CAGS AND ACS EVIDENCE BASED REVIEWS IN SURGERY. 45

# Impact of the 80-hour resident work week on mortality and morbidity in trauma patients

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The term "evidence-based medicine" was first coined by Sackett and colleagues as "the conscientious, explicit and judicious use of current best evidence in making decisions about the care of individual patients."[1] The key to practising evidence-based medicine is applying the best current knowledge to decisions in individual patients. Medical knowledge is continually and rapidly expanding. For clinicians to practise evidence-based medicine, they must have the skills to read and interpret the medical literature so that they can determine the validity, reliability, credibility and utility of individual articles. These skills are known as critical appraisal skills, and they require some knowledge of biostatistics, clinical epidemiology, decision analysis and economics, and clinical knowledge.

Evidence Based Reviews in Surgery (EBRS) is a program jointly sponsored by the Canadian Association of General Surgeons (CAGS) and the American College of Surgeons (ACS) and is supported by an educational grant from ETHICON and ETHICON ENDO-SURGERY, both units of Johnson & Johnson Medical Products, a division of Johnson & Johnson and ETHICON Inc. and ETHICON ENDO-SURGERY Inc., divisions of Johnson & Johnson Inc. The primary objective of EBRS is to help practising surgeons improve their critical appraisal skills. During the academic year, 8 clinical articles are chosen for review and discussion. They are selected for their clinical relevance to general surgeons and because they cover a spectrum of issues important to surgeons, including causation or risk factors for disease, natural history or prognosis of disease, how to quantify disease, diagnostic tests, early diagnosis and the effectiveness of treatment. A methodological article guides the reader in critical appraisal of the clinical article. Methodological and clinical reviews of the article are performed by experts in the relevant areas and posted on the EBRS website, where they are archived indefinitely. In addition, a listserv allows participants to discuss the monthly article. Surgeons who participate in the monthly packages can obtain Royal College of Physicians and Surgeons of Canada Maintenance of Certification credits and/or continuing medical education credits for the current article only by reading the monthly articles, participating in the listserv discussion, reading the methodological and clinical reviews and completing the monthly online evaluation and multiple choice questions.

We hope readers will find EBRS useful in improving their critical appraisal skills and in keeping abreast of new developments in general surgery. Four reviews are published in condensed versions in the *Canadian Journal of Surgery* and 4 are published in the *Journal of the American College of Surgeons*. For further information about EBRS, please refer to the CAGS or ACS websites. Questions and comments can be directed to the program administrator, Marg McKenzie, at mmckenzie@mtsinai.on.ca.

**Reference**

1. Evidence-Based Medicine Working Group. Evidence-based medicine. *JAMA* 1992;268:2420-5.

## Selected article

Morrison AC, 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;154:157–62.

## Abstract

**Question:** Has the implementation of the resident work hours restriction of 80 hours per week impacted on mortality of injured patients and the resources used to care for them? **Design:** Retrospective cohort study. **Data source:** National Trauma Data Bank (NTDB) version 6.2. **Results:** Overall mortality decreased from 4.64% in the pre–80 hour work week to 4.46% in the post–80 hour week ($p < 0.001$). Of particular interest were the differences in outcomes observed in academic versus nonacademic institutions. In university hospitals, the mortality decreased from 5.16% to 5.03% ($p = 0.03$), whereas in nonteaching hospitals, mortality increased from 3.38% to 3.85% ($p < 0.001$). There were also small but statistically significant improvements seen in secondary outcomes during the post–80 hour work week. **Conclusion:** The 80-hour work week has not resulted in significant deterioration in the outcome of injured patients.

## Commentary

In July 2003, the American Council on Graduate Medical Education (ACGME) instituted mandatory work hour regulations based on resident and patient safety factors. The ACGME mandated this change without prior study of its impact or long-term effects on resident education. Since its implementation, there has been an overwhelming amount of surgical education literature focused on examining the effects on patient outcomes, resident safety outcomes and on the delivery of medical education within these duty hour limitations. Surgical residency educators who traditionally relied on long work hours as a means to instill a strong work ethic and patient responsibility and to teach complex procedural tasks have expressed the most concern.

This retrospective cohort study compares mortality and resource consumption from a national data set of injured patients (National Trauma Data Bank; NTDB) in the 24 months before the implementation of work hour restrictions to the mortality and resource consumption in the 24 months after the restrictions were implemented. The work hour restrictions were implemented Jul. 1, 2003. The only information on the date of admission available from the database is the year of admission, so all data from 2003 were excluded. The pre–80 hour work week cohort included patients admitted between Jan. 1, 2001, and Dec. 31, 2002, and the post–80 hour work week cohort included patients admitted between Jan. 1, 2004, and Dec. 31, 2005.

The NTDB version 6.2 contains information on injured patients admitted to more than 400 hospitals in the United States and Puerto Rico. Data in this version were submitted voluntarily and represent a convenience sample rather than a population-based sample. There are several sources of potential bias and error that result. First, only patients admitted to hospital are included in the NTDB. Hospitals may have different definitions of dead on arrival, so some patients might be included from 1 centre and excluded from another, resulting in different estimates of overall mortality at each centre. Some hospitals include patients with isolated hip fractures and ground level falls and transmit these data to the NTDB. These patients have a low likelihood of mortality during the initial admission, and this selection bias will result in a lower risk-adjusted mortality for hospitals that include these patients. The percentage of patients with hip fractures and those classified as dead on arrival vary from 0% to 40% among participating hospitals, a percentage unlikely to reflect true differences in the injured population seen at these hospitals. Although these differences should not affect the results of this before–after study, this assumes that there were no changes in individual hospital policies with respect to definitions of dead on arrival and inclusion of patients with ground level falls, which may or may not be true.

Overall mortality decreased from 4.64% in the pre–80 hour work week to 4.46% in the post–80 hour work week ($p < 0.001$). This decrease was seen in moderately and severely injured patients, whereas mortality increased in patients with mild injuries. The decrease was also seen in all but elderly patients (> 55 years), in whom mortality increased significantly. There were significant decreases in overall length of stay (from 6.0 to 5.8 days; $p < 0.001$), intensive care unit (ICU) days (from 6.2 to 6.1 d; $p = 0.014$) and mechanical ventilation days (from 7.6 to 7.5 d; $p = 0.047$). In teaching hospitals, mortality decreased from 5.16% to 5.03% ($p = 0.03$), whereas in nonteaching hospitals, mortality increased from 3.37% to 3.85% ($p < 0.001$). The length of stay remained the same in teaching hospitals and increased in nonteaching hospitals.

Given the large number of patients in the study, it is unlikely that the differences in the length of stay, ICU days and mechanical ventilation days are clinically significant. Any actual difference in mortality is important from an individual standpoint; the authors do not provide confidence intervals, so it is impossible to know the precision of differences in mortality or secondary outcomes.

Two important determinants of mortality in injured patients are injury severity and age. The post–80 hour group had a slightly higher injury severity score, and the group was somewhat older, although it is unclear whether these differences were significant, supporting the conclusion that the differences seen were not due to differences in the 2 populations, at least with respect to the factors related to the primary outcome. The other primary factor

related to outcome is the mechanism of injury; this information is not presented, but most patients in the NTDB have a blunt mechanism of injury, and this is not likely to have been significantly different in the 2 study periods.

One of the limitations of this study is the presence of a large number of unmeasured confounders. The study period from 2001 to 2005 was notable in a number of ways. Prehospital care and regionalization of trauma care were both associated with improved outcomes. Nathens and colleagues[1] concluded that the effect of regionalization may not be evident until 10 years following implementation, a finding consistent with the maturation and development of trauma triage protocols, interhospital transfer agreements, organization of trauma centres and continuous quality assurance. The precise nature of the trauma systems participation of programs included in this study is unclear; only their trauma centre designation was reported. If we were to examine mortality over the next 10 years, we would likely continue to see reductions in mortality, irrespective of how much the residents work.

With respect to the resource consumption outcomes, decreasing overall length of stay, mechanical ventilation days and ICU stay is a focus of many quality and cost-saving efforts. Length of stay has been decreasing over time in many disease states owing to the high costs of inpatient admissions and the many drivers toward outpatient care. To relate this to resident work hours without addressing other potential factors, such as indexing to other diseases, looking at rates in the years before and after the study periods and adjusting for insurance status, is problematic. For instance, if length of stay for trauma patients was decreasing in the years before the study period and continued to decrease in the years after, this likely reflects overall quality improvement activities and hospital efforts to decrease length of stay rather than resident work hours. Similarly, if the effect is seen across all diseases in both teaching and nonteaching hospitals, it is less likely to be related to resident work hours, as they care for trauma patients.

The most important confounder with respect to the intervention or difference in resident work hours is the faculty presence. The inference is that most care provided to these patients was provided by residents. Faculty presence is required at the highest level of trauma activation at all level 1 and 2 trauma centres, which would encompass nearly all of the teaching hospitals. Owing to decreased resident workforce, many centres have come to rely on advance practice providers, both nurse practitioners and physician assistants.[2,3] The presence of faculty and advanced practice providers caring for patients in both time periods is unknown.

Other potential confounders with respect to the primary outcome include increased emphasis on performance improvement with risk-adjustment and targeted improvement activities, focus on ventilator-associated pneumonia, improved resuscitation strategies for hemorrhagic shock, and focus on in-hospital complications. Many of these efforts are concentrated at level 1 trauma centres, which are almost all teaching hospitals, potentially explaining the reason for the differential effect on mortality at teaching and nonteaching hospitals. The presence of so many potential confounders, and the inability to measure them, is the primary methodological problem of this study.

Probably nothing in the last decade has generated more controversy and emotion in the surgical community than the ACGME duty hour rules.[4] Dire predictions of the collapse of quality care in teaching hospitals did not occur. This and subsequent papers have shown that care in teaching hospitals remains safe and, if anything, has incrementally improved as hospitals and physicians have embraced a culture of safety and accountability for outcomes.

We are really not asking the right questions about what it means to put a limit on physician work hours. The public remains concerned about the safety of our hospitals, and the intuitive link between fatigue and error is not going to change. Avoiding impairment from fatigue has become a component of professionalism. Medicine has become a team sport, and no single individual can be expected to have all the answers for any given patient situation.

There is no doubt that there is unrest in our training system; some might even call it a crisis. Perhaps some of this has been precipitated by the duty hour regulations, but focusing solely on the duty hours is a distraction. We should be thinking about all of the other profound changes that have occurred over the last decade and the even more disruptive changes that we can see on the horizon. As we have learned from the quality literature, the solution is not to work harder or longer, but to work smarter.

**Competing interests:** None declared.

## References

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