Duty Hours: Time to Study?

Vineet M. Arora, MD, MAPP
Kevin G. M. Volpp, MD, PhD

As the nation's teaching hospitals implement the next rendition of limits for physicians-in-training on work hours during residency, it is imperative to understand the impact of such sweeping changes. There are a number of important questions related to the impact of duty hours on resident education and patient outcomes. At the same time, the medical education community must not lose sight of the many research questions, independent of duty hours, that must be answered to optimally configure resident education. Developing and implementing a comprehensive, coordinated research agenda around resident education addresses these larger matters, as well as the issues related to duty hours specifically, and will drive innovation and testing of new approaches, with the goal of facilitating the spread of best practices that optimize resident education and patient care outcomes.[1]

Challenges of Studying the New Duty Hour Limits

Evaluating the full impact of duty hour reform is challenging for several reasons. The first problem is that there are many factors affecting care delivery in teaching hospitals and it is difficult to disentangle the factors that are driven by duty hour reform from those caused by environmental or other factors. To some degree this can be done by using a "difference in difference" approach in which relevant educational or clinical metrics are compared from the time period before to right after duty hour changes in more versus less teaching-intensive hospitals.[2,3] By examining the relatively short time period that encompasses duty hour reform, it is likely that resident duty hour reform is the most significant catalyst for observed changes in program structure or clinical practices. However, over longer time periods, assessment of clinical or educational outcomes will be affected by all sorts of measured and unmeasured confounders. Unfortunately, this limits our ability to examine the key question: what is the long-term impact of duty hour changes on clinical skills and quality of care provided by trainees over decades of practice?

A second limitation to examining the impact of changes in resident duty hours is that the typical patient in a teaching hospital is cared for by many resident and nonresident providers, such that attribution is difficult with available administrative data. The increasing use of services staffed exclusively by nonresident providers, such as hospitalists and nonphysician clinicians, makes it even more challenging to identify patients cared for by residents. As a result, in national studies examining duty hours with administrative data, we can only measure mean impacts among all patients admitted to a given hospital with particular diagnoses.

Third, because policies like duty hour reform have been uniformly applied to all residency programs, concurrent control groups are not available. While nonteaching or less teaching-intensive hospitals have been used for this purpose, this approach is only valid if the trends prereform are similar in both the teaching and nonteaching groups.[2,3] In cases where this is not true, it is difficult to know whether any divergence in trends postduty hours is truly due to a particular reform or would have happened regardless.

Research Priorities

Given the challenges in examining the full impact of duty hours, it is important to consider the top research priorities for medical education in the context of 2011 duty hour reform. We have presented these research priorities as a top 10 list, which encompasses not only the impact of the 2011 duty hour reforms on desired outcomes but also the systematic investigation of unintended consequences and broader examination of the structure and processes used to train residents and care for patients (BOX).

We focus on clinical outcomes first because a primary motivation for limiting duty hours was the desire to reduce high rates of medical errors discussed in the Institute of Medicine's report *To Err Is Human*.[4] For many, the 2011 duty hours will be considered a "success" or "failure" based on what happens to patient outcomes. Systematic assessment of the impact of duty hour reform on different types of patients, which includes analysis of variable implementation of the 2011 duty hour standards, would be extremely valuable. Since the research that most directly supported the 2011 duty hour standards was conducted in an intensive care unit, examination of the 16-hour shift model in non–intensive care unit settings, across a number of dimensions, will be essential.[5] Different specialties will respond differently to the new requirements; effects should be carefully measured and compared across different surgical and medical fields.

Although these proximate outcomes are important to study, duty hour changes will have long-term impacts on

Vineet M. Arora, MD, MAPP, is Associate Professor of Medicine and Assistant Dean for Scholarship and Discovery, Pritzker School of Medicine, and Associate Program Director, Internal Medicine Residency Program, Department of Medicine, University of Chicago; and **Kevin G. M. Volpp, MD, PhD,** is Director, Philadelphia VA Center for Health Equity Research and Promotion, Professor, Department of Medicine, Perelman School of Medicine, and Professor, the Wharton School, University of Pennsylvania.

Corresponding author: Vineet M. Arora, MD, MAPP, University of Chicago, 5841 S Maryland Avenue, MC 2007 AMB W216, Chicago IL 60637, 773.702.8157, varora@uchicago.edu

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patient outcomes, through effects on resident education and resident well-being. These effects also will be difficult to evaluate. However, measures exist that could be used as proxies for resident education and well-being, like board score performance,[6] resident burnout,[7] rates of occupational hazards,[8] and car accidents.[9] A key aspect of resident well-being and a new element of the Accreditation Council for Graduate Medical Education's (ACGME's) 2011 common standards is the concept of "fitness for duty," which encompasses much more than fatigue. The ACGME 2011 Program Requirements call for residents to maintain alertness for their learning and patient care activities, and for residents and faculty to demonstrate an understanding and acceptance of their personal role, including management of their time before, during, and after clinical assignments. While it remains to be seen how programs will accomplish oversight of residents' management of their time away from the educational program, a natural starting place is to examine whether clinical work is performed outside of the hospital. The assumption that residents stop doing clinical work when they leave the hospital has been challenged outright with the advent of electronic health records, which enable remote access from home.[10,11] While this may reflect professional duty to continue patient care, the ACGME has further clarified that any clinical work, even if done from home, is to be counted toward the duty hour limits.[12] With the increasing use of electronic health records, understanding the frequency and nature of out-of-hospital clinical work is both paramount and possible. The difference between at-home study, which is not counted toward duty hours, and at-home clinical work, which will be counted, deserves analysis regarding successful accomplishment of the full-range of training competencies and potential relationships to fatigue, sleep, and "fitness for duty."

The mechanism whereby eliminating 30-hour shifts for interns could improve patient care most obviously relates to reduction of acute sleep deprivation and chronic sleep deprivation. It is important to document whether the changes observed are in fact due to improvements in sleep deprivation. While previous studies have shown that working less is associated with more resident sleep, residents still do not get adequate preventive and recovery sleep in the face of acute sleep loss owing to a variety of reasons.[13,14] In addition, with the incorporation of shift work and anticipated increase in night work for residency trainees, understanding how residents cope with increased night work and circadian challenges becomes imperative to optimize performance and learning.[15]

Unintended Consequences of New Duty Hour Limits

It is equally important to understand any unintended consequences of duty hour limits. One obvious and feared set of consequences are those due to untoward effects of increasing handoffs, often described as haphazard.[16] Unfortunately, the handoff research to date is limited in its ability to link handoff performance to patient outcomes, most likely owing to the complex system in which handoffs tend to operate. Future work should focus on evaluating the impact of systematic handoff improvements on patient outcomes, and testing the comparative effectiveness of new models. In addition to ensuring that handoff education is effective, it is equally important to understand what types of characteristics of handoffs are most desirable. As services are redesigned, it will be essential to study handoffs that provide more or less continuity for a given set of patients. For example, a handoff that occurs between 2 residents who are personally familiar with the patient, because they are both members of the team, ensures greater continuity than a handoff between a resident to a "floating" resident who is not a member of the team.

In addition to handoffs, increasing work intensity is another potential unintended consequence of restricting duty hours.[17] Because one response to work hour reforms may be to reduce hours without a corresponding decrease in workload, the intensity of work may grow. Increasing work intensity may result in a tradeoff in which errors due to fatigue are replaced by errors due to overwork, multitasking, or interruptions.[18] It is not clear at what point the pace of work reaches a level at which it is overly frenetic and thereby harmful to both residents and their patients.[19,20] For example, it is uncertain whether a resident should admit patients in a "bolus," concentrated over several hours or on 1 day of the week, or using a "drip" model, in which the resident admits a limited number of patients throughout the week.

BOX Research Priorities for Evaluating the Impact of Duty Hours: A Top 10 List

1. Impact of 2011 duty hours on immediate patient outcomes (eg, errors and patient quality)
2. Variability of effects of duty hour standards in different types of units (floor versus intensive care unit) and specialties
3. Impact of 2011 duty hours on resident education (eg, board examination scores)
4. Impact of 2011 duty hours on resident health and performance, including sleep and other metrics of cognitive performance
5. Defining optimal work intensity to catalyze learning while minimizing errors
6. Methods to monitor and define adequate clinical experiences for residents
7. Methods to ensure residents are fit for duty and are appropriately managing their time, including sleep, before and after duty periods
8. Types of handoff structure and processes that are safest
9. Characteristics of a qualified supervisor and which supervision methods are most effective
10. The best structure for resident teams

Experiential learning through patient care remains a cornerstone of training. Monitoring and assuring satisfactory clinical experiences, for the formation of clinical competence, is critical to the mission of residency training. Currently, this may be more straightforward to assess in some specialties than others. For instance, surgical residents are required to submit case logs to ACGME, which catalogs the frequency and type of operations per resident. These data can be used to ascertain changes in operative experience with the new duty hour reforms in addition to balancing case loads or assuring that a graduating resident has been exposed to a diversity of cases. However, this type of reporting is not mandated for all residencies. In addition, participation may be viewed differently by various residencies, such that brief involvement rather than full participation may occur, related to fewer available work hours. With prior duty hour reductions in 2003, surgical programs shifted some surgical training to the clinical simulation laboratory; experts predict that further shifts may occur, which mandates study of the ensuing effects on graduating residents.[21]

Future work should focus on examining the minimum level of experience in a variety of clinical domains to become proficient. Given the potential value of such information, it is worth advocating for a standardized reporting system in billing data, to attribute care of patients to specific residents. A pilot project to ensure correct attribution of patients to a specific resident could be undertaken in Medicare or University HealthSystem Consortium and serve as the foundation for developing the system on a larger scale.

As part of the new work limits, ACGME is placing a greater emphasis on supervision. It is currently unclear what types of supervision practices and approaches will ultimately result in the formation of independent clinical practitioners. Given the extremes in attending physicians' supervision styles, coupled with the variability in proficiency among residency trainees, a one-size-fits-all approach is unlikely to be effective.[22] This raises the question of whether matching specific residents and attending physicians to optimize learning should become more systematic. Given the dual role that senior residents play as learners and supervisors to more junior residents, it is also important to define the characteristics of a qualified supervisor.

Last but not least, it is important to understand how to best structure resident clinical teams. Unfortunately, studies of how to structure teams in residency training are lacking. Team structure tends to be driven by clinical service needs as opposed to optimal residency education. This stands in sharp contrast to the military, in which teams train together extensively. In contrast, resident teams are often broken apart every 1 to 4 weeks as residents move from rotation to rotation, which may result in a reliance on survival tactics and workarounds to adjust to new environments.[23] Matching of interns and residents is often done randomly. Careful research on team structure, scheduling, and matching could yield considerable dividends in terms of improved team and individual performance.

Barriers and Solutions

A major hurdle to advancing this research agenda is the paucity of reliable funding sources for research in medical education.[24] To our knowledge, none of the National Institutes of Health (NIH) institutes have declared this to be a special interest. Moreover, the disease-specific nature of NIH institutes precludes to some degree obtaining funds for studying issues in medical education that cut across clinical domains. Although residency education affects the care of millions of Americans, on whom hundreds of billions of dollars per year are spent in clinical care, there is no current mechanism to examine how well these funds are spent. Putting a small percentage of funds, now spent on indirect medical education, toward research on medical education would dramatically increase the amount of scholarship that could be conducted. This scholarship would, by promoting solutions that affect large portions of the US population, have considerable impact on the quality of future patient care.

The 2011 duty hour reforms will substantially change the way residency education is conducted in teaching hospitals throughout the United States. There are a number of priority issues that have always been important for medical educators to understand; they are now of critical importance. The complex interactions between duty hours, education, and clinical outcomes highlight the need for careful retrospective analysis of effects as well as rigorous testing of new approaches.

References

1 Volpp KG, Landrigan CP. Building physician work hour regulations from first principles and best evidence. *JAMA*. 2008;300(10):1197–1199.
2 Volpp KG, Rosen AK, Rosenbaum PR, et al. Mortality among patients in VA hospitals in the first 2 years following ACGME resident duty hour reform. *JAMA*. 2007;298(9):984–992.
3 Volpp KG, Rosen AK, Rosenbaum PR, et al. Mortality among hospitalized Medicare beneficiaries in the first 2 years following ACGME resident duty hour reform. *JAMA*. 2007;298(9):975–983.
4 Kohn LT, Corrigan JM, Donaldson, eds; Committee on Quality of Health Care in America. *To Err Is Human: Building a Safer Health System*. Washington, DC: National Academies Press; 2000.
5 Landrigan CP, Rothschild JM, Cronin JW, et al. Effect of reducing interns' work hours on serious medical errors in intensive care units. *N Engl J Med*. 2004;351(18):1838–1848.
6 Papadakis MA, Arnold GK, Blank LL, Holmboe ES, Lipner RS. Performance during internal medicine residency training and subsequent disciplinary action by state licensing boards. *Ann Intern Med*. 2008;148(11):869–876.
7 Gopal R, Glasheen JJ, Miyoshi TJ, Prochazka AV. Burnout and internal medicine resident work-hour restrictions. *Arch Intern Med*. 2005;165(22):2595–2600.
8 Ayas NT, Barger LK, Cade BE, et al. Extended work duration and the risk of self-reported percutaneous injuries in interns. *JAMA*. 2006;296(9):1055–1062.
9 Barger LK, Cade BE, Ayas NT, et al. Extended work shifts and the risk of motor vehicle crashes among interns. *N Engl J Med*. 2005;352(2):125–134.
10 Mourad M, Vidyarthi AR, Hollander H, Ranji SR. Shifting indirect patient care duties to after hours in the era of work hours restrictions. *Acad Med*. 2011;86(5):586–590.
11 Deaño RC, DeKosky A, Appannagari A, et al. Resident time spent in clinical and educational activities at home: implications for duty hours. *Arch Intern Med*. 2011;171(11):1038–1039.

12 Accreditation Council of Graduate Medical Education. Frequently asked questions about the ACGME common duty hours standards. http://www.acgme.org/acwebsite/dutyhours/dh-faqs2011.pdf. Accessed June 10, 2011.

13 Baldwin DC Jr, Daugherty SR, Tsai R, Scotti MJ Jr. A national survey of residents' self-reported work hours: thinking beyond specialty. *Acad Med*. 2003;78(11):1154–1163.

14 Arora VM, Georgitis E, Woodruff J, Humphrey H, Meltzer D. Improving the sleep hygiene of medical interns: can the S.A.F.E.R. program help? *Arch Intern Med*. 2007;167(16):1738–1744.

15 Reed DA, Fletcher KE, Arora VM. Systematic review: association of shift length, protected sleep time, and night float with patient care, residents' health, and education. *Ann Intern Med*. 2010;153(12):829–842.

16 Volpp KG, Grande D. Residents' suggestions for reducing errors in teaching hospitals. *N Engl J Med*. 2003;348(9):851–855.

17 Arora VM, Georgitis E, Siddique J, et al. Association of workload of on-call medical interns with on-call sleep duration, shift duration, and participation in educational activities. *JAMA*. 2008;300(10):1146–1153.

18 Fletcher KE, Reed DA, Arora VM. Doing the dirty work: measuring and optimizing resident workload. *J Gen Intern Med*. 2011;26(1):8–9.

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

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

21 Accreditation Council for Graduate Medical Education. Report of the ACGME Work Group on Resident Duty Hours. Chicago, IL: ACGME; June 11, 2002.

22 Farnan JM, Johnson JK, Meltzer DO, Humphrey HJ, Arora VM. On-call supervision and resident autonomy: from micromanager to absentee attending. *Am J Med*. 2009;122(8):784–788.

23 Bernabeo EC, Holtman MC, Ginsburg S, Rosenbaum JR, Holmboe ES. Lost in transition: the experience and impact of frequent changes in the inpatient learning environment. *Acad Med*. 2011;86(5):591–598.

24 Reed DA, Cook DA, Beckman TJ, Levine RB, Kern DE, Wright SM. Association between funding and quality of published medical education research. *JAMA*. 2007;298(9):1002–1009.