Effect of the ACGME Duty Hours Restrictions on Surgical Residents and Faculty: A Systematic Review

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Abstract

Purpose

Educators in surgical training programs are concerned that the Accreditation Council for Graduate Medical Education (ACGME) duty hours limitations may adversely affect surgical residents' education, especially their operative experience, so the authors aimed to evaluate the impact of duty hours reductions on surgical residency.

Method

The authors searched English- and French-language literature (2000–2008) for articles about the impact of duty hours restrictions on surgical residents' education and well-being and on faculty educators. They used the following databases: MEDLINE, EMBASE, Cochrane Central Register of Controlled Trials, and ERIC. The authors included every report that examined the effects of duty hours limits on surgical training, excluding opinion papers and editorials. Two reviewers independently performed data extraction and quality assessment for all reports and resolved disagreements by consensus.

Results

The authors retrieved 1,146 reports and included 56 in the study. They compiled positive and negative outcomes on (1) residents' education, (2) resident lifestyle, and (3) surgical faculty. Overall, the effects of duty hours reductions on residents' education and lifestyle were positive or neutral, but the effects on surgical faculty were negative. The 16 articles with the highest-quality scores had 27 positive themes and 11 negative themes.

Conclusions

This is the largest and most current review of the literature addressing the effect of the ACGME duty hours limitations on surgical training. Limitations had a positive effect on residents but a negative effect on surgical faculty. Importantly, duty hours limitations did not adversely affect surgical residents' operating-room experience.

Public, media, and political interest in the working conditions of medical residents rose greatly in the last decade of the 20th century. In 1989, New York State became the first U.S. jurisdiction to reduce duty hours for residents. Several states attempted to follow with legislative action, but all of these attempts failed.[1] The American College of Surgeons (ACS) resisted a reduction in duty hours on the grounds that such a reduction would decrease necessary operating-room experience and undermine the continuity of patient care.[1] The publication of the Institute of Medicine (IOM) report, *To Err Is Human*, in 1999 put enormous pressure on the Accreditation Council for Graduate Medical Education (ACGME), especially because it estimated that 44,000 of the 98,000 deaths that occurred in U.S. hospitals each year were attributable to medical error.[2] Although the publication of the IOM report was mainly aimed at understanding medical errors rather than connecting them to resident fatigue, the public might have presumed a connection between error and fatigue. These developments were followed in 2001 by a petition requesting the regulation of resident duty hours. The advocacy group Public Citizen, the Committee of Interns and Residents, and the American Medical Student Association jointly submitted this petition to the Occupational Safety and Health Administration.[1–3] Because such a regulation would infringe on the authority of the ACGME, the main regulatory body for residency programs, the ACGME accelerated efforts to address concerns about residents' duty hours and developed the duty hours standards that were implemented fully in July 2003 and are still current. The major changes in the ACGME duty hours comprise the following: Duty hours must be limited to 80 hours per week, in-house call must occur no more frequently than every third night, and continuous, on-site duty, including in-house call, must not exceed 24 consecutive hours.[4]

These developments gave rise to considerable concern on the part of the surgical specialties, mainly in light of the potential loss of operating-room experience and of continuity of care.[1] The long-held surgical tradition of "patient ownership" seemed to be under direct threat. This tradition implied that residents were so involved in individual patient care, knowing every detail of a patient's clinical condition and hospital course, that, in effect, they could not transfer this knowledge to another resident. Surgeons felt that long hours were essential to instill this ethos of dedicated patient care in the culture of surgical residency.[1]

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The new regulations are intended primarily to improve patient care and reduce the incidence of medical errors attributable to resident fatigue; however, they might also have an indirect impact on residents' education and lifestyle as well as on faculty members' productivity and lifestyle. The indirect potential impact on resident education includes the decrease in operating-room experience, a lack of time to attend clinics, and the reduction in educational encounters—all of which could lead to decreased competency. Duty hours rules could impact residents' lifestyle in a positive way if the residents have more time available for extracurricular activities, experience improved job satisfaction, gain more time to rest, and feel decreased stress levels. On the other hand, the new restrictions could have the opposite effect on faculty because, in theory, faculty may pick up the work that residents leave undone. Increased work for faculty, in turn, could lead to less time for them to participate in activities outside of work, increase their stress levels, and reduce the time available for their teaching and research activities.

The academic medicine community needs to systematically evaluate the impact of the ACGME duty hours restrictions on surgical residents within the United States. To evaluate the evidence about duty hours restriction, we performed a systematic review of the literature pertaining to the implementation of the ACGME duty hours standards in U.S. surgical residency programs. To our knowledge, this is the first systematic review of the effect of duty hours restrictions on surgical residents and faculty.

Method

Data sources

We searched the English- and French-language medical and surgical literature for articles published from January 2000 to September 2008 that examined the impact of duty hours restrictions on surgical residents' personal well-being, education, and training, and on faculty members. We included the following databases in our search: MEDLINE, EMBASE, BIOSIS Previews, the Cochrane Central Register of Controlled Trials, and ERIC.[†] We also manually searched the references of selected articles and performed a manual search of relevant medical education and surgical journals (i.e., *Academic Medicine*, *Current Surgery*, *Archive of Surgery*, *Journal of the American College of Surgeons*, *American Journal of Surgery*, and *Annals of Surgery*).

We also searched the following databases and Web sites for gray literature on the topic: Canadian Evaluation Society, Canadian Institute for Health Information, Canadian Medical Association Infobase, Grey Literature Report (New York Academy of Medicine), Health Canada Library Catalogue, National Center for Health Statistics (Centers for Disease Control and Prevention), National Guideline Clearinghouse (U.S.), Public Health Agency of Canada, PapersFirst, ProceedingsFirst, ProQuest Dissertations and Theses, Statistics Canada, Theses Canada, and WorldCat. We combined searches for the words, "residen*," "surg*," and "hour*" with the Boolean operator "and."

Study selection

We included studies that (1) examined the effect of the ACGME duty hours restrictions before and/or after their implementation, (2) were conducted in a surgical residency program in the United States, and (3) included outcomes directly related to resident education, resident lifestyle, and/or surgical faculty. We defined surgical specialties as any specialty with operating-room privileges, including general surgery and its subspecialties: cardiac surgery, ear nose and throat surgery, plastic surgery, ophthalmology, orthopedics, obstetrics–gynecology, and neurosurgery.

Data abstraction

Two of us (M.J., M.R.) independently extracted data from each report, using a standardized data extraction form that captured details on study design, number of participants, response rate, outcomes sought, interventions used, and methodological concerns. We resolved disagreements via consensus.

Using a thematic analysis,[5] we divided outcomes into themes. We again resolved disagreements through consensus. We subsequently classified themes as "positive" or "negative." We deemed a theme to be "negative" if the study authors considered the outcome to be detrimental in some way to resident education or to faculty or resident quality of life, and we deemed a theme to be "positive" if the study authors felt the outcome to be beneficial to resident education or to faculty or resident quality of life.

Assessment of study quality

Because the reports on this topic used very different methodologies to answer a common question, we felt that scoring the reports in order to discern between the higher-quality and lower-quality reports was essential. We devised a quality scoring instrument (Chart 1) based on a system for grading evidence in medical education developed by Harden and colleagues[6] and published in Best Evidence for Medical Education. We developed the scoring system by first discussing it with medical education experts at our institution (McGill) to ensure face validity. We presented a preliminary sample of 28 reports to these experts so they could familiarize themselves with the research. We then performed a pilot scoring, in which five reviewers scored five papers. The five reviewers then met to discuss the scoring and reach a consensus; the interrater reliability of the five reviewers was 95%.

[†] In MEDLINE, we first searched for articles about *residents*, beginning with the controlled vocabulary terms (MeSH terms) "physicians," "education, medical, graduate," or "internship and residency"; we also performed a keyword search of the title and abstract fields for the words "resident," "junior doctor," and "junior physician." We next searched for articles about *work hours* by using the MeSH terms "workload" or "personnel staffing and scheduling," in addition to conducting a keyword search using "work adj5 hour," "doctor adj5 hour," "physician adj5 hour," "dut adj5 hour," "resident adj5 hour," "shift adj5 hour," "workload," "work schedule," and "night float." We used the following MeSH terms to search for articles related to *personal well-being*, *patient care*, or *learning*: "work schedule tolerance," "sleep disorders," "chronobiology," "chronobiology disorders," "fatigue," "mental fatigue," "patient care," "treatment outcome," "learning," or "professional competence." We searched the literature relating to *surgical* contexts using the MeSH terms "specialities, surgical," or "surgical procedures, operative," as well as the subheading "surgery" and by performing a keyword search for "surgical" or "surger*." We combined the *residents*, *surgical*, *work hours*, and *personal well-being/patient care/learning* searches, using the Boolean operator "and." We also performed an additional search combining our *residents*, *surgical*, and *work hours* searches with a keyword search for "education" as well as with a subheading search for "education." We used a similar search strategy for the EMBASE, BIOSIS Previews, Cochrane Central Register of Controlled Trials databases, and ERIC.

Chart 1

Methodological Quality Scoring System, Based on Harden and Colleagues,[6] Used to Evaluate Studies (2000–2008) Evaluating the Effect of Work Hours Restrictions in U.S. Surgical Residencies

Study title:_____ Authors:_____			
Sample	Yes = 0.5	No	N/A
Is it large enough for the purpose?			
Could we safely say something about the general case based on this sample?			
Is there a reasonable response rate?			
Is the sample biased in any way?			
	Score		/2
Data collection	Yes = 0.65	No	N/A
Do you know where the data were collected?			
Is the data collection instrument properly described?			
Was the data collection instrument properly developed, piloted, or tested?			
	Score		/2
Data analysis	Yes = 1	No	N/A
Is the way the data were analyzed properly described so that you can do it in the same way?			
	Score		/1
Validity, reliability, and generalizability of findings	Yes = 1	No	N/A
Did the study try to establish or discuss the validity of the findings?			
Did the study try to establish or discuss the reliability of the findings?			
Is the likely generalizability of the study discussed?			
	Score		/3
Conclusions	Yes = 0.65	No	N/A
Are the conclusions actually borne out by the data?			
Do the recommendations actually follow from the findings?			
Does the research justify the conclusions (e.g., *small numbers in a qualitative study should not merit general conclusions for action*)?			
	Score		/2
Strength			
Opinion only			1
Nonvalidated survey or a resident operating room (OR) database with findings not of statistical significance			2
Resident OR database with statistically significant finding			3
Resident OR database and other instruments			4
	Score		/4
Utility			
Measuring reaction only			1
Measuring learning activities			2
Measuring outcomes			3
	Score		/3
Total score			/17

We applied the final scoring system to all studies, including those that used survey questionnaires only. Three reviewers scored the remaining 51 reports after receiving detailed training in the scoring. Three of us (M.J., M.R., L.S.) assessed all of the studies for quality and resolved disagreements by consensus. We scored the methodological strength of the reports by giving reports that used databases or validated surveys three points and giving reports that used both the maximum strength score of four points (study surveys that collected only opinions, that were not validated, that collected information about nonresidents, or whose findings were not statistically significant received only one or two points). We scored the utility of a study by assessing outcomes collected. A maximum utility score required a study protocol to examine quantitative outcomes such as exam scores and/or numbers of operative cases. We also considered survey response rate in our measure of high-quality articles. We felt that a response of more than 50% should be expected because most of these studies surveyed residents or faculty at the institution of at least one of the authors.

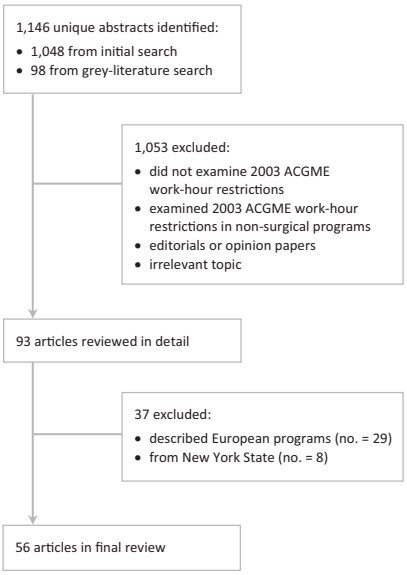

Figure 1 Selection of studies for review; after excluding irrelevant articles, European studies, and studies from New York, the final number of studies included is 56, all evaluating the impact of the Accreditation Council for Graduate Medical Education work hours restrictions on surgical residency programs.

Thus, we considered a response rate of more than 50% adequate, and we gave full points (0.5) to any study that achieved this.

We considered the high-quality studies to be those that not only achieved a minimum score of 3/4 in the strength section but also used a methodology other than nonvalidated surveys.

Results

Through our search, we retrieved 1,146 unique abstracts of which 98 were from the gray literature search (Figure 1). We excluded all opinion papers and editorials and all abstracts (no. = 1,053) that proved irrelevant to the topic. We also excluded all studies that examined working hours in European programs (no. = 29) because the limitations that applied in these programs were very different from those imposed by the ACGME. Finally, we also excluded all articles that described programs in New York State (no. = 8), in view of the fact that duty hours restrictions in that jurisdiction started in 1989 and were not monitored as effectively as the ACGME duty hours. Therefore, we included 56 research reports in this review.[4,7–61]

Overall, the 56 studies reported 71 positive and 68 negative outcomes. We divided these outcomes into (1) those related to resident education (no. = 58), (2) those related to resident psychological well-being (no. = 29), and (3) those related to surgical faculty (no. = 52). Sixteen of the 56 studies received a high score for quality.[13,16,22,23,27,28,30,34,43,44,50–53,55,61] In our judgment, these high-quality reports provide the most rigorous evidence, and in the following presentation of results we examine them as a subset. The overall analysis of all reports paralleled the results from these 16; however, the latter had a greater number of positive than negative themes. We thought that analyzing the whole literature and emphasizing the variability in methodology and strength would provide a better understanding for the reader. The high-quality studies reported 27 positive or neutral and 11 negative outcomes (Tables 1 and 2).

Resident education: Findings from overall analysis

Overall analysis of all 56 articles included in our final sample revealed 40 positive or neutral outcomes and 18 negative outcomes regarding resident education. We paired neutral and positive results because we thought that both constitute a positive effect, because the expectation is that duty hours reduction will reduce the number of residents' operating cases. Eighteen studies reported a neutral or positive effect on the number of operating-room cases,[4,13,22,23,26–28,30,41,43,44,47,50–55] whereas 11 papers reported a negative effect.[12,16–18,20,31–34,48,59] Five studies reported a positive effect on either the surgical board examination or American Board In Training Examination (ABSITE) scores.[22,23,30,50,61] No study reported a negative effect on examination performance. Seven studies[4,18,31,41,48,54,59] used surveys to determine the effect of the duty hours restrictions on operating-room experience, and 4[18,31,48,59] of these (57%) reported a negative effect. Investigators examined residents' logbooks or electronic databases in 22 studies[12,13,16,17,20,22,23,26–28,30,32–34,43,44,47,50–53,55] to determine the effect on the number of operative cases; of these 22, only 7[12,16,17,20,32–34] (30.5%) reported a negative effect.

Resident education: Findings from high-quality papers

The 16 high-quality studies included in our final sample reported 20 positive educational outcomes and only 4 negative educational outcomes (Table 2). Thirteen high-quality studies reported a positive or neutral effect on the number of operative cases,[13,22,23,27,28,30,43,44,50–53,55] and only 2 high-quality studies reported a negative effect.[16,34]

Five high-quality studies reported a positive or neutral effect on examination scores,[22,23,30,50,61] and no reports documented any decline in the ABSITE or the qualifying examination scores after the implementation of the duty hours restriction. Two other positive outcomes were reported: Gelfand and associates[28] reported no change in clinic attendance, and Schneider and colleagues[50] showed that residents were preparing better by reading about cases before the surgery. Gelfand and associates[28] also reported one of the negative outcomes: a reduction in the time available for educational activities. Spencer and Teitelbaum[53] described the second negative outcome in education: the significant decrease of residents' attendance at the outpatient surgery clinic.

Resident education: Summary

The two major themes in the reports that studied the effect of the ACGME duty hours on resident education were the effect on operating-room experience and the effect on examination scores. None of the 56 studies reported a worsening of exam scores. The majority of studies, especially the high-quality ones, reported a neutral to positive effect on number of operative cases, suggesting that the ACGME duty hours restrictions had a positive effect overall on resident education.

Psychological well-being of surgical residents: Findings from overall analysis

Our analysis identified six major outcomes related to residents' psychological well-being and lifestyle: (1) quality of life, (2) participation in extracurricular activities, (3) job satisfaction, (4) motivation, (5) burnout scores, and (6) medical students' opinions of surgeons' lifestyles. Eighteen studies reported an improvement in residents' quality of life after implementation of the ACGME duty hours restrictions.[4,8–10,17,21,24,29–31,35,40,41,45,46,49,54,61] Three studies reported decreased resident burnout scores[10,30,45]; three reported a more favorable view among medical

Table 1

Tally of Positive/Neutral and Negative Outcomes Reported in 16 High-Quality Studies (2000–2008) Evaluating the Effect of Work Hours Restrictions in U.S. Surgical Residencies

Theme	16 high-quality studies	
	No. of positive/neutral outcomes	No. of negative outcomes
Resident education		
Number of operative cases	13	2
Examination performance	5	0
Other effects	2	2
Resident lifestyle		
Quality of life	3	0
Burnout	1	0
Motivation	1	0
Faculty		
Work hours and workload	2	2
Job satisfaction	0	1
Satisfaction with resident education	0	1
Quality and continuity of care	0	1
Quality of life	0	1

students of surgeons' lifestyles[8,24,35]; two reported an improvement in residents' job satisfaction[49,61]; one reported an increase in extracurricular activities[49]; one reported an increase in motivation to work[30]; and one reported reduced psychological distress.[61] No studies examining the impact of the ACGME duty hours on surgical resident psychological well-being and lifestyle reported any negative themes or outcomes.

Psychological well-being of surgical residents: Findings from high-quality papers

Two of the high-quality studies examined residents' psychological well-being (the majority of studies examining the psychological well-being of surgical residents used nonvalidated surveys, so we did not consider their results to provide high-quality evidence). The authors of one of the high-quality reports, Zaré and colleagues,[61] used two validated questionnaires, the Symptom Checklist–90 (SCL-90-R) and the Perceived Stress Scale (PSS), to assess psychological well-being. They surveyed all the residents at four different U.S. surgical residency programs five to six months after the institution of the new duty hours restrictions. They used a control group of 108 surgical residents from the same institutions who had completed the surveys before the duty hours restrictions, and another control group of 960 people representing the general U.S. population. The results showed reduced psychological distress, as determined by the SCL-90-R, which evaluates a wide range of psychological problems; however, these authors discovered the same level of stress perception, as determined by the PSS, which measures how stressful the situation is in an individual life. The authors of the other high-quality report, Hutter and collaborators,[30] used the Maslach Burnout Inventory and the Herzberg Motivation Dimensions, both well-validated instruments, and found reduced resident burnout scores and increased resident motivation after the implementation of restrictions on duty hours. Their study also showed an improved quality of life for residents outside and inside the hospital.

Psychological well-being of surgical residents: Summary

The psychological well-being of residents improved after the new duty hours regulations were introduced, as evidenced by the fact that none of the 56 studies in our final sample reported negative themes. However, the majority of studies that examined residents' well-being did not use a strong methodology.

Surgical faculty members: Findings from overall analysis

Twenty studies examined the effect of duty hours restrictions on surgical faculty.[7,10,15,18,19,21,24,29,30,37–39,43,46,48–50,57–59] Themes emerging from studies of the effect on surgical faculty included faculty work hours, faculty academic and clinical productivity, availability of time for faculty to teach, job satisfaction among faculty, faculty quality of life, and shift of workload from residents to faculty. The main effect on faculty results from the inability of residents to complete all the tasks assigned to them within the time allowed, which, in turn, requires faculty to pick up some of the tasks assigned to residents. When faculty complete work assigned to residents, they have less time available for nonclinical activities such as research and teaching. A large number of the studies report faculty members' opinions; these survey studies, specifically on faculty opinions regarding the effect of the duty hours restrictions on residents and patient care, highlighted three themes: (1) satisfaction with residents' training, (2) continuity of patient care, and (3) and quality of patient care.

Overall, five studies reported an increase in faculty work hours and workload.[15,19,48,50,58] Three studies reported, respectively, that faculty had less time available for teaching[19,24,58]; that the quality of life was worsening for surgical faculty[19,29,30]; that work was shifting from residents to faculty[15,19,37]; and that faculty experienced increased job dissatisfaction.[19,50,58] Two studies showed no change in faculty productivity after the introduction of the new duty hours restrictions.[37,43] One study showed no change in hours worked.[43] No study reported a reduced workload for faculty, increased time for faculty to teach, or an improvement in faculty quality of life or job satisfaction.

Fourteen studies examined faculty opinion regarding resident training,[7,15,19,21,24,29,30,37,39,46,48,49,57,59] and all reported that faculty were dissatisfied with resident training. Further, 10 studies reported faculty dissatisfaction with patient care,[7,15,21,29,30,37,48,49,57,59] and 6 showed faculty dissatisfaction with continuity of patient care.[7,18,29,30,57,59] Only 2 studies reported no change in faculty views of patient care,[46,58] and no study reported neutral or positive effects on faculty opinions regarding the continuity of care.

Table 2

Results Reported in 16 High-Quality Papers (2000–2008) Evaluating the Effect of Work Hours Restrictions in U.S. Surgical Residencies

Study author (year)[Ref]	Positive/neutral outcomes	Negative outcomes	Effect on operating-room experience	Program
Bland et al 2005[13]	None reported	None reported	Neutral	General surgery
de Virgilio et al 2006[22]	No effect on American Board In Training Examination (ABSITE) and American Board of Surgery qualifying and certifying examination scores	None reported	Positive	Trauma surgery
Durkin et al 2008[23]	Improved ABSITE exam scores	None reported	Neutral	General surgery
Ferguson et al 2005[27]	None reported	None reported	Positive	General surgery
Gelfand et al 2004[28]	No changes in resident attendance of clinic	• Reduced participation of residents in educational activities • No effect on burnout scores for faculty and residents	Neutral	General surgery
Hutter et al 2006[30]	• Neutral effect on ABSITE exam scores • Improved quality of life for residents • Decreased burnout scores for residents • Increased motivation to work among residents	• Faculty less satisfied with surgical training • Faculty less satisfied with quality of patient care • Faculty less satisfied with continuity of care • Worsened lifestyle for faculty	Neutral	General surgery
Malangoni et al 2005[43]	• No effect on faculty work hours • No effect on faculty productivity		Neutral	Trauma surgery
McElearney et al 2005[44]	None reported	None reported	Neutral	General surgery
Schneider et al 2007[50]	• Improved ABSITE exam scores • No effect on continuity of care • Improved resident preparation (residents reading about cases prior to surgery)	• Increased work hours and load for faculty • Faculty less satisfied with job	Neutral	General surgery
Shin et al 2008[51]	None reported	None reported	Neutral	General surgery
Short et al 2006[52]	None reported	None reported	Neutral	Obstetrics–gynecology
Spencer & Teitelbaum 2005[53]	None reported	Decreased resident participation in clinic	Neutral	Pediatric surgery
Tran et al 2006[55]	None reported	None reported	Neutral	General surgery
Carlin et al 2007[16]	None reported	None reported	Negative	General surgery
Kairys et al 2008[34]	None reported	None reported	Negative	General surgery
Zaré et al 2005[61]	• Reduced psychological distress among residents • No effect on ABSITE exam scores	None reported	Not assessed	General surgery

Surgical faculty members: Findings from high-quality papers

Only three high-quality papers included themes related to faculty and the new resident duty hours[30,43,50] (we did not consider the majority of studies reporting faculty outcomes to be of high quality because they were mostly nonvalidated survey studies performed at single institutions[7,10,15,18,19,21,24,29,37–39,46,48,49,57–59]). Hutter and colleagues[30] used Web-based surveys using validated instruments such as the Maslach Burnout Inventory and the Herzberg Motivation Dimensions as well as taped one-to-one interviews and daily time cards before and after the institution of the duty hours restrictions. They reported that surgical faculty were less satisfied with surgical training, with the quality of patient care, and with continuity of patient care. They also reported a decrease in the quality of faculty lifestyle. One high-quality study reported increased faculty work hours, as measured by actual hours worked.[50] The same study showed less job satisfaction among surgical faculty, as measured by a survey.[50] The two positive outcomes coming from high-quality studies, by Malangoni and colleagues,[43] showed no change in hours worked nor any change in productivity.

Surgical faculty members: Summary

In summary, studies examining the effect of duty hours restrictions on faculty showed a negative impact. Many of these studies reported that faculty have a negative view of the effects of the ACGME duty hours. In fact, the majority of the negative themes

arose from lower-quality studies that examined faculty opinions.

Discussion and Conclusions

Traditionally, training in the surgical specialties has relied on long work hours to ensure the proper acquisition of procedural skills and to maintain the long-held tradition of "patient ownership."[1] Patient safety in surgery is believed to be closely related to the ethos of patient ownership that results from a close continuity of care.[1] Thus, many surgical program directors were skeptical of and resistant to the new duty hours restrictions, fearing that they would have a deleterious effect on continuity of care. Program directors and other surgical educators worried that the restrictions would negatively affect surgical residents' education (because of the loss of operating-room time) and thus compromise patient safety. Surgical residency programs attempted to adapt to the new duty hours through the following interventions: implementing night shifts, replacing in-hospital calls with home calls, hiring physician extenders, combining and cross-covering services, transitioning junior residents to more senior roles with greater responsibility, increasing the number of residents, and redesigning the residency program to include different residency models.

These interventions have not ended the controversy surrounding duty hours restrictions, as is apparent from the publication of the recent IOM report, *Resident Duty Hours: Enhancing Sleep, Supervision, and Safety*,[62] which recommends limiting continuous hours of work to 16 per day, providing a sleep period of 5 hours during longer shifts, reducing workload, and strictly adhering to an 80-hour workweek—all to further enhance patient safety and reduce the incidence of medical errors. The ACS position,[63] presented to the IOM in March 2008, expressed concern that restrictions on resident duty hours would result in poorly trained surgeons, which would, in turn, reduce patient safety and quality of care. In fact, the ACS is reporting an increase in the number of residents applying for fellowships, which it surmises reflects a lack of confidence among surgical graduates in the era of reduced duty hours.[63] The trend of more surgeons entering fellowships, the ACS argues, could lead to the provision of more highly specialized surgeons and fewer general surgeons.

This systematic review examined studies published during the five years immediately after the U.S.-wide implementation of the ACGME duty hours restrictions. Specifically, we examined the effects of the new restrictions on resident education, resident lifestyle, and surgical faculty. We applied established criteria to distinguish between high-quality studies and less methodologically robust studies, and we assigned less value to those studies that used nonvalidated opinion surveys (a common methodology of many reports in the literature).

Two of the most debated subjects in relation to the new duty hours and the surgical environment have been continuity of care and resident education—in particular, resident operating-room experience. Resident education, as expressed by operating-room experience and scores on examinations, was not adversely affected by the new duty hours. The effect on operating-room experience was reported in 13 high-quality studies to have been positive (no. = 2) or neutral (no. = 11), and only 2 high-quality studies reported a decline in the operating-room experience after the implementation of the new duty hours restrictions. Likewise, no studies reported declines in examination scores. All of the studies we reviewed reported that the quality of resident life improved considerably after the implementation of duty hours restrictions.

The finding that the level of operating-room experience did not decrease should not be unexpected. Studies conducted in Europe, where the number of work hours is reduced to fewer than 60 a week and is well monitored, report a good level of operating-room experience.[64,65] In a survey of 239 Dutch surgical residents working an average of 55 hours per week, the mean number of cases performed was 195 per year (range 35–450).[64] Youngson and colleagues[65] reported an increase in the number of operative cases and improved supervision in the United Kingdom, in the era of a 58-hour workweek.

Clearly, resistance and dissatisfaction exist among surgical faculty with respect to the ACGME duty hours restrictions: 76% of the negative themes we found in this review derived from surveys of surgical faculty. Faculty perceived negative effects with respect to resident training, quality of patient care, and continuity of patient care. They also reported an increase in their workload and more job dissatisfaction in comparison with the period before the restriction of duty hours.

Although we systematically reviewed the literature published on the effects of ACGME duty hours restrictions, the results of this analysis must be interpreted with caution. One of the major determinants of successful adaptation to a reduction in duty hours is the implementation of interventions that do not significantly affect program costs. Most of the 56 studies we reviewed did not outline clearly the interventions used to deal with reduced duty hours. Possibly, the institutions that hired physician extenders and implemented other interventions were those with better results, including the maintenance of the same operating-room experience. Also, institutions that wish to attract good residents are unlikely to publish studies describing a decline in operating-room experience. An additional major bias is that residents at some institutions may not have reported their working hours accurately and were, therefore, not truly adhering to the 80-hour workweek. Finally, some degree of reviewer bias is possible, although we selected the studies rated as high quality using established criteria.

The fact that fatigue can contribute to medical error is extensively documented in the literature, but, notably, not in surgical patients taken care of by surgeons. Some evidence supports a detrimental effect of fatigue on surgical residents' cognitive and motor skills,[66–68] but no published literature links fatigue directly to adverse outcomes for surgical patients. However, continuity of care is also a major patient safety mechanism, especially in the fast-paced surgical environment. In our opinion, continuity of care should be a major focus of future work, using technology and new techniques to ensure the proper transfer of patient care. Future studies should also document the effect of resident fatigue on surgical patient outcomes.

Although duty hours restrictions were associated with neutral effects on

operating-room experience and on exam scores, these are only two aspects of the determination of surgical competency. The majority of studies looked at only these two measures. Whether duty hours restrictions will really produce more competent surgeons is difficult to say. Future studies should examine the effect of duty hours restrictions on other measures of competency, such as professionalism, humanism, and/or communication skills. Also, surgical educators in the future should focus more attention on new technologies such as simulation and Web-based learning tools to optimize the learning experience in surgical residency programs.

Limiting duty hours is a paradigm shift in the surgical environment, and continued change will take time. The ACGME task force examining the effect of the 2003 duty hours has recently completed its work,[69] and the results will soon be public. Whether or not the task force recommends reducing duty hours further, the concerns of surgical faculty must be addressed. This study clearly demonstrates that surgical educators and faculty perceive a negative impact of duty hours. The discrepancy between the opinion of surgical faculty and the ACGME, if not resolved, may result in an increase in resident training duration or even in streaming residents into subspecialized training programs—both of which would adversely affect the surgical workforce. Although the reduction in surgical residents' duty hours seems to have had generally positive outcomes, more time is needed to anchor this change in the culture of surgical education.

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