

Accreditation Council for Graduate Medical Education Work Hour Requirements: A Review of Recent Evidence

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Introduction

To address increasing resident burnout and patient safety concerns, the Accreditation Council for Graduate Medical Education (ACGME) introduced resident work hour restrictions in 2003, limiting to 80 hours per week, capping overnight shifts to 24 hours with 6-hour post-call shifts, and mandating minimum 10 hours off between shifts.¹ In 2011, the ACGME introduced further restrictions in response to ongoing concerns, which included reducing intern shift lengths to 16 hours, limiting post-call shifts to 4 hours, and increasing time off after overnight shifts.² Following the enactment of these restrictions, several studies sought to critically examine the effects of new work hour limits.

Offering the first high-level evidence to inform policy, 2 national randomized trials evaluated whether flexible work hour restrictions affected patient and resident outcomes. The Flexibility in Duty Hour Requirements for Surgical Trainees (FIRST) Trial randomized surgical residency programs to a standard arm, adhering to ACGME work hour regulations, or to an intervention arm, permitting flexibility in maximum shift lengths and time off between shifts while upholding the maximum 80-hour work week restriction.³ Similarly, the Individualized Comparative Effectiveness of Models Optimizing Patient Safety and Resident Education (iCOMPARE) Trial followed the overall study design of the FIRST Trial but was conducted in internal medicine residency programs.⁴ The rationale for these

trials was to provide an option for work hour flexibility that promoted greater continuity of care and decreased patient handoffs, which could lower rates of medical error without sacrificing resident educational experiences. Guided by non-inferior findings of the FIRST and iCOMPARE trials, review of the literature, and evaluation of expert opinion, the ACGME revised its work hour policies in 2017 to allow more flexible scheduling.⁵ This revision rolled back the 16-hour intern shift restriction and waived the 24-hour call limit in cases where residents elected to stay for continuity of care or important educational opportunities.

Since initial implementation of the 2003 work hour requirements, the ACGME has conducted periodic reviews of the Common Program Requirements, including work hour policies. This report examines literature surrounding work hour policies and includes evaluation of new studies to understand the impact of work hour restrictions on both patient and resident outcomes across a variety of medical specialties to inform evidence-based policy revisions.

New Evidence Regarding Work Hour Limitations

We highlight 24 articles that capture the diverse landscape of work hour literature and broad impact of work hour reform on both patient and resident outcomes. A summary of study characteristics and main findings are presented in the online supplementary data TABLE. Study design and residency specialty are reflected in FIGURE 1.

Randomized Trials

Eleven studies were associated with 3 randomized trials assessing the impact of ACGME work hours (FIGURE 1).^{3,4,6-14} The FIRST (119 surgery programs) and iCOMPARE trials (63 internal medicine programs) found non-inferior patient outcomes when residents were randomized to flexible work hours

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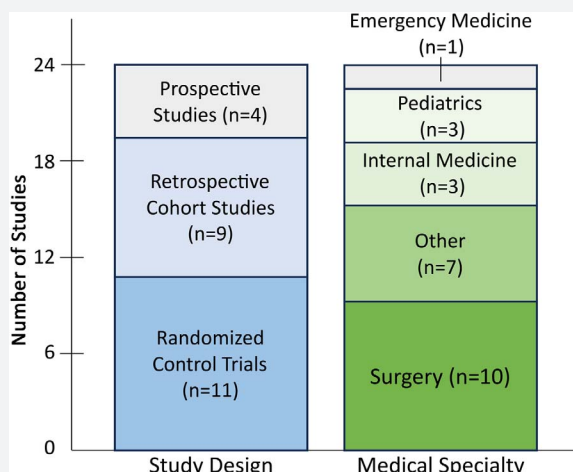


FIGURE 1
Included Studies—Methodology and Representative Specialties

(ie, elimination of 16-hour intern limit, elimination of 24-hour daily limit, and maintenance of 80-hour weekly limit) compared to residents under standard work hour policies.^{3,10} The Randomized Order Safety Trial Evaluating Resident-Physician Schedules (ROSTERS) study focused on pediatric residents working in intensive care units (ICUs) at 6 hospitals.⁶ This study found that residents randomized to work shorter individual shifts (≤ 16 hours) made more serious errors than residents working extended duration work shifts of 24 hours or more. Despite increased rates of medical errors, investigators

observed that residents randomized to shorter shifts reported decreased weekly work hours, increased sleep duration, and improved performance.^{6,7} Although significant site variation existed, locations with increased resident physician workload experienced more negative results when shifts were limited to ≤ 16 hours, possibly resulting from increased handoffs and workload compression.

Patient Outcomes

Twelve studies examined the impact of resident work hours on patient outcomes,^{3,6,7,10,15-22} with mortality most frequently assessed (FIGURE 2). In both the FIRST and iCOMPARE trials, change in 30-day mortality within flexible programs was non-inferior to standard programs.^{3,10} An observational study of national Medicare patient admission data before and after ACGME 2011 work hour implementation did not detect significant differences in 30-day mortality among teaching and nonteaching hospitals. Similar results were obtained in retrospective analyses using the Agency for Healthcare Research and Quality Healthcare Cost and Utilization Project National Inpatient Sample (HCUP-NIS) and American College of Surgeons National Surgical Quality Improvement Program (ACS-NSQIP) database for mortality when comparing pre- and post-ACGME 2011 work hour policy changes.^{17,19}

Along with mortality, several studies assessed length of stay and readmissions (FIGURE 2). Neither

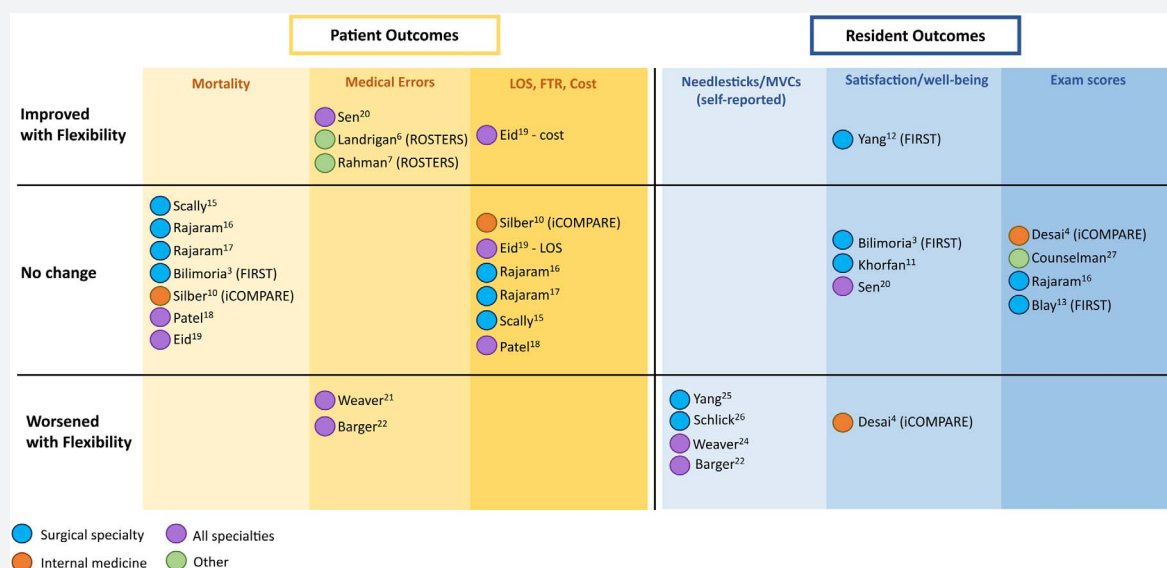


FIGURE 2
Effects of Work Hour Flexibility on Resident and Patient Outcome Measures

Abbreviations: LOS, length of stay; FTR, failure to rescue; ROSTERS, Randomized Order Safety Trial Evaluating Resident-Physician Schedules; FIRST, Flexibility in Duty Hour Requirements for Surgical Trainees; iCOMPARE, Individualized Comparative Effectiveness of Models Optimizing Patient Safety and Resident Education; MVC, motor vehicle crash.

metric exhibited significant differences associated with work hour reforms.^{10,15,18,19} Scally et al investigated the impact of ACGME 2011 work hour standards on failure to rescue, defined as mortality within 30 days of a recognized complication.¹⁵ This measure was used as a surrogate for resident-related processes of care, such as timely diagnosis and treatment administration.¹⁵ This study demonstrated no significant differences in failure to rescue before and after the 2011 work hour change comparing teaching and nonteaching hospitals with difference-in-difference analysis.¹⁵ Similarly, Rajaram et al analyzed differences in patient experience surveys for measures of resident-related factors, such as pain control, physician communication, and appropriate distribution of discharge information.²³ These investigators also found no changes before and after ACGME 2011 work hour reform.

Medical error rates were measured in several articles (FIGURE 2); however, the methods used to assess error were heterogeneous across studies.^{6,7,20-22,24} The ROSTERS study reported increased rates of serious medical error with 16-hour shift restrictions.⁶ In this study, serious medical errors were identified using independent chart reviewers, while other studies relied on resident self-reporting through survey methods.^{21,22} Given this methodologic heterogeneity, these studies yielded mixed results. One article suggested that ACGME 2011 work hour reform was associated with increased self-reported medical error,²⁰ whereas others reported that work hour reforms were associated with reduced risk of self-reported medical errors.²¹

Resident Outcomes

The relationship between work hour policy changes and resident-specific outcomes was explored through investigation of resident safety, education, and well-being (FIGURE 2). An analysis of the FIRST Trial found that residents with flexible policy schedules reported more frequent work hour violations (>80 hours per week, 3 or more times per month) than residents under standard policy schedules; however, this difference was primarily driven by interns. When these work hour violations were examined only among postgraduate year (PGY) 2 to PGY-5 residents, no significant differences were observed.¹⁴ Importantly, schedule flexibility was only utilized once or twice per month, and resident-reported reasons for flexibility implementation most commonly included patient care responsibilities.¹⁴

Resident safety outcomes—including needlestick injuries, attentional failures, and motor vehicle crashes—were also examined in relation to work hour changes (FIGURE 2). In 2023, a national prospective

study assessed resident-reported rates of health and safety hazards. Residents were surveyed monthly to recall total work hours, number of extended duration shifts, and number of medical errors.²² This study found increased risk of self-reported occupational exposures, percutaneous injuries, and attentional failures with increasing weekly work hours and extended duration shifts. Moreover, the combination of exceeding 80 hours per week and working extended duration shifts was associated with increased risk of motor vehicle crashes.²² These authors reported similar results in an earlier investigation of ACGME 2011 work hours and resident self-reported adverse safety outcomes, finding that 2011 work hour restrictions decreased risk of self-reported motor vehicle crashes, near crashes, percutaneous injuries, and attentional failures.²⁴ Similarly, 2 surgical studies utilized data from national surveys and found that frequently working more than 80 hours per week was associated with increased rates of self-reported needlestick injuries, nodding off while driving, and near-miss motor vehicle crashes.^{25,26}

Four studies explored the impact of work hour reforms on resident education in surgery, internal medicine, and emergency medicine (FIGURE 2).^{4,13,16,27} These studies did not find significant differences for in-service or board examination scores among different work hour groups. When resident perception of the educational environment was assessed, investigators found no differences in surgery resident satisfaction with education among flexible and standard work hour groups in the FIRST Trial; however, internal medicine interns in the iCOMPARE Trial were more likely to report dissatisfaction with overall educational quality in flexible programs.^{3,4}

Resident satisfaction with well-being, safety environment, and work hour changes was assessed by several studies (FIGURE 2).^{3,4,11,12,20} The FIRST Trial found no significant differences in resident satisfaction or overall well-being between flexible and standard work hour policies.³ Furthermore, residents in flexible programs felt that work hour flexibility did not negatively impact patient safety and continuity of care. Similar findings were reported in a prospective analysis of resident well-being before and after ACGME 2011 work hour changes for interns of all specialties.²⁰ Flexible policy residents in the FIRST Trial did report a negative effect of work hours on time for activities outside of work, but an analysis of these residents by PGY found that negative perceptions decreased as PGY increased.¹² Additionally, the proportion of residents who preferred flexible work hour policies increased as PGY increased, with only 13% of all surgical residents preferring standard work hours.¹² To evaluate long-term effects of

flexible work hour policies, a 4-year follow-up analysis of the FIRST Trial was conducted by analyzing results from annual surveys distributed to general surgery residents.¹¹ This study found that overall resident satisfaction remained high after 4 years, with significant increases in satisfaction with flexible work hour regulations and continuity of care at flexible programs. Resident satisfaction with overall well-being declined over time; however, this decline was observed globally with no differences detected between standard and flexible work hour programs.¹¹ Overall, this study did not detect differences in resident satisfaction, well-being, or work hour violations attributable to flexible work hour policies.

Interpreting the Evidence to Date

This report included 24 studies that found variable associations between resident work hour schedules and a wide range of patient- and resident-specific outcomes. Nearly half featured analyses from 1 of 3 major randomized control trials: FIRST, iCOMPARE, or ROSTERS, while the remainder employed diverse methodological approaches by a variety of research teams (supplemental TABLE). Surgical specialties were more frequently represented; however, many observational studies utilized national databases, with institution-level outcomes assumed to be globally representative of all resident specialties.

Patient Outcomes

The lack of clear associations between resident work hour policy and various patient outcomes continue to be common findings in the literature. Included studies reported no significant difference in patient outcomes such as mortality, readmissions, or length of stay associated with changes in work hours. Most studies examining patient outcomes leveraged large clinical registries (ACS-NSQIP) or national claims data (Medicare and HCUP). Even metrics thought to be more sensitive for resident-specific processes of care, such as failure to rescue, found no difference in outcomes associated with work hour changes. It could be argued that measures truly sensitive to resident fatigue (eg, errors in medication ordering) have not been broadly examined by current literature. Unfortunately, these metrics may be difficult to assess at scale, owing to multiple layers of redundancy protecting against these errors.

The influence of work hours on medical error rate remains a topic of debate, specifically the role of extended duration shifts (≥ 24 hours). Several included studies found increased rates of resident-reported medical errors with 80-hour weekly work

hour violations^{22,25,26}; however, investigations of extended duration shifts have yielded mixed results. The ROSTERS study reported that ICU residents working extended duration shifts of 24 hours or more had lower rates of serious errors than residents with 16-hour shift limits, particularly at sites with higher resident workload. These findings conflict with several studies from the same team of researchers, which argue that extended duration shifts are associated with increased medical error, adverse safety outcomes, and occupational hazards.^{21,22,24} Notably, these studies utilized different methods of recording medical error. The ROSTERS study calculated medical error rate from independent chart review, whereas other studies utilized resident-reported rates.^{21,22} These investigations highlight a specific area of methodological heterogeneity related to patient outcomes, and this variation likely contributes to lack of consensus between study findings and demonstrates an area for improvement in work hour literature.

Resident Outcomes

The effects of work hour policies on resident outcomes are also contentious, specifically relating to resident satisfaction and occupational hazards. Resident satisfaction may be a challenging measure for policy guidance given that resident needs vary by specialty and program requirements. As identified in the commentary accompanying the iCOMPARE Trial,²⁸ surgical residents in FIRST preferred flexible work hour policies, whereas internal medicine residents in iCOMPARE were less satisfied with flexible schedules. Further investigation of the FIRST Trial revealed a substantial number of surgical residents used schedule flexibility for specialty-specific circumstances, namely performance of operative cases.¹⁴ These studies demonstrate the unique and complex educational components of each specialty, which further complicate interpretation of work hour policy changes and highlight the need for specialty-specific evidence to guide future changes in work hour requirements.

Studying the effect of shift length on resident error and occupational hazards remains challenging, despite known association between sleep deprivation and performance. Several articles describe increased risk of medical error, needlestick injury, and motor vehicle crashes with increased work hours and more frequent extended duration shifts^{21,22,24-26}; however, the rates of these occupational hazard events were self-reported, often at long intervals, making them vulnerable to recall bias. Further research characterizing true rates of occupational exposures and association with work hours may be necessary to provide a more accurate assessment of risk.

Caveats to Consider

While this report is limited by a lack of multi-institutional studies or randomized trials evaluating post-ACGME 2017 work hour reform, the policy changes featured in 2017 (elimination of 16-hour shift restrictions for interns) were previously tested in the FIRST and iCOMPARE randomized trials. Nonetheless, contemporary analyses are needed to evaluate real-world implementation of the 2017 work hour policy changes. Additionally, only one analysis longitudinally assessed work hour reform and long-term outcomes.¹¹ As the landscape of clinical medicine evolves, long-term data characterizing the impact of work hour policies becomes increasingly valuable to ensure that policy continues to progress alongside patient and resident needs. Finally, most of the literature investigated either general surgery or internal medicine residents. The ACGME represents 146 specialties and subspecialties, and although surgery and internal medicine account for a considerable proportion of residency positions, there are significant gaps in specialty-specific investigations of work hour reform. Additional high-quality evidence reflecting outcomes of work hour requirements for a wider breadth of ACGME specialties would not only strengthen the current body of literature but could also identify specialty-specific needs for further work hour changes.

Conclusions

As literature surrounding work hour policy and effects on resident education and patient outcomes continues to evolve, areas of ambiguity persist. While studies included in this report were unable to detect significant differences in patient or resident education outcomes associated with changes in work hour requirements, consensus on the impact of work hours on resident satisfaction and well-being continues to be elusive, particularly as it varies by specialty. Although there is a reasonable agreement on the association between adverse outcomes and working longer than 80 hours per work week, debate on the safety of residents working extended duration shifts (>24 hours) continues. Forthcoming specialty-specific investigations focused on the impact of extended duration shifts, particularly utilizing metrics other than self-reported outcomes, will be essential for generating robust understanding of how work hours affect resident and patient safety.

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