. Educational opportunities increased with increased conference attendance.

Tierney WM, Overhage JM, McDonald CJ, Wolinsky FD. Medical students' and housestaff's opinions of computerized order-writing. Academic Medicine 1994; 69(5):386-9.

MERSQI score=8.5

Single institution study examining impact of computerized ordering on perceptions of workload which demonstrated that medical students had the most favorable impressions with only 20% of residents stating that the work is done faster (vs. 58% of jr students). This trend was independent of computer literacy.

Van Eaton EG, Horvath KD, Lober WB, Rossini AJ, Pellegrini CA. A Randomized, Controlled Trial Evaluating the Impact of a Computerized Rounding and Sign-out System on Continuity of Care and Resident Work Hours. J Am Coll Surg 2005; 200: 538-545.

MERSQI score=10.5

Prospective, randomized, cross over study that examines a web-based computerized rounding system. Number of patients missed on rounds, continuity of care, and workflow efficiency were evaluated and compared with residents using UWCores and those who did not use UWCores.

Victorino GP. Organ CH Jr. Physician assistant influence on surgery residents. Archives of Surgery 2003;138(9):971-5.

MERSQI score=8

Single institution study examining the impact of adding surgical PA's to a county hospital university-based surgical residency demonstrates a reduction in work hours six months after PA's joined the service. Interestingly, 6/10 residents believed PA's had no influence on time residents spend in hospital. Despite this, 6/10 residents thought PA's decreased stress levels and helped to improve morale.

Annotated Bibliography: Moonlighting

Baldwin DC Jr, Daugherty SR. Moonlighting and indebtedness reported by PGY2 residents: It's not just about money. Academic Medicine 2002; 77(10 SUPPL.):S36-S38.

MERSQI score=8.5

National survey of PGY1 and 2 (multispecialty) that demonstrates that only 2.3% of PGY1 residents moonlight, but that this increases to 15.9 for PGY2. Moonlighting was more common in specialties with fewer hours (except ortho surgery). Moonlighters reported less stress, fewer work hours, more sleep and higher satisfaction than the high intensity resident group. Most moonlighters were men, PGY2, married and with children. They were also less likely to be named in a lawsuit.

Cheng TL. House staff work hours and moonlighting: what do residents want? A survey of pediatric residents in California. American Journal of Diseases of Children 1991; 145(10):1104-8.

MERSQI score=6

Survey of pediatric residents in California demonstrating that moonlighting was considered to be an individual's choice and responsibility, but a majority are willing to restrict moonlighting if total house staff hours were also limited. Only 48% thought that housestaff should inform program director of moonlighting activities.

Cohen SN, Leeds MP. The moonlighting dilemma. Balancing education, service, and quality care while limiting risk exposure. JAMA 1989; 262(4):529-31.

MERSQI score=10.8

Single institution description of 'extended employment' or internal moonlighting program to preserve the opportunity for extra earnings in a way that also permitted enhanced weekend and night coverage in hospital ER and walk in centers. System also enabled hospital to track hours.

Jamshidi R, Reilly LM. Surgical residents' clinical activity during research years: shedding light on moonlighting practices. Journal of Surgical Education 2008; 65(1):22.

MERSQI score=10

Single institution study of surgical residents demonstrating that moonlighting was approximately 20 hour per week during research years. Option to moonlight was felt to be important during research time. Most important reasons for moonlighting were financial reasons and clinical acumen. 41% of research residents felt moonlighting interfered with optimal research productivity.

Langdorf MI, Ritter MS, Bearie B, Ferkich A, Bryan J. National survey of emergency medicine resident moonlighting. SAEM Inservice Examination Survey Task Force. Academic Emergency Medicine 1995; 2(4):308-14.

MERSQI score=9

National survey of resident experience on moonlighting practices in EM demonstrates that there is a weak correlation (r=.11) between educational debt and moonlighting hours for residents in the second year and above. 88% residents reported that their programs permitted moonlighting; 82% felt that moonlighting provided experience not available in residency; 2% reported being sued for malpractice as a result of moonlighting; 66% reported moonlighting for financial reasons; of moonlighting residents, 28% were unsure of malpractice insurance and 9% had no coverage at all.

Langdorf MI, Bearie B, Ritter MS, Ferkich A. Emergency medicine resident moonlighting: a survey of program directors. Academic Emergency Medicine 1995; 2(4):302-7.

MERSQI score=7

National survey of EM program directors that demonstrates that there is concern about the effects of moonlighting on resident education, especially regarding litigation, and hours. 90% of program directors believe moonlighting interferes with residency duties to some degree; 15 programs reported residents who had been sued for malpractice while moonlighting; 1/3 of PDs reported penalizing residents for abuse of moonlighting privileges. Nevertheless, 60% reported that moonlighting offers experience not available in residency and many recognized that the financial need to supplement income.

Li J, Tabor R, Martinez M. Survey of moonlighting practices and work requirements of emergency medicine residents. American Journal of Emergency Medicine 2000; 18(2):147-51.

MERSQI score=9

National survey of EM residents in 1997 demonstrating that half of residents moonlight, senior residents more likely to moonlight, moonlighting salaries double residents' income and are used to pay off debt; residents with higher student debt are more likely to moonlight, and 50% of residents would violate a ban on moonlighting. Residents felt moonlighting enhanced educational experience.

McCue JD, Janiszewski M, Stickley WT. Residents' views of the value of moonlighting. Archives of Internal Medicine 1990; 150(7):1511-3.

MERSQI score=8

Single institution study of community teaching hospital residents demonstrating that 65% of residents moonlighted; Moonlighters had an average higher debt ($41,644) than nonmoonlighters ($32,917). Residents viewed moonlighting as a positive educational experience that helped with their career decisions and did not interfere with responsibilities.

Yingling KW, Hattemer C, Rouan GW, Luke RG. Internal medicine residents' monitoring of their colleagues' moonlighting activities at the University of Cincinnati. Academic Medicine 1991; 66(11):705-6.

MERSQI score=7

Single institution study describing the implementation of a peer monitoring system for moonlighting documentation. 49% of residents moonlighted for an average of 27 hours per month.

Annotated Bibliography: Supervision

Blumberg ML, Joseph AM, Freeman JR. A strategy for improving the supervision and performance of moonlighting residents. Acad Med 1995; 70(2):155-7.

MERSQI score=13

Pre-post of 20 internal medicine residents and attendings at community-teaching hospital demonstrating that resident compliance with protocols was more consistent after initiation of faculty review of medical records (mean compliance of 95% SD 3% versus 92% SD 8%).

Everett GD. Impact of supervision by medical teachers and in-patient test control programmes on the out-patient test utilization of residents. Med Educ 1985; 19(2):138-42.

MERSQI score=12.5

For nine months, attending approval was needed all labs ordered. Residents were randomized to receive educational intervention on test ordering. Regardless of trainees' exposure to educational intervention on test ordering, test utilization styles of attending physicians did not have a significant effect on test utilization of residents.

Finlayson AJ, Bartolucci G, Streiner DL. Deployment, supervision and decision-making of residents in an emergency psychiatric service. Can J Psychiatry 1979; 24(3):207-11.

MERSQI score=9.5

Implementation of in house attending supervision at night resulted in a non-significant decrease (on 4 point Likert-type scale) in residents' perception of pressure (mean pre 3.0 vs. post 2.0), isolation (mean pre 3.0 vs. post 1.0), without any changes in learning (mean pre 2.0 vs. post 2.0) or satisfaction with experience (mean pre 1.0 vs. 1.0). Qualitative comments noted "[the presence of the attending] is more often symbolically satisfying, than a real help."

Gennis VM. Supervision in the outpatient clinic: effects on teaching and patient care. J Gen Intern Med 1993; 8(7):378-80.

MERSQI score=9

Pre-post single institution study examining differences in attending perception of resident histories before and after personally seeing he patient. After personally seeing the patient, attendings judged patients to be more severely ill on a 5 point scale (pre 2.41 vs. post 2.55, p=0.023) and rated the quality of the resident's history to be lower. Diagnostic changes in (29) 38% of cases, but "major" in only (4) 5.5%. At least one change in management in 58.1% of cases.

Holliman CJ, Wuerz RC, Kimak MJ, et al. Attending supervision of nonemergency medicine residents in a university hospital ED. Am J Emerg Med 1995; 13(3):259-61.

MERSQI score=12

Single institution study that demonstrated that after direct attending physician review of emergency medicine resident cases, 153 major changes (e.g. missed x-ray finding), and 353 minor changes (e.g. charting deficiency) were made. 9% of patients had more than one change recorded per encounter. No change in care for 590 patients (59%). 17 major changes judged to be life or limb-threatening.

Itani KM, DePalma RG, Schifftner T, et al. Surgical resident supervision in the operating room and outcomes of care in Veterans Affairs hospitals. Am J Surg 2005; 190(5):725-31.

MERSQI score=14.5

Study comparing patient outcomes at varying levels of attending supervision (level 3=attending not present in OR suite but immediately available vs. level 0=attending performed surgery vs. levels 1 and 2=attending in the OR assisting; attending in the OR not scrubbed). Overall complication rate lower for patients operated on under level 3 supervision than other levels (level 3 0.13 vs. other levels 0.16, $p<0.001$). However, more patients in the level 3 supervision group required emergency surgery (12.84%) as compared with the other levels of supervision (6.79%, $P < 0.001$)

Jaynes S, Charles E, Kass F, Holzman S. Clinical supervision of the initial interview: effects on patient care. Am J Psychiatry 1979; 136(11):1454-7.

MERSQI score=16

Study comparing attending psychiatrist involved in outpatient clinic visit vs. attending psychiatrist reviewing outpatient cases after evaluated by trainee. Directly supervised group had fewer patients judged to be severely ill (4% vs. 28%, $p<0.05$); and demonstrated a trend (chi-square tests level of significance ranged from $p<0.06$ to $p<0.13$) in the following: (1) improved patient status (44% vs. 20%); (2) greater success of continuing treatment (64% vs. 28%); (3) and fewer dropouts (8% vs. 40%).

Jin C, Novik S, Saravay S. Consultation-liaison psychiatry training and supervision results in fewer recommendations for constant observation. Gen Hosp Psychiatry 2000;22(5):359-64.

MERSQI score=12.5

Comparison of ordering constant observation (CO) for patients by residents with training in consultation-liaison (CL) psychiatry and direct attending physician supervision vs. control group (no training, indirect attending supervision). Residents in unsupervised untrained group had a significantly higher percentage of CO orders (44.1%) compared to those trained in the supervised trained (15.4%) (χ^2=12.1, df=1, $P<0.001$). Supervised trained residents ordered CO less frequently during regular hour consults (2.8%) when attending physicians are available in supervision compared to after hours when no attending presence is available (22.1%) (χ^2=6.72, df=1, $p<0.01$).

Kass F, Charles E, Eagle P, Yudofsky B. Assessing the impact of supervision on outpatient evaluation in psychiatry. QRB Qual Rev Bull 1984; 10(1):3-5.

MERSQI score=14

Attending psychiatrist reviewed outpatient cases vs. peer reviewed cases vs. no supervision. Supervised residents reported higher ratings of patient outcome on a 7 point scale (1=patient much better, 7=patient much worse). Traditional supervision (2.96, SD 0.98) vs. Peer (3.32, SD 0.81), Control (3.59, SD 0.88); One-way ANOVA ($F=3.35$, $p<0.05$).

Kroboth FJ, Brown FH, Stewart R, Karpt R, Karpf M, Levey GS. Impact of attending level supervision of the emergency department experience. Ann Emerg Med 1982; 11(4):192-6.

MERSQI score=10.5

After direct supervision by faculty instituted, a 20% increase in hospital admissions (17.5% vs. 20.5%, $p<0.01$), decreased utilization of observation unit (2.8% vs. 2.4%, $p<0.01$), fewer patients leaving without being examined (4.3% vs. 2.2%, $p<0.02$), and no change in number of patients leaving against medical advice or utilization of routine lab tests

Nguyen CT, Hernandez AV, Gao T, Thomas AA, Jones JS. Office based vasectomy can be performed by supervised urological residents with patient pain and morbidity comparable to those of a staff surgeon procedure. J Urol 2008; 180(4):1451-4.

MERSQI score=9.5

No significant differences noted between supervised trainee pain scores and that of pain scores of procedures performed by attending-level providers, after adjusting for age or side of surgery (1.01 vs. 1.76, p=0.10).

Schmidt UH, Kumwilaisak K, Bittner E, George E, Hess D. Effects of supervision by attending anesthesiologists on complications of emergency tracheal intubation. Anesthesiology 2008; 109(6):973-7.

MERSQI score=12.5

Direct attending physician supervision was associated with a significant decrease in complications (esophageal intubation, traumatic intubation, aspiration, dental injury, and endo-bronchial intubation) (6.1% vs. 21.7%, p=0.0001). Attending physicians had a significantly higher use of muscle relaxants (46% vs. 17%; p< 0.001). No difference in ventilator free days, 28 day mortality, patient disposition, intubation attempts, or year of training.

Sivaslioglu AA, Demir B, Dolen Y, Gelisen O, Haberal A. Residents performance in transobturator tape procedures for stress urinary incontinence. Eur J Obstet Gynecol Reprod Biol 2007; 134(2):259-61.

MERSQI score=12.5

Study comparing operative time, complications and patient outcomes of directly supervised resident vs. attending alone on trans-obturator tape (TOT) procedure. Mean operative time was significantly longer in supervised resident group (27min vs. 13min, p<0.05). No statistically significant differences in terms of complications, cure, recovery and failure between the two groups

Sox CM, Burstin HR, Orav EJ, et al. The effect of supervision of residents on quality of care in five university-affiliated emergency departments. Acad Med 1998; 73(7):776-82.

MERSQI score=12.5

Prospective cohort study assessing impact of direct supervision on resident physicians by attending physicians on quality of care in emergency departments. Directly supervised residents had significantly higher adjusted mean percentage compliance with process of care guidelines as measured by complaint-specific (e.g. chest pain) data forms (64%) than other residents (55%, p<0.001). No difference in patient satisfaction