

Conceptual Frameworks in the Study of Duty-Hour Changes in Graduate Medical Education: A Review

Alan Schwartz, PhD, Cleo Pappas, MLIS, Philip G. Bashook, EdD, Georges Bordage, MD, PhD, Marcia Edison, MBA, PhD, Bharati Prasad, MD, and Valerie Swiatkowski, MD

Dr. Schwartz is Associate Professor and Director of Research, Department of Medical Education, University of Illinois at Chicago, Chicago, Illinois.

Ms. Pappas is Assistant Professor and Assistant Information Service Librarian, Library of Health Sciences, University of Illinois at Chicago, Chicago, Illinois.

Dr. Bashook is Research Associate Professor, Department of Medical Education, University of Illinois at Chicago, Chicago, Illinois.

Dr. Bordage is Professor, Department of Medical Education, University of Illinois at Chicago, Chicago, Illinois.

Dr. Edison is Research Assistant Professor, Department of Medical Education, University of Illinois at Chicago, Chicago, Illinois.

Dr. Prasad is Assistant Professor, Section of Pulmonary, Critical Care, and Sleep Medicine, Department of Medicine, University of Illinois at Chicago, Chicago, Illinois.

Dr. Swiatkowski is Assistant Professor and Assistant Residency Director, Department of Obstetrics and Gynecology, University of Illinois at Chicago, Chicago, Illinois.

Correspondence should be addressed to Dr. Schwartz, Department of Medical Education (mc 591), University of Illinois at Chicago, 808 S. Wood St., 986 CME, Chicago, IL, USA 60612. Phone: 312 996 2070; Fax: 312 413 2048; E-mail: alansz@uic.edu.

Abstract

Purpose

Conceptual frameworks are approaches to a research problem that specify key entities and their relationships. The 2009 Institute of Medicine (IOM) report on resident duty hours, subsequent studies, and published responses to the report present a variety of conceptual frameworks for the study of the impact of duty-hour regulations. The authors sought to identify and describe these conceptual frameworks and their implications.

Method

The authors reviewed the IOM report and articles in both peer-reviewed and non-peer-reviewed literature for the period January 2008 through April 2010, identified using multiple electronic databases including Pubmed, EMBASE, CINAHL, BEME, and PsycInfo. Studies that explicitly described or argued for the effect of resident duty hours on any other outcome, as judged by consensus of multiple reviewers, were included. The authors selected 239 of 858 studies reviewed. Several of the authors reviewed articles to identify conceptual frameworks used implicitly or explicitly to describe the relationship between duty hours (or duty-hours regulations) and outcomes. Identification was by consensus.

Results

Twenty-three conceptual frameworks were identified, several of which made contradictory predictions about the impact of duty-hour regulations on patient outcomes, resident education, and other key outcomes.

Conclusions

The concept of *duty hours* itself is contested, and little attention has been paid to the nature and intensity of the activities that occupy residents' hours. Much research focuses on isolated outcomes of duty-hour changes without considering mediation or moderation. More studies are needed to define tradeoffs between outcomes and the value society places on these tradeoffs.

In 2003, the Accreditation Council for Graduate Medical Education (ACGME) instituted duty-hour regulations. U.S. residents of all specialties were limited to 80 hours per week (averaged over 4 weeks), 30 continuous hours (of which 24 could be spent in admitting patients), and overnight call no more than every third night (on average).¹ In addition, the ACGME mandated 10 hours off after each long shift and at least one day off per week (averaged over 4 weeks). Internal moonlighting was also included as hours worked.

In 2009, the Institute of Medicine (IOM) published *Resident Duty Hours: Enhancing Sleep, Supervision, and Safety*² (hereafter, "IOM report"), a review of the literature through 2008 on the impact of changes to the duty-hour regulations and the relationship between sleep, fatigue, and effective functioning in humans. Acknowledging the lack of key research studies, the IOM report nevertheless recommended changes to duty-hour regulations, including: 30-hour shifts with 16 hours of admissions and a 5-hour protected sleep period (or, alternatively, 16-hour shifts), overnight call no more than every third night (no averaging), additional time off after night shifts, one day off per week (no averaging), one 48-hour period off per month, and inclusion of both internal and external moonlighting as hours worked. The ACGME has recently adopted some of these recommendations.

Method

Conceptual frameworks

In this study, we reviewed and critiqued conceptual frameworks in which duty-hour changes were cast as predictors of important outcomes, particularly frameworks employed by the IOM report and responses to it.

Conceptual frameworks "represent ways of thinking about a problem or a study, or ways of representing how complex things work the way they do." ³ They are important in research because they contribute to programmatic scholarship in which researchers share common approaches and can build upon each other's work. Every argument advanced in favor of or against changes in duty-hour regulations, as well as every research study that seeks to measure the impact of changes, involves an explicit or implicit conceptual framework that underlies the reasoning. Some conceptual frameworks may be applied in studies both favoring and opposing changes; for example, two articles may both use a conceptual framework based in sleep biology, but one may argue that detrimental performance resulting from sleep deprivation represents a threat to patient safety, while another may argue that the effect of sleep deprivation is not substantial enough to threaten patient safety. Other conceptual frameworks draw attention solely to either advantages or disadvantages of duty-hour regulations.

A conceptual framework typically specifies a set of relevant entities of study or action (such as actors, organizations, and outcomes), processes acting on these entities, and the presumed, observed, or predicted relationships between entities and processes.⁴ Each conceptual framework includes and focuses on certain entities, processes, and relationships and excludes others.

Conceptual frameworks may be based on theories, best practices, or models. *Theories* are distinguished by being evidence-based, explanatory, and predictive in nature ⁵. *Best practices* reflect observed relationships between entities that have not developed into the level of prediction that characterizes theory, often because they have been observed in limited settings or amidst confounding relationships. *Models* describe presumptive relationships between entities; when well-specified, they may be empirically tested, but conceptual frameworks based on models generally do not (yet) have evidence behind them.

In summary, conceptual frameworks may be based on

- theories, where reasoning is deductive, insight is based on evidence, and the frameworks are explanatory and predictive,
- best practices, where reasoning is inductive, insight is based on evidence, and the frameworks are descriptive, or
- models, where reasoning is deductive, insight is based on presumptions, and the frameworks are descriptive.

Sources of data

The first source of data was the IOM report itself, which constitutes an important literature review and source of conceptual frameworks in its own right. The second source of data was articles published in the period 2008-2010; these would not have been incorporated in the IOM report. One of us (CP), an experienced health science librarian, designed and conducted searches across multiple bibliographic databases,

such as BEME, CINAHL, EMBASE, PsycInfo, and PubMed. Searches used terms specific to the controlled vocabularies of each database (e.g. MESH) as well as keyword searches on "resident" and "work hours or duty hours."

Two of us (AS, GB) reviewed abstracts by hand to eliminate articles that did not focus on duty hours. The initial search was conducted in July 2009 and was supplemented by a second search using the same process conducted in April 2010. Because conceptual frameworks are often presented in theoretical articles, letters to editors, and position statements of organizations, we did not limit the search to traditional peer-reviewed articles.

Identification of conceptual frameworks

To be included in the review, articles must have explicitly described or argued for the effect of resident duty hours on an outcome. After eliminating articles that clearly did not address such an effect, we reviewed articles and the IOM report to identify outcomes following changes in resident duty hours. We broadly defined an *outcome* as any consequence of duty-hour changes that was studied, reported, predicted, presumed, or assumed in any of the texts reviewed. We repeatedly reviewed outcomes to combine similar outcomes and to organize the outcomes into a general taxonomy.

Following identification of outcomes, we reviewed articles again to identify conceptual frameworks that had been used implicitly or explicitly to describe the relationship between duty hours (or duty-hours regulations) and outcomes. Several of us reviewed the identified frameworks to confirm their structures. We resolved disagreements by discussion and consensus.

Results

Our search identified 239 articles that were reviewed in full. The number of relevant articles *retrieved* by each search for articles published between July 2009 and April 2010 and the number *included* in the review are shown in Supplemental Digital Appendix 1. Figure 1 illustrates the results of the search process. Supplemental Digital Appendix 2 lists all 239 articles we reviewed. Of those articles, 11 had appeared in early 2008 and were also cited in the IOM report. The two supplemental digital appendices may be found at [http://---\[THE JOURNAL WILL SUPPLY THE URL. I WILL SEND THE EDITED APPENDICES NO LATER THAN TOMORROW, 9-21\]-----](http://---[THE JOURNAL WILL SUPPLY THE URL. I WILL SEND THE EDITED APPENDICES NO LATER THAN TOMORROW, 9-21]-----)

-.

Conceptual frameworks

We identified 23 conceptual frameworks; a complete summary appears in Table 1. In this review, we focus only on those frameworks employed in the IOM report or across multiple publications.

Frameworks based on theory

Sleep deprivation. The IOM report incorporates multiple conceptual frameworks. The preface outlines its basic explicit conceptual framework, ^{2 (p xii)} in which the key outcome is patient safety. Fatigue reduces safety; sleep reduces fatigue; restricting duty hours can provide increased sleep, but will also increase handoffs, which may reduce safety. The IOM report emphasizes that more time for sleep, not merely reduced working hours, is predicted to result in reduced fatigue. This was also recognized by the ACGME investigators at the time of the 2003 regulations.⁶ The physiological effects of sleep deprivation in human beings have been studied extensively, and constitute the

theoretical basis of this conceptual framework (for example, see Gohar et al ⁷ and Mitchell et al ⁸ for research about sleep deprivation in residents).

“Swiss cheese.” Many industries consider the relationship between work hours and work errors using Reason's “Swiss cheese” conceptual framework,⁹ which posits that organizations erect multiple systems as barriers to error. Each system contains “holes” – opportunities for failure. When the holes of all the systems are aligned, error can occur. Residents have been conceptualized as one of the error-prevention systems employed by hospitals, and fatigue as a condition that may contribute to failure of this system.¹⁰ The Swiss cheese framework predicts when errors can occur and explains why stress on a single system (e.g. sleep-deprived residents) may not directly increase errors – for example, because of oversight by attending physicians.¹¹ Perneger¹² notes that users of the framework vary in their understanding of its entities and relationships.

Shift worker fatigue and risk. A set of conceptual frameworks focus on shift worker fatigue, shift worker risk, shift risk, long work hours, and day work versus night work. Night work reduces quality of sleep, overall health, and work-family balance in nurses; these observations may also apply to physicians.¹³ The 2006 National Occupation Research Agenda (NORA) Long Work Hours Team proposed a framework to study the impact of long working hours.¹⁴ Long hours result in less effective time for sleep and non-work activities and greater vulnerability to workplace hazards and demands. These, in turn, lead to fatigue, stress, and other conditions, which endanger workers, families, employers, and the community. Individual and job characteristics may moderate the impact of long work hours. A National Institute for Occupational Safety and Health review found that most studies reported increases in relative risk for accidents, higher

fatigue, and poorer cognitive performance among workers with longer shifts and longer work weeks.¹⁵

Folkard and others¹⁶⁻¹⁷ developed a risk index, by reviewing studies of predictors of accidents and injuries, that has been used to recommend shifts for doctors in the United Kingdom.¹⁸ Reducing total work hours decreases risk only when all else is equal; shift length, number of successive shifts, and rest periods have larger effects. They suggest setting limits on fatigue or risk levels, rather than on specific features of the work schedule. However, determining "acceptable" fatigue requires making tradeoffs, and measuring actual fatigue to assess fitness for duty is a complex problem.

Unique frameworks. Two theoretical frameworks that we identified only in single publications were (1) a theoretical model of resident-reported contributions to patient care mistakes¹⁰ and (2) the use of Ericsson's deliberate practice framework¹⁹ to focus on practice hours during resident activities.²⁰

Frameworks based on best practices

Three conceptual frameworks, presenteeism,²¹ hourly productivity,²² and preceptor relationships,²³ were based on best practices. However, each was employed in only a single article. These frameworks are not discussed in depth here; for further information, consult Table 1.

Frameworks based on models

Regulation is constraint ("One size does not fit all"). Many responses by organizations to proposed regulation of resident duty hours point out differences among specialties and among residents at different stages of training.^{11, 24-25} The American

Board of Surgery suggests that emergency care specialties require different working hours than elective care specialties and that working-hour restrictions should be relaxed as residents advance in training, to approach more closely what they will experience in practice.¹¹ The American Association of Directors of Psychiatric Residency Training (AADPRT) noted that the IOM report's recommendations will affect programs differently depending on their size and degree of financial support.²⁶ The AADPRT cautions that "one size does not fit all," echoing sentiments expressed about the 2003 ACGME regulations.²⁷ The American Gastroenterological Association highlights unique features of subspecialty fellowship services and proposes a conceptual framework in which intensity and nature of work determine duty-hour limitations.²⁸

A general underlying conceptual framework, "regulation is constraint," is used to argue that uniform regulations restrict the ability of residencies to innovate to improve clinical care and resident education.^{26, 29} Of course, regulations also limit the ability of residencies to overwork residents or institute changes detrimental to patient care. Several organizations^{11, 26} simultaneously argue against additional universal work-hour regulations and yet favor the existing uniform 80-hour limit; Higginson³⁰ suggests this inconsistency reveals a bias for the status quo.

Role of sleep deprivation. Several publications propose conceptual frameworks in which sleep deprivation is manageable, necessary, or an important symbol. The first we refer to as "Sleep-deprived practice is a skill." For example, a study of neurology residents demonstrated that sleepiness increased with call or night shifts, but cognitive performance did not decline; the authors conclude that "sleep-deprived neurology residents may be able to overcome sleep loss-related performance difficulties for short

periods."³¹ The American College of Surgeons²⁴ argues that residents are responsible for their sleep, capable of managing fatigue, and experience fatigue when they fail to regulate their personal and professional activities. It also assumes that residents must prepare to practice as attending physicians under conditions of extended duty hours and fatigue. However, research suggests that attending physicians may not have such practice patterns.³²⁻³³ Moreover, work-hour restrictions for attending physicians in the United States may be instituted in the future.³⁴⁻³⁵

A second variant of the framework is that sleep-deprived practice is evidence of commitment to patient needs over physician needs.^{13, 24, 36-37} Proponents suggest that duty-hour limits lead residents to see themselves as “shift workers” rather than responsible for a patient’s complete course of care.³⁸ However, the assumption that a shift worker cannot be a dedicated professional has been questioned.³⁹ Some note that attending physicians seem to practice within an 80-hour week with little concern for “shift mentality.”³²⁻³³ Sometimes, this model also incorporates the idea that sleep deprivation is a rite of passage in physician development.^{37, 40} Lopez and Katz⁴⁰ criticize this framework, noting that research suggests that habituation to stress leads to ethical erosion rather than to stronger professional identity.

Worker rights. The United Kingdom (UK) and European Union (EU) duty-hour regulations are based on the Community Charter of the Fundamental Social Rights of Workers, a conceptual framework emphasizing worker (physician) health, safety, and stress, rather than patient safety (although patient safety frameworks are also applied). Under the European Working Time Directive (EWTD), residents were limited to a working week of 58 hours (average) in 2004, 56 hours in 2007, and 48 hours beginning

August 2009. EWTD limits shift lengths to 13 hours with 20-minute breaks every 6 hours. As a result, traditional resident call is not feasible; 24-hour coverage is provided through two 13-hour or three 9-hour shift periods.¹⁸ Physicians may "opt out" of the EWTD.

Because of the recent EWTD 48-hour week, there has been little research to date with objectively measured outcomes. Claims of adverse effects are generally supported by citations to essays, position papers, and surveys of health care professionals.^{13, 41-43} A pilot study of 48-hour versus 56-hour schedules at one UK hospital found that amount of sleep did not differ; doctors in the 48-hour group reported worse educational opportunities but made significantly fewer medical errors.⁴⁴ A Finnish study found that patients in wards where physicians and nurses worked, on average, longer than 8.75 hours per day, were at over 3 times greater odds of hospital-acquired infections.⁴⁵ The Association of Surgeons in Training at the Royal College of Surgeons of England observed a reduction in operative cases performed by trainees and recommended a European Union of Medical Specialties proposal⁴⁶ to extend working hours to 48 hours of combined service and training and 12 hours of dedicated training time.⁴⁷

We also identified a more general "Ethical treatment of workers" framework. In the United States, the Committee of Interns and Residents of the Service Employees International Union supports the immediate implementation of the IOM report's recommendations to improve conditions for residents.⁴⁸ Residents in Québec, Canada, and their union filed a grievance arguing that 24-hour call schedules violate the Canadian Charter of Rights and Freedoms.⁴⁹

Fixed pie / zero sum. A common conceptual framework that we term *fixed-pie / zero-sum* assumes fixed resources (resident hours, residency program length, educational dollars, faculty hours, patients) and a simple interdependent equilibrium model. Thus, reduction of resident hours must be accompanied by an increase in another resource. The Orthopedic Trauma Association³⁸ expressed concerns about the potential of increased handoffs, greater faculty workload, and cross-coverage to reduce resident education and patient safety. They also noted the potential for longer training programs and increased monitoring costs, as do editorials in the *Journal of Clinical Sleep Medicine*^{50,51} and the American Osteopathic Association's response to a letter in their journal.⁵²

Another suggested response to fewer resident duty hours is to increase utilization of other health professionals as physician extenders so that non-educational patient care work is not performed by residents.^{24, 50, 53} Increased responsibility assigned to physician extenders may promote their recognition as important patient care professionals, but may also subject them to increased workloads. In Europe, advanced practice nurses have undertaken procedures such as cannulation, intubation, and prescribing. In turn, health care support workers substitute for nurses in patient comfort and support roles. An unanticipated consequence of duty-hour regulations may thus be increasing the medicalization of the nursing profession.⁴¹

The fixed-pie conceptual framework depends on the zero-sum assumption. If society will provide additional resources, or if innovations produce organizational slack,⁵⁴ the pie may be expandable, rather than fixed.

Degradation of skill. Many training organizations fear that reduced duty hours will translate into less skilled residents.²⁴ The most basic variation of this conceptual framework assumes that duty hours are spent primarily in educational activities. Reduction in duty hours reduces educational time, which leads to less skilled residents.^{25, 55-56} Duty-hour regulations have been in force for just barely long enough to see impact on trainees in normed examinations, and there is evidence of worse performance on one board examination among surgical residents trained since the 2003 regulations⁵⁷ (but see Froelich et al.⁵⁸ and Sneider et al.⁵⁹ for demonstrations of no difference in surgical in-training exam scores).

In the "covert" variation, the impact of duty-hour restrictions is masked by an additional clinical workload assumed by more senior trainees and attending physicians, for whom the work is less educational.¹¹ In the "self-assessment" variation, residents themselves perceive their lesser skill and increasingly seek subspecialty fellowships, effectively lengthening their training and increasing their debt.⁶⁰ This leads to fewer and less-skilled primary care physicians. Although there is as yet little evidence that supports a general lessening of resident skill, these frameworks suggest that such evidence may emerge in the next five years.

Compensatory improvement. Some IOM report recommendations employ an implicit conceptual framework that we term *compensatory improvement*. In this framework, hospitals strive to maintain an equilibrium position from which they can achieve their mission. Changes that threaten the mission (such as increasing handoffs leading to worse patient outcomes) induce the organization to apply resources to restore equilibrium. For example, the institution may implement new handoff systems

that increase continuity of care.^{2(p109)} This framework assumes that organizations can and will proactively improve in response to regulatory changes rather than simply meet requirements.

Professional role. Several conceptual frameworks have been proposed with roots in models of professional or societal ethics. Professional ethics is an essentially contested concept⁶¹; although everyone may agree on the basic structure of an ethic, differing assumptions may lead to wholly different entailments. For example, the professional ethics of medicine require physicians to place the needs of their patients ahead of their own. Opponents of additional duty-hour restrictions consider protected sleep (derisively, “nap time”) to be a physician need that should be subordinated to continuity of care, a patient need.^{11, 25} In contrast, restriction proponents consider a well-rested physician to be good for patients³⁹ and to promote empathy,³⁰ and they argue that the service needs of hospitals should be subject to this need.²⁸

Discussion

Summary of results

Conceptual frameworks vary in their ideological and empirical bases. Many are in opposition, some making directly contradictory predictions. For example, the “sleep deprivation” framework is often used to posit a beneficial patient impact from less fatigue, while the “degradation of skill” framework posits a detrimental impact from reduced physician skill as the result of fewer hours on duty. Key outcomes predicted by the conceptual frameworks reviewed are summarized in Table 2 and described below.

Conceptual frameworks focusing on *patient outcomes* either emphasize reduction in errors from better-rested residents or increases in errors from decreased continuity and increased handoffs. Recent large-scale studies comparing patient outcomes before and after the 2003 ACGME regulations find no effect, or small positive effects, of those regulations.⁶²⁻⁶⁴

Conceptual frameworks focusing on *resident outcomes* are frequently proposed and usually emphasize either improvements in health, safety, and quality of life for residents from increased sleep, or concerns about reduced educational opportunities and skill degradation. Other frameworks suggesting positive impacts of regulations (on empathy, worker rights) and negative impacts (on professional identity, patient ownership, post-residency practice) have also been espoused, but not studied extensively.

Conceptual frameworks focusing on *faculty outcomes* uniformly predict negative impacts from duty-hour changes. Conceptual frameworks focusing on *institutions or residencies* are often driven by the high expected costs of implementing the IOM report's recommendations. These costs may be partially recouped by society through increased patient safety, but significant costs will fall largely on training programs. Without additional resources, educational missions may be jeopardized, and smaller programs may face a crisis of viability. Conceptual frameworks focusing on the activities of *other health professionals* note the increased workload likely to fall on physician extenders in order to implement the IOM report's recommendations.

Limitations

There are several limitations to our review. We focus on conceptual frameworks raised in the IOM report or in subsequent literature published after or in response to the report. Accordingly, we may not have identified the complete universe of conceptual frameworks that have been employed in this discourse since the earliest discussions of duty-hour restrictions in graduate medical education. As a consequence, we focus on the existence, rather than the prevalence, of the frameworks we identify. Our identification of frameworks is a subjective process, and although we confirmed findings through review of multiple investigators, it is possible that our own biases might have caused us to specify a framework incorrectly or fail to identify additional frameworks. Our own conceptual framework for the study of frameworks is likely to illuminate some aspects of the greater discourse and conceal others.

Conclusion: Gaps in the discourse and directions for future study

The concept of *duty hours* itself is contested. As shown in Figure 2, residents engage in a variety of activities (inner circle), including uninterrupted protected sleep, interruptible rest (e.g., home call or call room), patient care tasks with low educational value (e.g., "scut"), patient care tasks with high educational value, non-patient educational activities (e.g., didactic conferences or practice with simulators), and administrative activities. Whether non-patient educational activities and on-call rest are duty hours is controversial enough to have spawned legal cases in the European Court⁶⁵ and proposals for distinguishing "purely training" hours from "combined service and training hours."⁴⁶ In addition, residents and program directors vary in their understanding of the ACGME guidelines.⁶⁶ Concerns about the balance of education and service for

housestaff have a long history in medicine and remain an important unresolved issue in medical education.⁶⁷⁻⁶⁸ Theories of fatigue suggest that fatigue and risk depend on the relationship between hours worked and the content of the work. The nature of this relationship, as well as methods of measurements of work intensity and consequent fatigue, need further study.

Much research in and since the IOM report focuses on isolated outcomes of duty-hour changes. Few conceptual frameworks we identified posit mediational relationships or address endogenous changes in residency choice or work patterns as a result of new regulations. For example, reconfiguring duty hours is expected to reduce fatigue and thus enhance resident learning,² but is also expected to reduce opportunities to practice and thus could degrade resident learning.^{29, 38, 69}

There is a dearth of frameworks that provide models for the net tradeoffs between key outcomes such as patient safety, resident safety, resident education, resource costs, and quality of life for resident and attending physicians (Nuckols et al.⁷⁰ is a notable exception). Investigations should be designed to guide the development of a theory of the relationships between outcomes, which may not be simply additive.

To recommend policy, we must understand not only the inherent tradeoffs, but also the *value* society places on such tradeoffs, and its willingness to pay to maximize value. As an extreme example, a society that values safety above all might spend lavishly to institute overlapping short shifts and extend residency by several years. Studying societal values is time-consuming. Rigorous short-term, practice-based research on innovative implementation of duty-hour changes is also necessary.⁷¹

Duty hours are likely to be regulated in some fashion for the conceivable future. The rationale, implementation, and evaluation of different approaches to the work time of residents (and, potentially, students and attending faculty), however, will continue to be an important focus of debate in medical education and practice. We believe that there is value for residents, program directors, and society as a whole in defining – and in some cases broadening – the terms and understanding this debate.

Conceptual frameworks underlie arguments about the impact of duty-hour changes. They frame assumptions about research hypotheses and designs to develop evidence about these hypotheses. Despite their importance, the conceptual frameworks our study revealed were often implicit, serving as a backdrop to argument and research rather than receiving attention themselves. We encourage researchers and advocates to make their conceptual frameworks explicit and to detail their bases, workings, and implications. Such practices will help researchers position their work in relation to other studies, better select key variables for their investigations, and foster knowledge-building.

Funding/Support: This study was funded in part by a contract from the Accreditation Council for Graduate Medical Education to the Department of Medical Education at the University of Illinois at Chicago (Schwartz, PI). The sponsor had no role in the design and conduct of the study, collection, management, analysis, and interpretation of the data, or preparation, review, or approval of the report. All authors had full access to all the data in the study and take responsibility for the integrity of the data and the accuracy of the data analysis.

Other disclosures: Dr. Schwartz serves as a consultant to the American Board of Pediatrics and Association of Pediatric Program Directors on projects unrelated to the subject of this report. Dr. Bashook serves as a consultant to the Royal College of Dentists of Canada on projects unrelated to the subject of this report, and is a partner in an educational consulting company.

Ethical approval: Not applicable

Previous presentations: Earlier versions of this report, or data from it, have been used in a commissioned report to the Accreditation Council for Graduate Medical Education in 2009, in an invited presentation for the University of Illinois at Chicago Department of Medical Education in 2010, and in an invited seminar in 2010 as part of the University of Chicago Department of Medicine Research in Medical Education Seminar Series.

References

1. Accreditation Council for Graduate Medical Education. *Common program requirements for duty hours*. Chicago, IL: ACGME; 2003.
http://www.acgme.org/acWebsite/dutyHours/dh_ComProgrRequirmentsDutyHours0707.pdf.
Accessed September 20, 2010.
2. Institute of Medicine. *Resident Duty Hours: Enhancing Sleep, Supervision, and Safety*. Washington, D.C.: The National Academies Press; 2009.
3. Bordage G. Conceptual frameworks to illuminate and magnify. *Med Educ*. 2009;43:312-319.
4. Rocco TS, Plakhotnik MS. Literature reviews, conceptual frameworks, and theoretical frameworks: Terms, functions, and distinctions. *Human Resource Development Review*. 2009;8(1):120.
5. Reyna VF. Theories of medical decision making and health: An evidence-based approach. *Med Decis Making*. November 1, 2008 2008;28(6):829-833.
6. Baldwin DC, Jr., Daugherty SR. Sleep deprivation and fatigue in residency training: Results of a national survey of first- and second-year residents. *SLEEP*. 2004;27(2):217-223.
7. Gohar A, Adams A, Gertner E, et al. Working memory capacity is decreased in sleep-deprived internal medicine residents. *Journal of Clinical Sleep Medicine*. 2009;5(3):191-197.
8. Mitchell CD, Mooty CR, Dunn EL, Ramberger KC, Mangram AJ. Resident fatigue: Is there a patient safety issue? *Am J Surg*. 2009;198(6):811-816.
9. Reason J. *Human Error*. New York: Cambridge University Press; 1990.
10. Fletcher KE, Parekh V, Halasyamani L, et al. Work hour rules and contributors to patient care mistakes: A focus group study with internal medicine residents. *Journal of hospital medicine (Online)*. May 2008;3(3):228-237.

11. Lewis FR. Comment of the American Board of Surgery on the recommendations of the Institute of Medicine Report, "Resident Duty Hours: Enhancing Sleep, Supervision, and Safety." *Surgery*. 2009;146(3):410-419.
12. Perneger TV. The Swiss cheese model of safety incidents: Are there holes in the metaphor? *BMC Health Services Research*. 2005;5(1):71.
13. Bamford N, Bamford D. The effect of a full shift system on doctors. *Journal of Health Organization and Management*. 2008;22(3):223-237.
14. Caruso CC, Bushnell T, Eggerth D, et al. Long working hours, safety, and health: Toward a National Research Agenda. *American Journal of Industrial Medicine*. 2006;49(11):930.
15. Caruso CC, Hitchcock E, Dick R, Russo J, Schmit J. *Overtime and Extended Work Shifts: Recent Findings on Illnesses, Injuries, and Health Behaviors*: U.S. Department of Health and Human Services (NIOSH); 2004. 2004-143.
16. Folkard S, Lombardi D. Modeling the impact of the components of long work hours on injuries and accidents. *American Journal of Industrial Medicine*. 2006;49(11).
17. QinetiQ Centre for Human Sciences, Simon Folkard Associates Limited. *The development of a fatigue/risk index for shiftworkers*. United Kingdom: Health and Safety Executive; 2006.
18. Horrocks N, Pounder R. *Designing Safer Rotas for Junior Doctors in the 48-Hour Week*. London, UK: Royal College of Physicians of London; 2006.
19. Ericsson KA. Deliberate practice and the acquisition and maintenance of expert performance in medicine and related domains. *Acad Med*. October 2004;79(10 Supplement):S70-S81.
20. Omahen DA. The 10,000-hour rule and residency training. *CMAJ: Canadian Medical Association journal = journal de l'Association medicale canadienne*. Jun 9 2009;180(12):1272.
21. Nielsen BW, Allen TL. Presenteeism, A Novel Concept Five Years after Duty Hour Restrictions. *Council on Resident Education in Obstetrics and Gynecology*. San Diego, CA; 2009.

22. Jeanmonod R, Jeanmonod D, Ngiam R. Resident productivity: Does shift length matter? *The American Journal of Emergency Medicine*. Sep 2008;26(7):789-791.
23. 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: the official journal of the Ambulatory Pediatric Association*. Sep-Oct 2007;7(5):348-353.
24. Britt LD, Sachdeva AK, Healy GB, Whalen TV, Blair PG. Resident duty hours in surgery for ensuring patient safety, providing optimum resident education and training, and promoting resident well-being: A response from the American College of Surgeons to the Report of the Institute of Medicine, "Resident Duty Hours: Enhancing Sleep, Supervision, and Safety". *Surgery*. 2009;146(3):398-409.
25. Borman KR, Fuhrman GM. "Resident Duty Hours: Enhancing Sleep, Supervision, and Safety": Response of the Association of Program Directors in Surgery to the December 2008 Report of the Institute of Medicine. *Surgery*. 2009;146(3):420-427.
26. Greenberg W, Faulkner L, Kaye D, Roberts L. (Letter from AADPRT to ACGME of April 29, 2009). 2009; http://www.aadprt.org/news/acgme/aadrpt_letter_to_acgme_050909.pdf. Accessed July 1, 2009.
27. Baldwin DC, Jr., Daugherty SR, Tsai R, Scotti MJ, Jr. A national survey of residents' self-reported work hours: thinking beyond specialty. *Academic Medicine*. Nov 2003;78(11):1154-1163.
28. Katzka DA, Proctor DD. The GI fellowship viewpoint. *Gastroenterology*. Apr 2009;136(4):1147-1148.
29. Grady MS, Batjer HH, Dacey RG. Resident duty hour regulation and patient safety: establishing a balance between concerns about resident fatigue and adequate training in neurosurgery. *J Neurosurg*. 2009;110(5):828-836.

30. Higginson JD. Perspective: limiting resident work hours is a moral concern. *Academic Medicine*. Mar 2009;84(3):310-314.
31. Reimann M, Manz R, Prieur S, Reichmann H, Ziemssen T. Education research: cognitive performance is preserved in sleep-deprived neurology residents. *Neurology*. 2009;73(21):e99-e103.
32. Anim M, Markert RJ, Wood VC, Schuster BL. Physician practice patterns resemble ACGME duty hours. *The American Journal of Medicine*. Jun 2009;122(6):587-593.
33. Cyr-Taro AE, Kotwall CA, Menon RP, Hamann MS, Nakayama DK. Employment and satisfaction trends among general surgery residents from a community hospital. *Journal of surgical education*. Jan-Feb 2008;65(1):43-49.
34. Hyman NH. Attending work hour restrictions: is it time? *Archives of surgery*. Jan 2009;144(1):7-8.
35. Sataloff RT. Resident duty hours: Concerns and consequences. *Ear, nose, & throat journal*. Mar 2009;88(3):812-816.
36. Cass H, Smith I, Unthank C, Starling C, Collins J. Improving compliance with requirements on junior doctors' hours. *BMJ Publishing Group Ltd.*; 2003; 327(7409):270-273. (Erratum in *BMJ* 2003;327:586)
37. Charap M. Reducing resident work hours: Unproven assumptions and unforeseen outcomes. *Annals of Internal Medicine*. May 18 2004;140(10):814-815.
38. Anglen JO, Bosse MJ, Bray TJ, et al. The Institute of Medicine report on resident duty hours. Part I: The Orthopaedic Trauma Association response to the report. *The Journal of bone and joint surgery.American volume*. Mar 1 2009;91(3):720-722.
39. Dembe A. Ethical issues relating to the health effects of long working hours. *Journal of Business Ethics*. 2009;84:195-208.

40. Lopez L, Katz JT. Perspective: creating an ethical workplace: reverberations of resident work hours reform. *Academic Medicine*. Mar 2009;84(3):315-319.
41. Wilkinson C. Junior doctors' working hours: Perspectives on the reforms. *International Journal of Nursing Practice*. 2008;14:200-214.
42. Wade R, Henderson J. Perceived impact of EWTD on UK doctors. *Bulletin of The Royal College of Surgeons of England*. 2009;91(4):132-134.
43. Mann S. The evolution of restricted hours of duty for resident medical officers in New Zealand: a personal view. *Clinical medicine (London, England)*. Nov-Dec 2005;5(6):650-652.
44. Cappuccio FP, Bakewell A, Taggart FM, et al. Implementing a 48 h EWTD-compliant rota for junior doctors in the UK does not compromise patients' safety: Assessor-blind pilot comparison. *QJM: monthly journal of the Association of Physicians*. Apr 2009;102(4):271-282.
45. Virtanen M, Kurvinen T, Terho K, et al. Work hours, work stress, and collaboration among ward staff in relation to risk of hospital-associated infection among patients. *Medical Care*. Mar 2009;47(3):310-318.
46. Benes V. The European Working Time Directive and the effects on training of surgical specialists (doctors in training). *Acta Neurochirurgica*. 2006;148(9):1020-1026.
47. Marron C, Shah J, Mole D, Slade D. ASIT Opinion on the European Working Time Directive (EWTD). *The Association of Surgeons in Training at the Royal College of Surgeons of England. London, UK*. 2006.
48. Committee of Interns and Residents/SEIU Healthcare. Not whether, but how...Not if, but when: Time to act on the Institute of Medicine recommendations on patient and resident physician safety. 2009. <http://www.cirseiu.org/assets/assetcontent/a96df179-53ca-4706-8a8a-7f3002566263/546bfa9e-94e2-495f-9d30-54cc81f55e47/eb970c2d-2504-430a-86b3-b8c766a595c4/1/CIR%20IOM%20Position%20Paper.pdf>. Accessed September 20, 2010.

49. Eggertson L. Residents claim 24-hour call violates Charter rights. *CMAJ: Canadian Medical Association journal = journal de l'Association medicale canadienne*. Apr 28 2009;180(9):918.
50. Blatman KH. The Institute of Medicine resident work hours recommendations: A resident's viewpoint. *Journal of clinical sleep medicine: JCSM: official publication of the American Academy of Sleep Medicine*. Feb 15 2009;5(1):13.
51. Meinke L. The Institute of Medicine resident work hours recommendations: A program director's viewpoint. *Journal of clinical sleep medicine: JCSM: official publication of the American Academy of Sleep Medicine*. Feb 15 2009;5(1):12.
52. Conklin JH. AOA should support IOM report on resident work hours. *J Am Osteopath Assoc*. 2010;110(3):111-193.
53. Pezzi C, Leibrandt T, Suryadevara S, Heller JK, Hurley-Martonik D, Kukora JS. The present and future use of physician extenders in general surgery training programs: one response to the 80-hour work week. *J Am Coll Surg*. 2009;208(4):587-591.
54. Bourgeois LI. On the measurement of organizational slack. *Acad Manage Rev*. 1981:29-39.
55. Christmas AB, Brintzenhoff RA, Sing RF, et al. Resident work hour restrictions impact chief resident operative experience. *Am Surg*. 2009;75(11):1065-1068.
56. 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. *J Thorac Cardiovasc Surg*. 2009;137(3):710-713.
57. Jagannathan J, Vates GE, Pouratian N, et al. Impact of the Accreditation Council for Graduate Medical Education work-hour regulations on neurosurgical resident education and productivity. *Journal of Neurosurgery*. 2009;110(5):820-827.

58. 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.
59. Sneider EB, Larkin AC, Shah SA. Has the 80-hour workweek improved surgical resident education in New England? *Journal of Surgical Education*. 2009;2009(66):3.
60. Moalem J, Brewster L, James T. Position statement on further work hour restrictions: The views of current and recent trainees. *Surgery*. 2009;146(3):428-429.
61. Gallie WB. Essentially contested concepts. *Proceedings of the Aristotelian Society*. 1955; 56:167-198.
62. Morrison CA, Wyatt MM, Carrick MM. Impact of the 80-hour work week on mortality and morbidity in trauma patients: an analysis of the National Trauma Data Bank. *J Surg Res*. 2009;154(1):157-162.
63. Pape HC, Pfeifer R. Restricted duty hours for surgeons and impact on residents quality of life, education, and patient care: a literature review. *Patient Safety in Surgery*. 2009;3(1):3.
64. 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(2):316-321.
65. Mommaerts M. The European working time directive - Facts and issues. *Journal of Cranio-Maxillofacial Surgery*. 2009;37(2):110-112.
66. Schlueter ME, Phan PH, Martin CS, Breece D, Boysen DA. Understanding Accreditation Council for Graduate Medical Education (ACGME) guidelines: resident and program director interpretations of work-hour restrictions. *Journal of Surgical Education*. 2009;66(6):374-378.

67. Ludmerer K. *Time to Heal: American Medical Education from the Turn of the Century to the Era of Managed Care*: Oxford University Press, USA; 1999.
68. Cooke M, Irby DM, O'Brien BC. *Educating Physicians: A Call for Reform of Medical School and Residency*. San Francisco: Josey-Bass - The Carnegie Foundation for the Advancement of Teaching; 2010.
69. Jasti H, Hanusa BH, Switzer GE, Granieri R, Elnicki M. Residents' perceptions of a night float system. *BMC Medical Education*. 2009;9:52.
70. Nuckols TK, Bhattacharya J, Wolman DM, Ulmer C, Escarce JJ. Cost implications of reduced work hours and workloads for resident physicians. *The New England Journal of Medicine*. 2009;360(21):2202-2215.
71. Volpp KG, Landrigan CP. Building physician work hour regulations from first principles and best evidence. *JAMA*. September 10, 2008 2008;300(10):1197-1199.

[Figure Legends]

Figure 1 The process for choosing the articles included in this report's analysis.

Figure 2 Resident activities, and types of hours potentially subject to regulation.

Resident time can be divided into at least six kinds of activities (inner circle) and combinations of these activities may represent different definitions of working hours (outer arrows).

Table 1

The Twenty-Three Conceptual Frameworks Identified in the Present Review *

Name of framework [†]	Predictors	Outcomes	Relationships highlighted in the framework
Frameworks based on theory			
Sleep deprivation ²	Quantity and quality of sleep General human performance	Resident skills	Lack of quality sleep leads to worse performance. Changes in duty hours can increase quality sleep and improve performance.
Swiss cheese ^{8-9,58}	Hazards Systems to prevent harm (the “cheese”) Active failures and latent conditions allowing failure (“holes” in the cheese) Resident fatigue as a particular limitation of the health care system	Patients’ medical outcomes	Safety is compromised when multiple systems fail simultaneously. Fewer duty hours lead to less resident fatigue, which limits the chance of the resident system failing at the same time other systems fail.
Day vs. night work ¹²	Start and end times of work shifts	Resident quality of life	Night work leads to lower-quality sleep, worse health, and less work/family balance.

Name of framework †	Predictors	Outcomes	Relationships highlighted in the framework
National Occupation Research Agenda Long Work Hours Team framework ¹³	<p>Work hours and other schedule characteristics</p> <p>Availability of time for recovery and non-work activities</p> <p>Exposure to job demands and hazards</p> <p>Worker characteristics and job characteristics</p>	<p>Workers, immediate negative outcomes: Reduced/disturbed sleep, fatigue, stress, negative mood, dysfunction</p> <p>Long-term outcomes: Workers' quality of life, workers' family members' quality of life, institutional productivity and injury costs, patient /community safety</p>	<p>(1) Work hours and schedule result in reduced time for recovery and non-work activities as well as greater exposure to job demands and hazards.</p> <p>(2) Reduced time for recovery/non-work and exposure to job demands/hazards lead to immediate negative outcomes.</p> <p>(3) These contribute to multiple long-term adverse outcomes for workers, family, employers, and community.</p> <p>Relationships (2) and (3) are moderated by worker and job characteristics.</p>
National Institute for Occupational Safety and Health report ¹⁴	<p>12-hour or longer, including "on-call" shifts vs. 8-hour shifts</p>	<p>Worker safety, illness, health behaviors</p> <p>Worker performance</p>	<p>Relative to 8-hour shifts, overtime, extended duty, and on-call schedules were associated with more illness and injury, worse health behaviors, and lower performance.</p>
Shift risk ¹⁵	<p>Relative risk for first shift in the span RR_T</p> <p>Additional risk for number of successive shifts CR_N</p> <p>Additional risk for length of shifts CR_L</p> <p>Additional risk for interval between breaks CR_B</p>	<p>Worker relative risk of accident or incident for a given span of shifts, denoted RR_S. Risk is relative to five 8-hour day shifts with a single mid-shift break.</p>	<p>$RR_S = RR_T + CR_N + CR_L + CR_B$</p>

Name of framework †	Predictors	Outcomes	Relationships highlighted in the framework
Shift worker fatigue ¹⁶⁻¹⁷	<p>Cumulative fatigue C, based on complete pattern of shift schedules</p> <p>Duty timing T, based on when a particular shift starts and ends</p> <p>Job type/breaks J, based on shift content including activity and breaks</p> <p>Each modeled, and varies from 0-1</p>	<p>Resident fatigue, specifically average probability of a high score on the Karolinka Sleepiness Scale</p>	$FI = 100 [1 - (1 - C)(1 - J - T)]$
Shift worker risk ¹⁶⁻¹⁷	<p>Cumulative fatigue C, based on complete pattern of shift schedules</p> <p>Duty timing T, based on when a particular shift starts and ends</p> <p>Job type/breaks J, based on shift content including activity and breaks</p> <p>Each modeled, and varies from 0-1</p>	<p>Resident relative risk of accident on a particular shift</p>	$RI = C * J * T$

Name of framework †	Predictors	Outcomes	Relationships highlighted in the framework
Resident-reported contributors to patient care mistakes ⁹	<ul style="list-style-type: none"> Resident quality of life Patient continuity of care Institution entropy Resident handoffs Resident experience Resident workload Professional work ethic Resident fatigue 	Patient safety	<p>Duty-hour changes lead to unintended consequences of less time in hospital and improved resident well-being.</p> <p>Duty-hour changes lead to unintended consequences of more discontinuity and duty hours themselves as a goal.</p> <p>Improved well-being mitigates factors that lead to patient care mistakes; other consequences aggravate these factors.</p>
Deliberate practice ¹⁸⁻¹⁹	Hours of deliberate practice	Resident education	Reduced duty hours overall can be compensated for by increasing the proportion of time spent in learning
Frameworks based on best practices			
Presenteeism ²⁰	<ul style="list-style-type: none"> Workload Available coverage Professional work ethic 	<ul style="list-style-type: none"> Resident safety Patient medical outcomes 	<p>Residents with a strong work ethic and a high work load relative to available coverage will attempt to work even when they are sick.</p> <p>Reporting to work sick leads to risk of contagion for other residents and patients.</p>
Hourly productivity ²¹	<ul style="list-style-type: none"> Length of shifts Patients seen per shift hour 	<ul style="list-style-type: none"> Resident case volume per rotation Institutional patient admissions 	<p>Medium-length shifts (e.g. 9 hours) increase resident hourly productivity.</p> <p>Increased hourly productivity results in a greater number of patients seen overall and per-resident.</p>

Name of framework †	Predictors	Outcomes	Relationships highlighted in the framework
Preceptor relationship ²²	Number of different preceptors, e.g., continuity clinic	Faculty satisfaction	Duty-hour restrictions increase the total number of preceptors residents work with to accommodate scheduling needs. Preceptors feel less attached to individual residents and less satisfied with their relationships.
Frameworks based on models			
Regulation is constraint, aka “One size does not fit all” ^{25, 28} , and many other organizational responses	Rigidity of regulation enforcement Flexibility within regulations	Institutions’ ability to adapt, innovate	Rigid constraints limit movement (innovation) to within the constraints. If constraint is too tight, movement within the constraints may not be sufficient for innovation.
Successful sleep-deprived practice is a skill		Resident skills	The ability to practice successfully without adequate rest is learnable and improves through experience in such practice.
Sleep-deprived practice is evidence of commitment ^{36, 38}		Resident professionalism	A physician demonstrates dedication through caring for patients regardless of his/her personal discomfort and needs, including fatigue. Practice is often connected to sleep-deprivation as a rite of passage in the development of a physician.
Community Charter of the Fundamental Social Rights of Workers (1989, basis of the 1993 EU Working Time Directive 93/104/EC; doctors in training included as workers by amendment 2000/34/EC)		Resident safety	Excessive work hours reduce worker safety and health, which are fundamental social rights.

Name of framework †	Predictors	Outcomes	Relationships highlighted in the framework
Ethical treatment of workers ³⁷	<p>Resident safety</p> <p>Societal ethics</p> <p>Patient safety</p>	<p>Extended duty may be coercive and deceptive and thus unethical treatment of workers, and may lead to inequities in the labor market.</p> <p>There is a societal interest in protecting workers.</p> <p>The medical profession's ethics prohibit practice in ways that would cause harm to patients.</p>	<p>Total residency resources – funding, hours, years, attending time – are fixed.</p> <p>Reduced hours will need to be made up for by shifting funding from education to clinical care (e.g., to hire physician extenders), or teaching time from attending physicians, or by increasing residency length.</p>
Fixed pie / zero-sum (Conceptual framework used in many organizational responses)	<p>Funding available for residency program</p> <p>Resident hours available to see clinical cases</p> <p>Length of residency program in years</p> <p>Time available to attending physicians to teach</p>	<p>Resident education</p> <p>Institution cost to residency program</p>	<p>Residents are receiving less training time and becoming less skilled.</p> <p>Patient outcomes have been maintained because faculty have taken over work previously done by residents.</p> <p>When residents eventually become faculty, however, patient outcomes will decline; alternatively, residents will recognize their limits and be more likely to see subspecialty training, leaving the least prepared residents to become attending physicians in primary care.</p>
Degradation of skill ^{35,45,59}	<p>Resident skills</p> <p>Patient medical outcomes</p>		

Name of framework †	Predictors	Outcomes	Relationships highlighted in the framework
Compensatory improvement ²	Number of handoffs Health care organizations Continuity of care Patient safety	Patient medical and non-medical outcomes	Decreased duty hours increase handoffs. Increased handoffs result in decreased continuity of care, which results in risks to patient safety. Health care organizations wishing to maintain safety will devise improved mechanisms for maintaining continuity across handoffs.
Professional role (aka "shift-worker mentality") ^{12,34-35}	Professional attitude putting needs of the patient before those of the physician	Resident professional behavior, ethical development Patient continuity of care	Arbitrary limits on duty hours lead residents to see themselves as shift workers, not as responsible for a patient's complete course of care. Residents may be ill-prepared for independent practice post-residency.
Empathy ²⁹	Resident quality of life	Resident professionalism	Rest and work/life balance lead to an appreciation of life. Appreciation of life leads to increased empathy with suffering of others. Empathy is a defining characteristic of a physician.

* *Conceptual frameworks* are approaches to a research problem that specify key entities and their relationships. They are important in research because they contribute to programmatic scholarship in which researchers share common approaches and can build upon each other's work. Every argument advanced in favor of or against changes in duty-hour regulations, as well as every research study that seeks to measure the impact of changes, involves an explicit or implicit conceptual framework that underlies the reasoning.

† Superscripted numbers refer to citations in the reference list that is part of this report.

Table 2

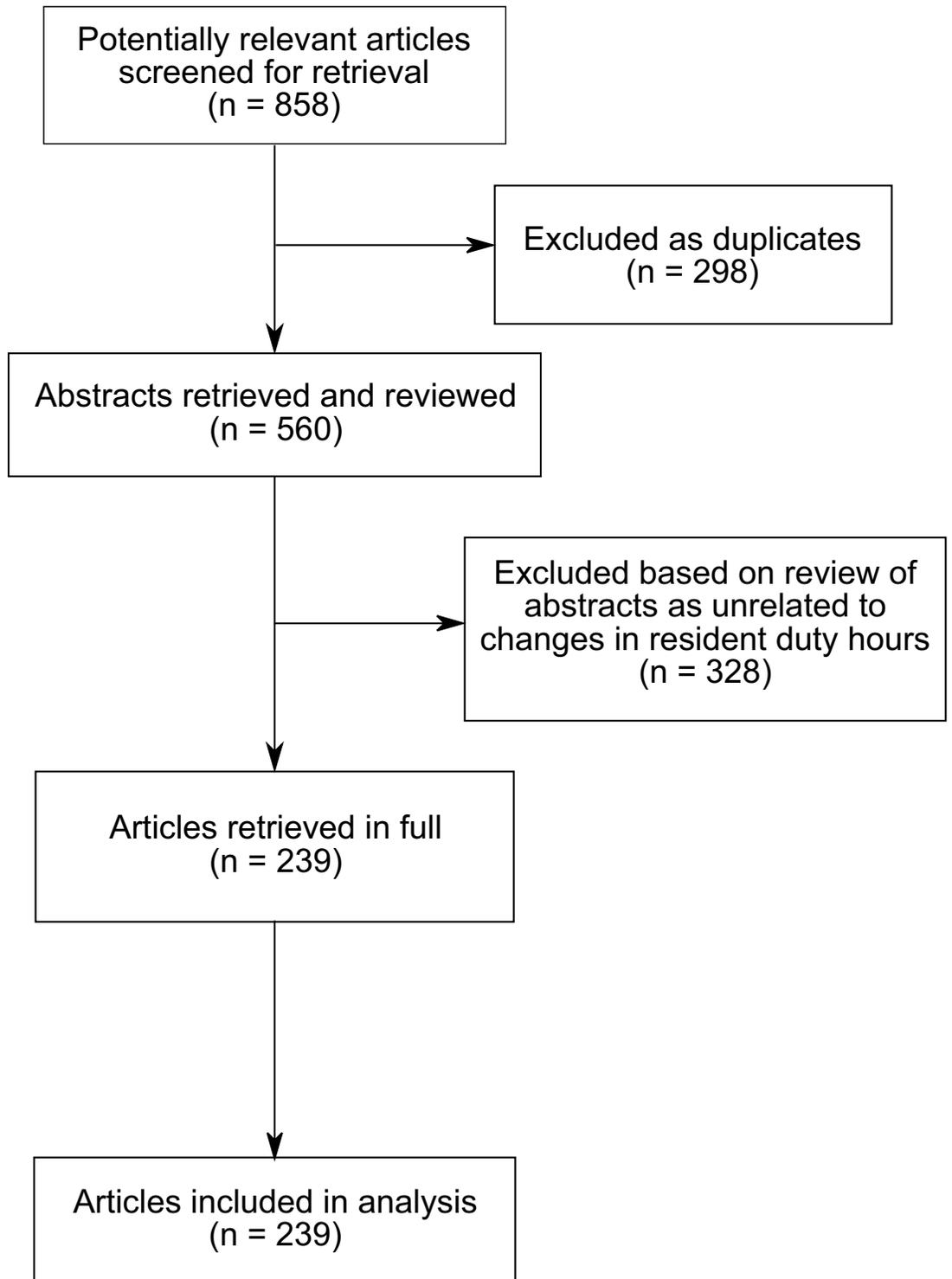
Direction of Key Outcomes Predicted by the Three Types of Conceptual Frameworks Identified in the Present

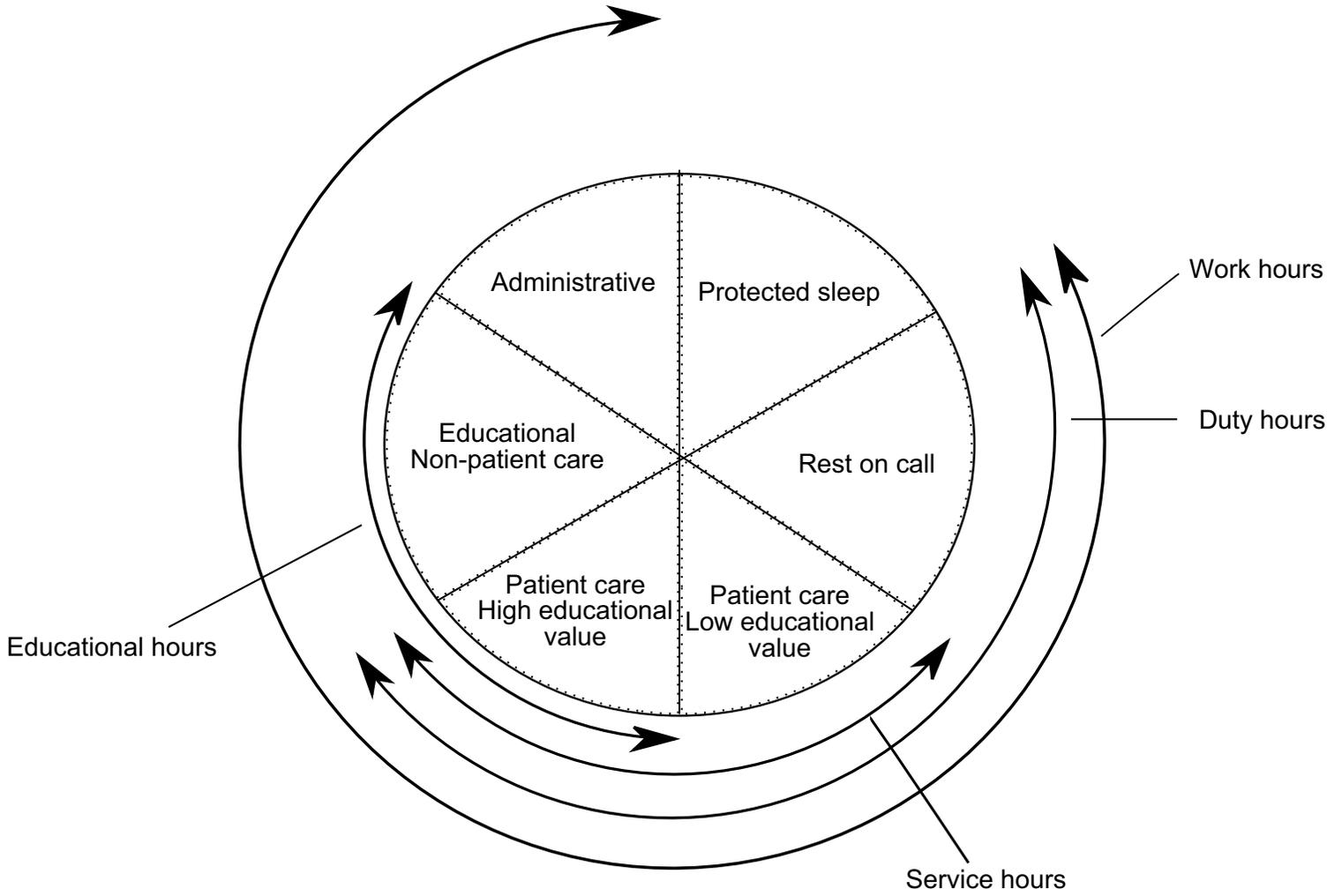
Review *

Type of framework	Patient outcomes	Resident outcomes	Faculty outcomes	Institution outcomes	Outcomes affecting other health professions
Based on theory	↓Error from fatigue	↓Accidents ↓Sleepiness ↓Practice ↓Skills	NA	↑Costs	NA
Based on best practices	NA	↑Productivity ↑Quality of life (rest) ↓Quality of life (night shifts) ↑Presenteeism	↓Preceptor relationships ↓Quality of life (Workload)	↑Productivity	↑Workload
Based on models	↑Quality of handoffs (compensatory improvement) ↓Continuity ↑Handoffs	↑Empathy ↑Rights ↓Commitment ↓Ownership ↓Post-residency practice	↓Future skill ↓Skilled primary care physicians	↓Resources for education ↓Sustainability of small programs	↑Autonomy ↑Medicalization

* *Conceptual frameworks* are approaches to a research problem that specify key entities and their relationships. They are important in research because they contribute to programmatic scholarship in which researchers share common approaches and can build upon each other's work. Every argument advanced in favor of or against changes in duty-hour

regulations, as well as every research study that seeks to measure the impact of changes, involves an explicit or implicit conceptual framework that underlies the reasoning.





Supplemental Digital Appendix 1

Data sources, literature review strategy, and results for searching the published literature (searches conducted in July 2009 and April 2010, combined)

Data source	Search strategy	Retrieved	Included
BEME	"Find on page" search for the term "80"	0	0
CINAHL	keyword search of resident AND 80 hours	1	1
COCHRANE database of systematic reviews	"ACGME" in title, abstract, or keywords ("resident" in abstract or "registrar" in abstract) and "duty" in abstract and "hour" in abstract and "restriction" in abstract	17	0
Conference Papers Index	residents AND 80 AND hours	9	1
Dissertations and Theses	(residents) AND (80) AND (hours) (residents) AND (work hours)	39	2
EMBASE	resident AND 80 hours limited to human and 2008-2010	6	6
EMBASE	(workload OR "work schedule" OR "work schedule tolerance" OR fatigue OR "mental fatigue" OR "work hours" OR "personnel staffing" OR scheduling) AND (sleep OR "sleep deprivation" OR "sleep disorder" OR "circadian rhythm" OR chronobiology) AND (residency OR "education, medical, graduate" OR "internship and residency" OR "night float"), limited to 2005-2010	170	167
ERIC	exp Graduate Medical Education/ limited to yr "2007 - 2010"	58	0
Proceedings First	Residents AND 80 hours	2	0
PsycInfo	residents and 80 and hours limited to 2008-2010	43	18
PubMed	(80 hour AND residents)	297	119
PubMed	Related articles search related to Fletcher et al., and related articles on relevant related articles	94	94
PubMed	(workload OR "work schedule" OR "work schedule tolerance" OR fatigue OR "mental fatigue" OR "work hours" OR "personnel staffing" OR scheduling) AND (sleep OR "sleep deprivation" OR "sleep disorder" OR "circadian rhythm" OR chronobiology) AND (residency OR "education, medical, graduate" OR "internship and residency" OR "night float"), limited to 2008-2010	34	34
Web of Science (Current Contents)	"80 hours"AND medical AND education + related articles search on relevant articles, limited to 2008-2010	27	24
Overall	All above combined, duplicate articles removed, limited to 2008-2010		239

Supplemental Digital Appendix 2

Literature published in 2008-2010 and reviewed

1. Restrictions on resident work-hours: Responses from organizations representing surgery. (2009). *Surgery*, 146(3), 397-397.
2. Alshekhlee, A., Walbert, T., DeGeorgia, M., Preston, D. C., Furlan, A. J. (2009). The impact of Accreditation Council for Graduate Medical Education duty hours, the July phenomenon, and hospital teaching status on stroke outcomes. *Journal of Stroke and Cerebrovascular Diseases*. 18(3), 232-238.
3. American College of Surgeons Task Force on the Resident 80-hour Work Week. (2009). Position of the American College of Surgeons on Restrictions on Resident Work Hours. *Bulletin of the American College of Surgeons*, 94(1), 11-18.
4. Anglen, J. O., Bosse, M. J., Bray, et al. (2009). The Institute of Medicine report on resident duty hours. Part I: The Orthopaedic Trauma Association response to the report. *The Journal of Bone and Joint Surgery. American volume*, 91(3), 720-722.
5. Anim, M., Markert, R. J., Wood, V. C., Schuster, B. L. (2009). Physician practice patterns resemble ACGME duty hours. *The American Journal of Medicine*, 122(6), 587-593.
6. Arora, V. M., Georgitis, E., Siddique, J., et al. (2008). Association of workload of on-call medical interns with on-call sleep duration, shift duration, and participation in educational activities. *JAMA*. 300(10), 1146-1153.
7. Arora, V., Meltzer, D. (2008). Effect of ACGME duty hours on attending physician teaching and satisfaction. *Archives of Internal Medicine*, 168(11), 1226-1228.
8. Ayalon, L. (2008). Subjective socioeconomic status as a predictor of long-term care staff burnout and positive caregiving experiences. *International Psychogeriatrics / IPA*, 20(3), 521-537.
9. Ayalon, R. D., Friedman, F., Jr. (2008). The effect of sleep deprivation on fine motor coordination in obstetrics and gynecology residents. *American Journal of Obstetrics and Gynecology*, 199(5), 576.e571-576.e575.

10. Babyatsky, M. W., Bazari, H., Del Valle, J. (2009). Response to the Institute of Medicine's recommendations on resident duty hours: the medical residency program and GI fellowship viewpoints. *Gastroenterology*, 136(4), 1145-1147.
11. Bakaeen, F. G., Huh, J., Lemaire, S. A., et al. (2009). The July effect: impact of the beginning of the academic cycle on cardiac surgical outcomes in a cohort of 70,616 patients. *The Annals of Thoracic Surgery*, 88(1), 70-75.
12. Baker, S. R., Romero, M. J., Patel, A., Maaty, M. (2009). Internal and External Moonlighting by Radiology Trainees A Survey of the Extent of Participation by Current Residents and Fellows(1). *Academic Radiology*.
13. Bamford, N., Bamford, D. (2008). The effect of a full shift system on doctors. *Journal of Health Organization and Management*, 22(3), 223-237.
14. Bashore, T. M., Wang, A. (2008). Recent accreditation council for graduate medical education initiatives have not been shown to improve the education of cardiology fellows. *Circulation*, 118(5), 532-537; discussion 537.
15. Baskies, M. A., Ruchelsman, D. E., Capeci, C. M., Zuckerman, J. D., Egol, K. A. (2008). Operative experience in an orthopaedic surgery residency program: the effect of work-hour restrictions. *The Journal of Bone and Joint Surgery. American volume*, 90(4), 924-927.
16. Basner, M., Rubinstein, J., Fomberstein, K. M., et al. (2008). Effects of night work, sleep loss and time on task on simulated threat detection performance. *Sleep*, 31(9), 1251-1259.
17. Bates, D. W. (2009). Fatigue, resident work hours, and safety. *Medical Care*, 47(7), 711-713.
18. Baysari, M., Caponecchia, C., McIntosh, A., Wilson, J. (2009). Classification of errors contributing to rail incidents and accidents: A comparison of two human error identification techniques. *Safety Science*, 47(7), 948-957.
19. Bekmezian, A., Chung, P. J., Yazdani, S. (2008). Staff-only pediatric hospitalist care of patients with medically complex subspecialty conditions in a major teaching hospital. *Archives of Pediatrics and Adolescent Medicine*, 162(10), 975-980.
20. Blanchard, M. S., Meltzer, D., Polonsky, K. S. (2009). To nap or not to nap? Residents' work hours revisited. *The New England Journal of Medicine*, 360(21), 2242-2244.

21. Blatman, K. H. (2009). The Institute of Medicine resident work hours recommendations: a resident's viewpoint. *Journal of Clinical Sleep Medicine*, 5(1), 13.
22. Block, A. E., Norton, D. M. (2008). Nurse labor effects of residency work hour limits. *Nursing economic\$,* 26(6), 368-373.
23. Borman, K. R., Fuhrman, G. M. (2009). "Resident Duty Hours: Enhancing Sleep, Supervision, and Safety": Response of the Association of Program Directors in Surgery to the December 2008 Report of the Institute of Medicine. *Surgery*, 146(3), 420-427.
24. Britt, L. D., Sachdeva, A. K., Healy, G. B., Whalen, T. V., Blair, P. G. (2009). Resident duty hours in surgery for ensuring patient safety, providing optimum resident education and training, and promoting resident well-being: A response from the American College of Surgeons to the Report of the Institute of Medicine, "Resident Duty Hours: Enhancing Sleep, Supervision, and Safety". *Surgery*, 146(3), 398-409.
25. Brown, L. K. (2008). Physicians and sleep deprivation. *Current Opinion in Pulmonary Medicine*, 14(6), 507-511.
26. Buch, K. E., Genovese, M. Y., Conigliaro, J. L., et al. (2008). Non-physician practitioners' overall enhancement to a surgical resident's experience. *Journal of Surgical Education*, 65(1), 50-53.
27. Byrne, J. M., Loo, L. K., Giang, D. (2009). Monitoring and improving resident work environment across affiliated hospitals: a call for a national resident survey. *Academic Medicine*, 84(2), 199-205.
28. Caldicott, C. V., Holsapple, J. W. (2008). Training for fitness: reconsidering the 80-hour work week. *Perspectives in Biology and Medicine*, 51(1), 134-143.
29. Camire, E., Moyon, E., Stelfox, H. T. (2009). Medication errors in critical care: risk factors, prevention and disclosure. *CMAJ: Canadian Medical Association Journal / Journal de l'Association Medicale Canadienne*, 180(9), 936-943.
30. Cao, C. G., Weinger, M. B., Slagle, J., Zhou, C., Ou, J., Gillin, S., et al. (2008). Differences in day and night shift clinical performance in anesthesiology. *Human Factors*, 50(2), 276-290.

31. Cappuccio, F. P., Bakewell, A., Taggart, F. M., et al. (2009). Implementing a 48 h EWTD-compliant rota for junior doctors in the UK does not compromise patients' safety: assessor-blind pilot comparison. *QJM: monthly journal of the Association of Physicians*, 102(4), 271-282.
32. Carney, P. I. (2009). Hours on end. *Medical Economics*, 86(5), 40-42.
33. Caruso, C. C., Waters, T. R. (2008). A review of work schedule issues and musculoskeletal disorders with an emphasis on the healthcare sector. *Industrial Health*, 46(6), 523-534.
34. Chang, V. Y., Arora, V. (2008). Effects of the accreditation council for graduate medical education duty-hour limits on sleep, work hours, and safety. *Pediatrics*, 122(6), 1413-1414; author reply 1414-1415.
35. Chee, M. W., Tan, J. C., Zheng, H., et al. (2008). Lapsing during sleep deprivation is associated with distributed changes in brain activation. *The Journal of Neuroscience*, 28(21), 5519-5528.
36. Christmas AB, Brintzenhoff RA, Sing RF, et al. Resident work hour restrictions impact chief resident operative experience. *The American Surgeon*. 2009;75(11):1065-1068.
37. Chudgar, S. M., Cox, C. E., Que, L. G., Andolsek, K., Knudsen, N. W., Clay, A. S. (2009). 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? *Critical Care Medicine*, 37(1), 49-60.
38. Cole, S., Arnold, M., Sanderson, A., Cupp, C. (2009). Pregnancy during otolaryngology residency: experience and recommendations. *The American Surgeon*, 75(5), 411-415.
39. Collier, R. (2009). Sleepless in the surgical ward. *CMAJ: Canadian Medical Association Journal / Journal de l'Association Medicale Canadienne*, 180(11), 1095-1096.
40. Collins, J., Hinshaw, J. L., Fine, E., Albanese, M. A. (2008). Diagnostic radiology resident compliance with recommended health guidelines: effect of resident work environment. *Academic Radiology*, 15(8), 1046-1057.
41. Committee of Interns and Residents/SEIU Healthcare. (2009). Not whether, but how...Not if, but when: Time to act on the Institute of Medicine recommendations on patient and resident physician safety [Electronic Version] from <http://www.cirseiu.org/assets/assetcontent/a96df179->

[53ca-4706-8a8a-7f3002566263/546bfa9e-94e2-495f-9d30-54cc81f55e47/eb970c2d-2504-430a-86b3-b8c766a595c4/1/CIR%20IOM%20Position%20Paper.pdf](https://www.fda.gov/oc/ohrt/53ca-4706-8a8a-7f3002566263/546bfa9e-94e2-495f-9d30-54cc81f55e47/eb970c2d-2504-430a-86b3-b8c766a595c4/1/CIR%20IOM%20Position%20Paper.pdf). Accessed September 20, 2010.

42. Committee on Patient Safety and Quality, I. (2008). ACOG committee opinion number 398, February 2008: fatigue and patient safety. *Obstetrics and Gynecology*, 111(2 Pt 1), 471-474.
43. Conklin JH. AOA should support IOM report on resident work hours. *The Journal of the American Osteopathic Association*. 2010;110(3):111-193.
44. 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. *The Journal of Thoracic and Cardiovascular Surgery*. 2009;137(3):710-713.
45. Connors, R. C., Doty, J. R., Bull, D. A., May, H. T., Fullerton, D. A., Robbins, R. C. (2009). Effect of work-hour restriction on operative experience in cardiothoracic surgical residency training. *The Journal of Thoracic and Cardiovascular Surgery*, 137(3), 710-713.
46. Conway, P. H., Tamara Konetzka, R., Zhu, J., Volpp, K. G., Sochalski, J. (2008). Nurse staffing ratios: trends and policy implications for hospitalists and the safety net. *Journal of Hospital Medicine (Online)*, 3(3), 193-199.
47. Cull, W. L., Caspary, G. L., Olson, L. M. (2008). Many pediatric residents seek and obtain part-time positions. *Pediatrics*, 121(2), 276-281.
48. Curet, M. J. (2008). Resident work hour restrictions: where are we now? *Journal of the American College of Surgeons*, 207(5), 767-776.
49. Cyr-Taro, A. E., Kotwall, C. A., Menon, R. P., Hamann, M. S., Nakayama, D. K. (2008). Employment and satisfaction trends among general surgery residents from a community hospital. *Journal of Surgical Education*, 65(1), 43-49.
50. Dassinger, M. S., 3rd, Eubanks, J. W., 3rd, Langham, M. R., Jr. (2008). Full work analysis of resident work hours. *The Journal of Surgical Research*, 147(2), 178-181.
51. Davenport, D. L., Henderson, W. G., Hogan, S., Mentzer, R. M., Jr., Zwischenberger, J. B., Participants in the Working Conditions of Surgery Residents and Quality of Care Study. (2008). Surgery resident working conditions and job satisfaction. *Surgery*, 144(2), 332-338.e335.

52. Dembe, A. (2009). Ethical issues relating to the health effects of long working hours. *Journal of Business Ethics*, 84, 195-208.
53. Depriest, J. L. (2008). Resident perceptions of work hour limitations: has the 80-hour work week doomed the 3-year Internal Medicine residency? *Journal of General Internal Medicine*, 23(1), 114.
54. Dimitris, K. D., Taylor, B. C., Fankhauser, R. A. (2008). Resident work-week regulations: historical review and modern perspectives. *Journal of Surgical Education*, 65(4), 290-296.
55. Dozois EJ, Holubar SD, Tsikitis VL, et al. Perceived impact of the 80-hour workweek: Five years later. *Journal of Surgical Research*. 2009;156(1):3-15.
56. Durkin, E. T., McDonald, R., Munoz, A., Mahvi, D. (2008). The impact of work hour restrictions on surgical resident education. *Journal of Surgical Education*, 65(1), 54-60.
57. Dyrbye, L. N., Shanafelt, T. D., Thomas, M. R., Durning, S. J. (2009). Brief observation: a national study of burnout among internal medicine clerkship directors. *The American Journal of Medicine*, 122(3), 310-312.
58. Dyrbye, L. N., Thomas, M. R., Harper, W., Massie, F. S., Jr., Power, D. V., Eacker, A., et al. (2009). The learning environment and medical student burnout: a multicentre study. *Medical Education*, 43(3), 274-282.
59. Dyrbye, L. N., West, C. P., Shanafelt, T. D. (2009). Defining burnout as a dichotomous variable. *Journal of General Internal Medicine*, 24(3), 440; author reply 441.
60. Eckleberry-Hunt, J., Lick, D., Boura, J., Hunt, R., Balasubramaniam, M., Mulhem, E., et al. (2009). An exploratory study of resident burnout and wellness. *Academic Medicine*, 84(2), 269-277.
61. Eggertson, L. (2009). Residents claim 24-hour call violates Charter rights. *CMAJ: Canadian Medical Association Journal / Journal de l'Association Medicale Canadienne*, 180(9), 918.
62. Ehara, A. (2008). Are long physician working hours harmful to patient safety? *Pediatrics International*, 50(2), 175-178.
63. Engum, S. A., Breckler, F. D. (2008). An evaluation of medication errors-the pediatric surgical service experience. *Journal of Pediatric Surgery*, 43(2), 348-352.

64. Fahrenkopf, A. M., Sectish, T. C., Barger, L. K., Sharek, P. J., Lewin, D., Chiang, V. W., et al. (2008). Rates of medication errors among depressed and burnt out residents: prospective cohort study. *BMJ (Clinical research ed.)*, 336(7642), 488-491.
65. Feinland, J. B., Sankey, H. Z. (2008). The obstetrics team: midwives teaching residents and medical students on the labor and delivery unit. *Journal of Midwifery and Women's Health*, 53(4), 376-380.
66. Ferguson, S. A., Thomas, M. J., Jay, S.M., Weissenfeld, A. P., Dorrian, J., Dawson, D. (2008). The impact of work hours, sleep, and wake on subjective fatigue ratings in Australian doctors. *Journal of Sleep Research*, 17(supplement 1), 122.
67. Ferguson, S. A., Lamond, N., Kandelaars, K., Jay, S. M., Dawson, D. (2008). The impact of short, irregular sleep opportunities at sea on the alertness of marine pilots working extended hours. *Chronobiology International*, 25(2), 399-411.
68. Fields RC, Bowman MC, Freeman BD, Klingensmith ME. Implementation of an "after hours" resident educational program in a general surgery residency: A paradigm for increasing formal didactic training outside of the hospital setting in the era of the 80-hour workweek. *Journal of Surgical Education*. 2009;66(6):340-343.
69. Fletcher, K. E., Parekh, V., Halasyamani, L, et al. (2008). Work hour rules and contributors to patient care mistakes: a focus group study with internal medicine residents. *Journal of Hospital Medicine (Online)*, 3(3), 228-237.
70. Fletcher, K. E., Wiest, F. C., Halasyamani, L., et al. (2008). How do hospitalized patients feel about resident work hours, fatigue, and discontinuity of care? *Journal of General Internal Medicine*, 23(5), 623-628.
71. Foley, P. J., Roses, R. E., Kelz, R. R., et al. (2008). The state of general surgery training: a different perspective. *Journal of Surgical Education*, 65(6), 494-498.
72. Fortuna, R. J., Palfrey, J. S., Shelov, S. P., Samuels, R. C. (2009). Paediatric experiences with work-hour limitations. *Journal of Evaluation in Clinical Practice*, 15(1), 116-120.
73. Franzen, P. L., Siegle, G. J., Buysse, D. J. (2008). Relationships between affect, vigilance, and sleepiness following sleep deprivation. *Journal of Sleep Research*, 17(1), 34-41.

74. Friesen, L. D., Vidyarthi, A. R., Baron, R. B., Katz, P. P. (2008). Factors associated with intern fatigue. *Journal of General Internal Medicine*, 23(12), 1981-1986.
75. 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.
76. Froelich, J., Milbrandt, J. C., Allan, D. G. (2009). Impact of the 80-hour workweek on surgical exposure and national in-training examination scores in an orthopedic residency program. *Journal of Surgical Education*, 66(2), 85-88.
77. Frost, P., Wise, M. (2008). Residency duty-hour limits: time to change how key clinical faculty work? *Archives of Internal Medicine*, 168(2), 244.
78. Gander, P., Millar, M., Webster, C., Merry, A. (2008). Sleep loss and performance of anaesthesia trainees and specialists. *Chronobiology International*, 25(6), 1077-1091.
79. Gander, P., van den Berg, M., Signal, L. (2008). Sleep and sleepiness of fishermen on rotating schedules. *Chronobiology International*, 25(2), 389-398.
80. Ganguli, S., Camacho, M., Yam, C. S., Pedrosa, I. (2009). Preparing first-year radiology residents and assessing their readiness for on-call responsibilities: results over 5 years. *American Journal of Roentgenology*, 192(2), 539-544.
81. Gerdes, J., Kahol, K., Smith, M., Leyba, M. J., Ferrara, J. J. (2008). Jack Barney award: the effect of fatigue on cognitive and psychomotor skills of trauma residents and attending surgeons. *American Journal of Surgery*, 196(6), 813-819; discussion 819-820.
82. Gohar A, Adams A, Gertner E, et al. Working memory capacity is decreased in sleep-deprived internal medicine residents. *Journal of Clinical Sleep Medicine*. 2009;5(3):191-197.
83. Goitein, L., Shanafelt, T. D., Nathens, A. B., Curtis, J. R. (2008). Effects of resident work hour limitations on faculty professional lives. *Journal of General Internal Medicine*, 23(7), 1077-1083.
84. Goldstein EB, Savel RH, Chorost MI, Borgen PI, Cunningham J. Use of text messaging to enhance compliance with the accreditation council for graduate medical education resident duty hour requirements. *Journal of Surgical Education*. 2009;66(6):379-382.

85. Golub, J. S., Johns, M. M., 3rd, Weiss, P. S., Ramesh, A. K., Ossoff, R. H. (2008). Burnout in academic faculty of otolaryngology-head and neck surgery. *The Laryngoscope*, 118(11), 1951-1956.
86. Gopaldas RR, Huh J, Bakaeen FG, et al. The impact of resident work-hour restrictions on outcomes of cardiac operations. *Journal of Surgical Research*. 2009;157(2):268-274.
87. Grady MS, Batjer HH, Dacey RG. Resident duty hour regulation and patient safety: establishing a balance between concerns about resident fatigue and adequate training in neurosurgery. *Journal of Neurosurgery*. 2009;110(5):828-836.
88. Grady, M. S., Batjer, H. H., Dacey, R. G. (2009). Resident duty hour regulation and patient safety: establishing a balance between concerns about resident fatigue and adequate training in neurosurgery. *Journal of Neurosurgery*, 110(5), 828-836.
89. Greenberg, W., Faulkner, L., Kaye, D., Roberts, L. (2009). (Letter from AADPRT to ACGME of April 29, 2009). Retrieved July 1, 2009, from http://www.aadrpt.org/news/acgme/aadrpt_letter_to_acgme_050909.pdf
90. Hanlon, J. G., Hayter, M. A., Bould, M. D., Joo, H. S., Naik, V. N. (2009). Perceived sleepiness in Canadian anesthesia residents: a national survey. *Canadian Journal of Anaesthesia / Journal Canadien d'Anesthesie*, 56(1), 27-34.
91. Heller, F. R. (2008). Restriction of duty hours for residents in internal medicine: a question of quality of life but what about education and patient safety? *Acta Clinica Belgica*, 63(6), 363-371.
92. Heponiemi, T., Kouvonen, A., Vanska, J., Halila, H., Sinervo, T., Kivimaki, M., et al. (2008). Effects of active on-call hours on physicians' turnover intentions and well-being. *Scandinavian Journal of Work, Environment and Health*, 34(5), 356-363.
93. Herzer, K. R., Rodriguez-Paz, J. M., Doyle, P. A., Flint, P. W., Feller-Kopman, D. J., Herman, J., et al. (2009). A practical framework for patient care teams to prospectively identify and mitigate clinical hazards. *Joint Commission Journal on Quality and Patient Safety / Joint Commission Resources*, 35(2), 72-81.
94. Higginson, J. D. (2009). Perspective: limiting resident work hours is a moral concern. *Academic Medicine*, 84(3), 310-314.

95. Hill, J. D., Smith, R. J. (2009). Monitoring stress levels in postgraduate medical training. *The Laryngoscope*, 119(1), 75-78.
96. Ho CA, Wilson PL. A comparison of fracture reductions performed by physician extenders and orthopaedic residents in the acute pediatric orthopaedic practice. *Journal of Orthopedic Trauma*. 2010;24(4):244-249.
97. Holt KD, Miller RS, Philibert I, Heard JK, Nasca TJ. Residents' perspectives on the learning environment: Data from the Accreditation Council for Graduate Medical Education resident survey. *Academic Medicine*. 2010;85(3):512-518.
98. Horswell, B. (2009). Resident work hours. *Journal of Oral and Maxillofacial Surgery*, 67(5), 1153.
99. Hyman, N. H. (2009). Attending work hour restrictions: is it time? *Archives of Surgery (Chicago, Ill.: 1960)*, 144(1), 7-8.
100. Institute of Medicine. *Resident Duty Hours: Enhancing Sleep, Supervision, and Safety*. Washington, D.C.: The National Academies Press; 2009.
101. Jagannathan, J., Vates, G. E., Pouratian, N., et al. (2009). Impact of the Accreditation Council for Graduate Medical Education work-hour regulations on neurosurgical resident education and productivity, *Journal of Neurosurgery*. United States.
102. Jagsi, R., Weinstein, D. F., Shapiro, J., Kitch, B. T., Dorer, D., Weissman, J. S. (2008). 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*, 168(5), 493-500.
103. Jamshidi, R., Ozgediz, D. (2008). Medical student teaching: a peer-to-peer toolbox for time-constrained resident educators. *Journal of Surgical Education*, 65(2), 95-98.
104. Jasti H, Hanusa BH, Switzer GE, Granieri R, Elnicki M. Residents' perceptions of a night float system. *BMC Medical Education*. 2009;9:52.
105. Jay, S. M., Dawson, D., Ferguson, S. A., Lamond, N. (2008). Driver fatigue during extended rail operations. *Applied Ergonomics*, 39(5), 623-629.
106. Jeanmonod R, Damewood S, Brook C. Resident productivity: trends over consecutive shifts. *International Journal of Emergency Medicine*. 2009;2(2):107-110.

107. Jeanmonod, R., Jeanmonod, D., Ngiam, R. (2008). Resident productivity: does shift length matter? *The American Journal of Emergency Medicine*, 26(7), 789-791.
108. Kahol, K., Leyba, M. J., Deka, M, et al. (2008). Effect of fatigue on psychomotor and cognitive skills. *American Journal of Surgery*, 195(2), 195-204.
109. Kairys JC, Dimuzio PJ, Crawford AG, Grabo DJ, Yeo CJ. Changes in operative case experience for general surgery residents: has the 80-hour work week decreased residents' operative experience? *Advances in Surgery*. 2009;43:73-90.
110. Kairys, J. C., McGuire, K., Crawford, A. G., Yeo, C. J. (2008). Cumulative operative experience is decreasing during general surgery residency: a worrisome trend for surgical trainees? *Journal of the American College of Surgeons*, 206(5), 804-811; discussion 811-803.
111. Kane, s., Blanchard, M. H., Siddiqui, N. Y., Bailit, J. L. (2008). Effect of resident duty hours restrictions on ambulatory experience and surgical procedural volume. *Obstetrics and Gynecology*, 111(4), 67s.
112. Kaplan LJ, Maerz LL, Schuster K, et al. Uncovering system errors using a rapid response team: cross-coverage caught in the crossfire. *Journal of Trauma*. 2009;67(1):173-178.
113. Katz, J. T. (2009). Safely and rationally aligning goals--a plea for flexibility. *Journal of Clinical Sleep Medicine*, 5(1), 11.
114. Katzka, D. A., Proctor, D. D. (2009). The GI fellowship viewpoint. *Gastroenterology*, 136(4), 1147-1148.
115. Keily RJ, Jr., Senkowski CK. Effect of the night float system on operative case volume for senior surgical residents. *Journal of Surgical Education*. 2009;66(6):314-318.
116. Kelsall, D. (2009). Must we keep depriving residents of sleep? *CMAJ: Canadian Medical Association Journal / Journal de l'Association Medicale Canadienne*, 180(11), 1087, E1059.
117. Kemp, C. D., Bath, J. M., Berger, J, et al. (2008). The top 10 list for a safe and effective sign-out. *Archives of Surgery (Chicago, Ill.: 1960)*, 143(10), 1008-1010.
118. Khairy, G. A. (2009). Surgical residency training program. Are changes needed? *Saudi Medical Journal*, 30(5), 698-701.

119. Kreimer, S. (2008). Medical education. Workload, not just hours, impacts quality of care provided by medical residents. The Institute of Medicine and others look at restructuring caseloads. *Hospitals and Health Networks*, 82(12), 11.
120. Krueger, P. M., Friedman, E. M. (2009). Sleep duration in the United States: a cross-sectional population-based study. *American Journal of Epidemiology*, 169(9), 1052-1063.
121. Kuehn, B. M. (2009). IOM: Shorten residents' work shifts to reduce fatigue, improve patient safety. *JAMA: the journal of the American Medical Association*, 301(3), 259-261.
122. Lamond, N., Jay, S. M., Dorrian, J., Ferguson, S. A., Roach, G. D., Dawson, D. (2008). The sensitivity of a palm-based psychomotor vigilance task to severe sleep loss. *Behavior Research Methods*, 40(1), 347-352.
123. Landrigan, C. P. (2008). Driving drowsy. *Journal of Clinical Sleep Medicine*, 4(6), 536-537.
124. Landrigan, C. P., Fahrenkopf, A. M., Lewin, D., et al. (2008). Effects of the accreditation council for graduate medical education duty hour limits on sleep, work hours, and safety. *Pediatrics*, 122(2), 250-258.
125. Lang, D. L. (2009). Burnout rate is lower among academic physicians when time is spent on meaningful work. *Gastroenterology*.
126. Lawrence, R. H., Tomolo, A. M., Garlisi, A. P., Aron, D. C. (2008). Conceptualizing handover strategies at change of shift in the emergency department: a grounded theory study. *BMC Health Services Research*, 8, 256.
127. Lee, H. C., Rhee, C. J., Sectish, T. C., Hintz, S. R. (2009). Changes in attendance at deliveries by pediatric residents 2000 to 2005, *American Journal of Perinatology*. United States.
128. Leff, D. R., Aggarwal, R., Rana, M., et al. (2008). Laparoscopic skills suffer on the first shift of sequential night shifts: program directors beware and residents prepare. *Annals of Surgery*, 247(3), 530-539.
129. Legassie, J., Zibrowski, E. M., Goldszmidt, M. A. (2008). Measuring resident well-being: impostorism and burnout syndrome in residency. *Journal of General Internal Medicine*, 23(7), 1090-1094.

130. Lewis, F. R. (2009). Comment of the American Board of Surgery on the recommendations of the Institute of Medicine Report, "Resident Duty Hours: Enhancing Sleep, Supervision, and Safety". *Surgery*, 146(3), 410-419.
131. Lim, J., Dinges, D. F. (2008). Sleep deprivation and vigilant attention. *Annals of the New York Academy of Sciences*, 1129, 305-322.
132. Lipsett, P. A. (2009). Resident work-hours or "duty hours": Evidence versus emotion *. *Critical Care Medicine*, 37(9), 2661-2662 2610.1097/CCM.2660b2013e3181ad7774.
133. Liu, C. C., Wissow, L. S. (2008). Residents who stay late at hospital and how they perform the following day. *Medical Education*, 42(1), 74-81.
134. Lobato, R. D., Fernandez-Alen, J., Alday, R. (2008). The impact of resident work hour limitations on medical student clerkships in Spain. *Neurocirugia (Asturias, Spain)*, 19(3), 213-217.
135. Lopez, L., Katz, J. T. (2009). Perspective: creating an ethical workplace: reverberations of resident work hours reform. *Academic Medicine*, 84(3), 315-319.
136. Lypson, M. L., Hamstra, S. J., Colletti, L. (2009). Is the accreditation council for graduate medical education a suitable proxy for resident unions? *Academic Medicine*, 84(3), 296-300.
137. Mainiero MB, Davis LP, Chertoff JD. Resident duty hour limits: recommendations by the IOM and the response from the radiology community. *Journal of the American College of Radiology*. 2010;7(1):56-60.
138. Mazotti LA, Vidyarthi AR, Wachter RM, Auerbach AD, Katz PP. Impact of duty-hour restriction on resident inpatient teaching. *Journal of Hospital Medicine*. 2009;4(8):476-480.
139. McBurney, P. G., Gustafson, K. K., Darden, P. M. (2008). Effect of 80-hour workweek on continuity of care. *Clinical Pediatrics*, 47(8), 803-808.
140. McCray, L. W., Cronholm, P. F., Bogner, H. R., Gallo, J. J., Neill, R. A. (2008). Resident physician burnout: is there hope? *Family Medicine*, 40(9), 626-632.
141. Meinke, L. (2009). The Institute of Medicine resident work hours recommendations: a program director's viewpoint. *Journal of Clinical Sleep Medicine*, 5(1), 12.
142. Mellman, D. L., Jaffe, R., Dauer, E. A. (2009). Quality and compliance: the dual responsibilities of the chief medical officer. *Physician Executive*, 35(3), 22-25.

143. Meretoja, O. A. (2009). We should work less at night. *Acta Anaesthesiologica Scandinavica*, 53(3), 277-279.
144. Mitchell CD, Mooty CR, Dunn EL, Ramberger KC, Mangram AJ. Resident fatigue: is there a patient safety issue? *American Journal of Surgery*. 2009;198(6):811-816.
145. Mitchell, R., Regan-Smith, M., Fisher, M. A., Knox, I., Lambert, D. R. (2009). A new measure of the cognitive, metacognitive, and experiential aspects of residents' learning. *Academic Medicine*, 84(7), 918-926.
146. Moalem J, Salzman P, Ruan DT, et al. Should all duty hours be the same? Results of a national survey of surgical trainees. *Journal of the American College of Surgeons*. 2009;209(1):47-54.e42.
147. Moalem, J., Brewster, L., James, T. (2009). Position statement on further work hour restrictions: The views of current and recent trainees. *Surgery*, 146(3), 428-429.
148. Mommaerts, M. (2009). The European working time directive - Facts and issues. *Journal of Cranio-Maxillofacial Surgery*, 37(2), 110-112.
149. Morrison CA, Wyatt MM, Carrick MM. Impact of the 80-hour work week on mortality and morbidity in trauma patients: an analysis of the National Trauma Data Bank. *Journal of Surgical Research*. 2009;154(1):157-162.
150. Morrison, C. A., Wyatt, M. M., Carrick, M. M. (2009). Impact of the 80-hour work week on mortality and morbidity in trauma patients: an analysis of the National Trauma Data Bank. *Journal of Surgical Research*, 154(1), 157-162.
151. Murphy, J. F. (2009). Resident duty hours in the U.S.: new directives. *Irish Medical Journal*, 102(1), 4-5.
152. Nagamatsu, S., Kami, M., Nakata, Y. (2009). Healthcare safety committee in Japan: mandatory accountability reporting system and punishment. *Current Opinion in Anaesthesiology*, 22(2), 199-206.
153. Namdari S, Baldwin KD, Weinraub B, Mehta S. (2010). Changes in the number of resident publications after inception of the 80-hour work week. *Clinical Orthopedics*, 468(8), 2278-2283.

154. Nasca, T. J. (2009). The Institute of Medicine report on resident duty hours. Part II: A response to the Orthopaedic Trauma Association leadership regarding their position paper on the Institute of Medicine report. *The Journal of Bone and Joint Surgery. American volume*, 91(3), 722-723.
155. National Workforce Projects. (2008). *Guide to New Deal and Working Time Directive for Junior Doctors*. Manchester, UK: National Health Service.
156. Netterstrom, B., Conrad, N., Bech, P., et al. (2008). The relation between work-related psychosocial factors and the development of depression. *Epidemiologic Reviews*, 30, 118-132.
157. Nielsen, B. W., Allen, T. L. (2009). *Presenteeism, A Novel Concept Five Years after Duty Hour Restrictions*. Paper presented at the Council on Resident Education in Obstetrics and Gynecology, San Diego, CA.
158. Noroozi, A. R., Philbert, R. F. (2008). Residents' perception of the impact of the Bell Commission in oral surgery training: an initial study. *Journal of Oral and Maxillofacial Surgery*, 66(7), 1329-1334.
159. Nuckols, T. K., Bhattacharya, J., Wolman, D. M., Ulmer, C., Escarce, J. J. (2009). Cost implications of reduced work hours and workloads for resident physicians. *The New England Journal of Medicine*, 360(21), 2202-2215.
160. Omahen, D. A. (2009). The 10,000-hour rule and residency training. *CMAJ: Canadian Medical Association Journal / Journal de l'Association Medicale Canadienne*, 180(12), 1272.
161. Ortolon, K. (2009). Taking it to the limits: Texas residency programs adapt to fewer work hours. *Texas Medicine*, 105(3), 47-51.
162. Owens, J. A., Avidan, A., Baldwin, D. C., Jr., Landrigan, C. (2008). Improving sleep hygiene. *Archives of Internal Medicine*, 168(11), 1229-1230; author reply 1230.
163. Pallesen S, Bjorvatn B, Magerøy N, Saksvik IB, Waage S, Moen BE. (2010). Measures to counteract the negative effects of night work. *Scandinavian Journal of Work, Environment, and Health*, 36(2): 109-120.
164. Pape HC, Pfeifer R. Restricted duty hours for surgeons and impact on residents quality of life, education, and patient care: a literature review. *Patient Safety in Surgery*. 2009;3(1):3.

165. Pape, H. C., Pfeifer, R. (Writer) (2009). Restricted duty hours for surgeons and impact on residents quality of life, education, and patient care: a literature review, *Patient Safety in Surgery*. England.
166. Payette, M., Chatterjee, A., Weeks, W. B. (2009). Cost and workforce implications of subjecting all physicians to aviation industry work-hour restrictions. *American Journal of Surgery*.
167. Peisah, C., Latif, E., Wilhelm, K., Williams, B. (2009). Secrets to psychological success: why older doctors might have lower psychological distress and burnout than younger doctors. *Aging and mental health*, 13(2), 300-307.
168. Pezzi C, Leibrandt T, Suryadevara S, Heller JK, Hurley-Martoni D, Kukora JS. (2009). The present and future use of physician extenders in general surgery training programs: one response to the 80-hour work week. *Journal of the American College of Surgeons*, 208(4), 587-591.
169. Pezzi, C., Leibrandt, T., Suryadevara, S., Heller, J. K., Hurley-Martoni, D., Kukora, J. S. (2009). The present and future use of physician extenders in general surgery training programs: one response to the 80-hour work week. *Journal of the American College of Surgeons*, 208(4), 587-591.
170. Phan, K., Brown, S. R. (2009). Decreased continuity in a residency clinic: a consequence of open access scheduling. *Family Medicine*, 41(1), 46-50.
171. Pinzur MS. (2009). FootForum: the 80-hour work week. *Foot and Ankle International*, 30(10):1026.
172. Prasad, M., Iwashyna, T. J., Christie, J. D., Kramer, A. A., Silber, J. H., Volpp, K. G., et al. (2009). Effect of work-hours regulations on intensive care unit mortality in United States teaching hospitals *. *Critical Care Medicine*, 37(9), 2564-2569
2510.1097/CCM.2560b2013e3181a93468.
173. Privette AR, Shackford SR, Osler T, Ratliff J, Sartorelli K, Hebert JC. (2009). 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. *Annals of Surgery*, 250(2), 316-321.

174. Quan, S. F. (2009). Work hours during residency training--the IOM speaketh. *Journal of Clinical Sleep Medicine*, 5(1), 9-10.
175. Rasminsky, S., Lomonaco, A., Auchincloss, E. (2008). Work hours regulations for house staff in psychiatry: bad or good for residency training? *Academic psychiatry: the journal of the American Association of Directors of Psychiatric Residency Training and the Association for Academic Psychiatry*, 32(1), 54-60.
176. Ratanawongsa, N., Roter, D., Beach, M. C., et al. (2008). Physician burnout and patient-physician communication during primary care encounters. *Journal of General Internal Medicine*, 23(10), 1581-1588.
177. Ratanawongsa, N., Wright, S. M., Carrese, J. A. (2008). Well-being in residency: effects on relationships with patients, interactions with colleagues, performance, and motivation. *Patient Education and Counseling*, 72(2), 194-200.
178. Reader, T. W., Cuthbertson, B. H., Decruyenaere, J. (2008). Burnout in the ICU: potential consequences for staff and patient well-being. *Intensive Care Medicine*, 34(1), 4-6.
179. Reddy, R., Guntupalli, K., Alapat, P., Surani, S., Casturi, L., Subramanian, S. (2009). Sleepiness in medical ICU residents. *Chest*, 135(1), 81-85.
180. Reed, D. A., Levine, R. B., Miller, R. G., et al. (2008). Impact of duty hour regulations on medical students' education: views of key clinical faculty. *Journal of General Internal Medicine*, 23(7), 1084-1089.
181. Reimann M, Manz R, Prieur S, Reichmann H, Ziemssen T. Education research: cognitive performance is preserved in sleep-deprived neurology residents. *Neurology*. 2009;73(21):e99-e103.
182. Rice, L. B. (2009). Evidence-based evaluation of physician work hour regulations. *JAMA*, 301(5), 484; author reply 484-485.
183. Ro, K. E., Gude, T., Tyssen, R., Aasland, O. G. (2008). Counselling for burnout in Norwegian doctors: one year cohort study. *BMJ*, 337, a2004.
184. Robeznieks, A. (2008). Sleeping in order. While the IOM eyes more rest for resident doctors, some decry costs, say patient risk would rise. *Modern Healthcare*, 38(49), 6-7, 1.

185. Rocco, T. S., Plakhotnik, M. S. (2009). Literature reviews, conceptual frameworks, and theoretical frameworks: Terms, functions, and distinctions. *Human Resource Development Review*, 8(1), 120.
186. Rodriguez-Paz, J. M., Kennedy, M., Salas, E., et al. (2009). Beyond "see one, do one, teach one": toward a different training paradigm. *Postgraduate Medical Journal*, 85(1003), 244-249.
187. Rogers, N. L., Dinges, D. F. (2008). Interaction of chronic sleep restriction and circadian system in humans. *Journal of Sleep Research*, 17(4), 406-411.
188. Rose, M., Manser, T. (2008). Effects of call on sleep and mood in internal medicine residents. *Behavioral Sleep Medicine*, 6(2), 75-88..
189. Rose, S. H., Long, T. R., Elliott, B. A., Brown, M. J. (2009). A historical perspective on resident evaluation, the Accreditation Council for Graduate Medical Education Outcome Project and Accreditation Council for Graduate Medical Education duty hour requirement. *Anesthesia and Analgesia*, 109(1), 190-193.
190. Rosen, A. K., Loveland, S. A., Romano, P. S., et al. (2009). Effects of resident duty hour reform on surgical and procedural patient safety indicators among hospitalized veterans health administration and medicare patients. *Medical Care*, 47(7), 723-731.
191. Roses RE, Foley PJ, Paulson EC, et al. (2009). Revisiting the rotating call schedule in less than 80 hours per week. *Journal of Surgical Education*, 66(6), 357-360.
192. Roy, C. L., Liang, C. L., Lund, M., et al. (2008). Implementation of a physician assistant/hospitalist service in an academic medical center: impact on efficiency and patient outcomes. *Journal of Hospital Medicine (Online)*, 3(5), 361-368.
193. Sataloff, R. T. (2009). Resident duty hours: concerns and consequences. *Ear, Nose, and Throat Journal*, 88(3), 812-816.
194. Schlueter ME, Phan PH, Martin CS, Breece D, Boysen DA. Understanding accreditation council for graduate medical education (ACGME) guidelines: resident and program director interpretations of work-hour restrictions. *Journal of Surgical Education*. 2009;66(6):374-378.

195. Schor, N. F. (2008). Resident work hours: isolating one ledger column and missing the point. *Neurology*, 71(5), 374.
196. Sehgal, N. L., Fox, M., Vidyarthi, A. R., et al. (2008). A multidisciplinary teamwork training program: the Triad for Optimal Patient Safety (TOPS) experience. *Journal of General Internal Medicine*, 23(12), 2053-2057.
197. Sehgal, N. L., Shah, H. M., Parekh, V. I., Roy, C. L., Williams, M. V. (2008). Non-housestaff medicine services in academic centers: models and challenges. *Journal of Hospital Medicine (Online)*, 3(3), 247-255.
198. Shanafelt, T. D., West, C. P., Sloan, J. A., et al. (2009). Career fit and burnout among academic faculty. *Archives of Internal Medicine*, 169(10), 990-995.
199. Shin, S., Britt, R., Doviak, M., Britt, L. D. (2009). The impact of the 80-hour work week on appropriate resident case coverage. *Journal of Surgical Research*, 162(1), 33-36.
200. Shin, S., Britt, R., Britt, L. D. (2008). Effect of the 80-hour work week on resident case coverage. *Journal of the American College of Surgeons*, 206(5), 798-800; discussion 801-793.
201. Shin, S., Britt, R., Britt, L. D. (2008). Effect of the 80-hour work week on resident case coverage: corrected article. *Journal of the American College of Surgeons*, 207(1), 148-150.
202. Shonka, D. C., Jr., Ghanem, T. A., Hubbard, M. A., Barker, D. A., Kesser, B. W. (2009). Four years of accreditation council of graduate medical education duty hour regulations: have they made a difference? *The Laryngoscope*, 119(4), 635-639.
203. Signal, T. L., Ratieta, D., Gander, P. H. (2008). Flight crew fatigue management in a more flexible regulatory environment: an overview of the New Zealand aviation industry. *Chronobiology International*, 25(2), 373-388.
204. Sills, E. S., Walsh, A. P. (2009). Limiting resident duty hours in the US: new directives. *Irish Medical Journal*, 102(3), 92.
205. Singletary, S. E. A fire in our hearts: passion and the art of surgery. (2010). *Annals of Surgical Oncology*, 17(2), 365-370.

206. Smith, M. E., Desai, S. S., Allen, E. S., Saha, S., Hunter, A. J. (2009). Impact of shorter inpatient faculty rotations on resident learning experience. *The American Journal of Medicine*, 122(1), 96-100.
207. Sneider EB, Larkin AC, Shah SA. Has the 80-hour workweek improved surgical resident education in New England? *Journal of Surgical Education*. 2009;2009(66):3.
208. Son, M., Kong, J., Koh, S., Kim, J., Harma, M. (2008). Effects of long working hours and the night shift on severe sleepiness among workers with 12-hour shift systems for 5 to 7 consecutive days in the automobile factories of Korea. *Journal of Sleep Research*, 17(4), 385-394.
209. St Peter, S. D., Calkins, C. M., Holcomb, G. W., 3rd, Snyder, C. L., Ostlie, D. J. (2008). Financial impact of in-house attending surgeon: a prospective study. *Journal of Pediatric Surgery*, 43(6), 994-997.
210. Stahlfeld, K. R., Robinson, J. M., Burton, E. C. (2008). What do physician extenders in a general surgery residency really do? *Journal of Surgical Education*, 65(5), 354-358.
211. Stucky, E. R., Dresselhaus, T. R., Dollarhide, A., et al. (2009). Intern to attending: assessing stress among physicians. *Academic Medicine*, 84(2), 251-257.
212. Suryadevara, A. C., Zandifar, H., Guyer, M., Kellman, R. M. (2008). Day float: an alternative to the night float coverage system for residency programs. *The Laryngoscope*, 118(7), 1257-1259.
213. Suwazono, Y., Dochi, M., Kobayashi, E., et al. (2008). Benchmark duration of work hours for development of fatigue symptoms in Japanese workers with adjustment for job-related stress. *Risk Analysis*. 28(6), 1689-1698.
214. Sweet, R. M., McDougall, E. M. (2008). Simulation and computer-animated devices: the new minimally invasive skills training paradigm. *The Urologic Clinics of North America*, 35(3), 519-531, x.
215. Tait, M. J., Fellows, G. A., Pushpanathan, S., Sergides, Y., Papadopoulos, M. C., Bell, B. A. (2008). Current neurosurgical trainees' perception of the European Working Time Directive and shift work. *British Journal of Neurosurgery*, 22(1), 28-31; discussion 32-23.

216. Taoda, K., Nakamura, K., Kitahara, T., Nishiyama, K. (2008). Sleeping and working hours of residents at a national university hospital in Japan. *Industrial Health*, 46(6), 594-600.
217. Thomas, K. W. (2009). Challenges, duty hours, and metrics in the intensive care unit resident rotation. *Critical Care Medicine*, 37(4), 1490-1492.
218. Utley, B., Carter, J., Maa, J. (2009). Resident work hour restrictions and the future of medical student surgical education. *Journal of the American College of Surgeons*, 208(3), 480.
219. Vallier, H. A., Prokuski, L. J., Nash, C. J., Patterson, B. M. (2009). Effects of resident work-hour restrictions on orthopaedic education and patient care. *Current Orthopaedic Practice*, 20(1), 77-86.
220. Vallier, H. A., Prokuski, L. J., Nash, C. J., Patterson, B. M. (2009). Education: effects of resident work-hour restrictions on orthopaedic education and patient care. *Current Orthopaedic Practice*, 20(1), 77-86.
221. Vaughn, D. M., Stout, C. L., McCampbell, B. L., et al. (2008). Three-year results of mandated work hour restrictions: attending and resident perspectives and effects in a community hospital. *The American Surgeon*, 74(6), 542-546; discussion 546-547.
222. Virtanen, M., Kurvinen, T., Terho, K., et al. (2009). Work hours, work stress, and collaboration among ward staff in relation to risk of hospital-associated infection among patients. *Medical Care*, 47(3), 310-318.
223. Virtanen, M., Singh-Manoux, A., Ferrie, J. E., et al. (2009). Long working hours and cognitive function: the Whitehall II Study. *American Journal of Epidemiology*, 169(5), 596-605.
224. Volpp, K. G. (2008). A delicate balance: physician work hours, patient safety, and organizational efficiency. *Circulation*, 117(20), 2580-2582.
225. Volpp, K. G., Landrigan, C. P. (2008). Building physician work hour regulations from first principles and best evidence. *JAMA*, 300(10), 1197-1199.
226. Wada, K., Arimatsu, M., Yoshikawa, T, et al. (2008). Factors on working conditions and prolonged fatigue among physicians in Japan. *International Archives of Occupational and Environmental Health*, 82(1), 59-66.

227. Wade, R., Henderson, J. (2009). Perceived impact of EWTD on UK doctors. *Bulletin of The Royal College of Surgeons of England*, 91(4), 132-134.
228. Warm, E. J., Schauer, D. P., Diers, T., et al. (2008). The ambulatory long-block: an accreditation council for graduate medical education (ACGME) educational innovations project (EIP). *Journal of General Internal Medicine*, 23(7), 921-926.
229. Watson, J. C. (2008). Resident work hours: distinguishing resident service issues from education and safety. *Neurology*, 71(5), 375-376; discussion 376-377.
230. Wayne, D. B., Arora, V. (2008). Resident duty hours and the delicate balance between education and patient care. *Journal of General Internal Medicine*, 23(7), 1120-1121.
231. Wayne, J. D., Tyagi, R., Reinhardt, G., et al. (2008). Simple standardized patient handoff system that increases accuracy and completeness. *Journal of Surgical Education*, 65(6), 476-485.
232. Whiting, J. F. (2010). Of puppies and dinosaurs: why the 80-hour work week is the best thing that ever happened in American surgery. *Archives of Surgery*, 145(4), 320-321.
233. Wijnhoven, B. P., Watson, D. I., van den Ende, E. D., Dutch Association of Surgical, T. (2008). Current status and future perspective of general surgical trainees in the Netherlands. *World Journal of Surgery*, 32(1), 119-124.
234. Wilkes, L. E., Royek, A. B., Leaphart, W. L., Gallup, D. G. (2008). Effect of 80-hour work week restrictions on Obstetrics and Gynecology resident education. *Obstetrics and Gynecology*, 111(4), 67s.
235. Wilkinson, C. (2008). Junior doctors' working hours: Perspectives on the reforms. *International Journal of Nursing Practice*, 14, 200-214.
236. Woodrow, S. I., Park, J., Murray, B. J., et al. (2008). Differences in the perceived impact of sleep deprivation among surgical and non-surgical residents. *Medical Education*, 42(5), 459-467.
237. Woods, S. E., Zabat, E., Talen, M. R., Bishop, S., Stephens, L., Engel, A. (2008). Residents' perspective on the impact of the 80-hour workweek policy. *Teaching and Learning in Medicine*, 20(2), 131-135.

238. World Alliance For Patient Safety Drafting, G., Sherman, H., Castro, et al. (2009). Towards an international classification for patient safety: the conceptual framework. *International Journal for Quality in Health Care*, 21(1), 2-8.
239. Yaghoubian, A., Saltmarsh, G., Rosing, D. K., Lewis, R. J., Stabile, B. E., de Virgilio, C. (2008). Decreased bile duct injury rate during laparoscopic cholecystectomy in the era of the 80-hour resident workweek. *Archives of Surgery (Chicago, Ill.: 1960)*, 143(9), 847-851; discussion 851.
240. Yoon, J. D., Arora, V. M. (2008). Can faculty assess resident professionalism with duty hours? *Archives of Internal Medicine*, 168(3), 331; author reply 331-332.