

Sleep deprivation

An in-depth understanding of the pathogenesis and mechanisms of [sleep disorders](#) is important for finding reliable treatments and interventions in the future. A study aims to explore the effect of sleep deprivation by modified multiple platform-water maze (MMP-WM) on rat neurological function and Tau protein in the hippocampus, as well as the intervention effect of [remimazolam](#). First, 40 Sprague Dawley (SD) rats were divided into a control group (no treatment), a Rem group (remimazolam), an MMP-WM group (sleep deprivation model in rats established by MMP-WM), and a combined group (MMP-WM + remimazolam). Five rats were randomly selected from each group for behavior tests at 1 d and 7 d of drug administration or sleep deprivation for Morris water maze and open field test. After that, the rats were executed, the hippocampus was isolated for Nissl staining, and the protein expression of phosphorylated Tau (p-Tau) in the CA1 region of the hippocampus was measured by immunohistochemistry. At 1 d, the status in the MMP-WM group was more similar to that in the control group. The MMP-WM group showed sparsely arranged hippocampal CA1 neurons, reduced number of Nissl bodies, prolonged escape latency, decreased number of platform crossings and percentage of activity time in the central region, substantially increased p-Tau expression. In contrast, the combined group showed significant improvement in nerve injury, behavior test results, and p-Tau at 7 d compared with the MMP-WM group and the same group at 1 d. In addition, detection of brain-derived neurotrophic factor (BDNF) and neurotransmitter levels in the cerebrospinal fluid also showed improved neurologic function in the combined group. These results confirm that MMP-WM was effective in the establishment of sleep sleep-deprivation rat model that accurately reflects the pathological manifestations of sleep disorders in humans, and the use of remimazolam effectively reversed the pathological damage in sleep-deprived rats. ¹⁾.

Long [working hours](#) and [sleep deprivation](#) have been a facet of [physician training](#) in the US since the advent of the modern residency system. However, the scientific evidence linking fatigue with deficits in human performance, accidents and errors in industries from aeronautics to medicine, nuclear power, and transportation has mounted over the last 40 years. This evidence has also spawned regulations to help ensure public safety across safety-sensitive industries, with the notable exception of medicine. In late 2007, at the behest of the US Congress, the Institute of Medicine embarked on a year-long examination of the scientific evidence linking resident physician sleep deprivation with clinical performance deficits and medical errors. The Institute of Medicine's report, entitled "Resident duty hours: Enhancing sleep, supervision and safety", published in January 2009, recommended new limits on resident physician work hours and workload, increased supervision, a heightened focus on resident physician safety, training in structured handovers and quality improvement, more rigorous external oversight of work hours and other aspects of residency training, and the identification of expanded funding sources necessary to implement the recommended reforms successfully and protect the public and resident physicians themselves from preventable harm. Given that resident physicians comprise almost a quarter of all physicians who work in hospitals, and that taxpayers, through Medicare and Medicaid, fund graduate medical education, the public has a deep investment in physician training. Patients expect to receive safe, high-quality care in the nation's teaching hospitals. Because it is their safety that is at issue, their voices should be central in policy decisions affecting patient safety. It is likewise important to integrate the perspectives of resident physicians, policy makers, and other constituencies in designing new policies. However, since its release, discussion of the Institute of Medicine report has been largely confined to the medical education community, led by the Accreditation Council for Graduate Medical Education (ACGME). To begin gathering these perspectives and developing a plan to implement safer work hours for resident

physicians, a conference entitled “Enhancing sleep, supervision and safety: What will it take to implement the Institute of Medicine recommendations?” was held at Harvard Medical School on June 17-18, 2010. This White Paper is a product of a diverse group of 26 representative stakeholders bringing relevant new information and innovative practices to bear on a critical patient safety problem. Given that our conference included experts from across disciplines with diverse perspectives and interests, not every recommendation was endorsed by each invited conference participant. However, every recommendation made here was endorsed by the majority of the group, and many were endorsed unanimously. Conference members participated in the process, reviewed the final product, and provided input before publication. Participants provided their individual perspectives, which do not necessarily represent the formal views of any organization. In September 2010 the ACGME issued new rules to go into effect on July 1, 2011. Unfortunately, they stop considerably short of the Institute of Medicine's recommendations and those endorsed by this conference. In particular, the ACGME only applied the limitation of 16 hours to first-year resident physicians. Thus, it is clear that policymakers, hospital administrators, and residency program directors who wish to implement safer health care systems must go far beyond what the ACGME will require. We hope this White Paper will serve as a guide and provide encouragement for that effort.

RESIDENT PHYSICIAN WORKLOAD AND SUPERVISION: By the end of training, a resident physician should be able to practice independently. Yet much of resident physicians' time is dominated by tasks with little educational value. The caseload can be so great that inadequate reflective time is left for learning based on clinical experiences. In addition, supervision is often vaguely defined and discontinuous. Medical malpractice data indicate that resident physicians are frequently named in lawsuits, most often for lack of supervision. The recommendations are: The ACGME should adjust resident physicians workload requirements to optimize educational value. Resident physicians as well as faculty should be involved in work redesign that eliminates nonessential and noneducational activity from resident physician duties. Mechanisms should be developed for identifying in real-time when a resident physician's workload is excessive, and processes developed to activate additional providers. Teamwork should be actively encouraged in delivery of patient care. Historically, much of medical training has focused on individual knowledge, skills, and responsibility. As health care delivery has become more complex, it will be essential to train resident and attending physicians in effective teamwork that emphasizes collective responsibility for patient care and recognizes the signs, both individual and systemic, of a schedule and working conditions that are too demanding to be safe. Hospitals should embrace the opportunities that resident physician training redesign offers. Hospitals should recognize and act on the potential benefits of work redesign, eg, increased efficiency, reduced costs, improved quality of care, and resident physician and attending job satisfaction. Attending physicians should supervise all hospital admissions. Resident physicians should directly discuss all admissions with attending physicians. Attending physicians should be both cognizant of and have input into the care patients are to receive upon admission to the hospital. In-house supervision should be required for all critical care services, including emergency rooms, intensive care units, and trauma services. Resident physicians should not be left unsupervised to care for critically ill patients. In settings in which the acuity is high, physicians who have completed residency should provide direct supervision for resident physicians. Supervising physicians should always be physically in the hospital for supervision of resident physicians who care for critically ill patients. The ACGME should explicitly define “good” supervision by specialty and by year of training. Explicit requirements for intensity and level of training for supervision of specific clinical scenarios should be provided. Centers for Medicare and Medicaid Services (CMS) should use graduate medical education funding to provide incentives to programs with proven, effective levels of supervision. Although this action would require federal legislation, reimbursement rules would help to ensure that hospitals pay attention to the importance of good supervision and require it from their training programs.

RESIDENT PHYSICIAN WORK HOURS: Although the IOM “Sleep, supervision and safety” report provides a comprehensive review and discussion of all aspects of graduate medical education training, the report's focal point is its recommendations regarding the hours that resident physicians are currently required to work. A considerable body of

scientific evidence, much of it cited by the Institute of Medicine report, describes deteriorating performance in fatigued humans, as well as specific studies on resident physician fatigue and preventable medical errors. The question before this conference was what work redesign and cultural changes are needed to reform work hours as recommended by the Institute of Medicine's evidence-based report? Extensive scientific data demonstrate that shifts exceeding 12-16 hours without sleep are unsafe. Several principles should be followed in efforts to reduce consecutive hours below this level and achieve safer work schedules. The recommendations are: Limit resident physician work hours to 12-16 hour maximum shifts A minimum of 10 hours off duty should be scheduled between shifts Resident physician input into work redesign should be actively solicited Schedules should be designed that adhere to principles of sleep and circadian science; this includes careful consideration of the effects of multiple consecutive night shifts, and provision of adequate time off after night work, as specified in the IOM report Resident physicians should not be scheduled up to the maximum permissible limits; emergencies frequently occur that require resident physicians to stay longer than their scheduled shifts, and this should be anticipated in scheduling resident physicians' work shifts Hospitals should anticipate the need for iterative improvement as new schedules are initiated; be prepared to learn from the initial phase-in, and change the plan as needed As resident physician work hours are redesigned, attending physicians should also be considered; a potential consequence of resident physician work hour reduction and increased supervisory requirements may be an increase in work for attending physicians; this should be carefully monitored, and adjustments to attending physician work schedules made as needed to prevent unsafe work hours or working conditions for this group "Home call" should be brought under the overall limits of working hours; work load and hours should be monitored in each residency program to ensure that resident physicians and fellows on home call are getting sufficient sleep Medicare funding for graduate medical education in each hospital should be linked with adherence to the Institute of Medicine limits on resident physician work hours.

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Cheng H, Gan L, Wang Y, Li L, Li Y. Effect of sleep deprivation by MMP-WM on rat neurological function and Tau protein in hippocampus. *Cell Mol Biol (Noisy-le-grand)*. 2023 Nov 15;69(11):103-108. doi: 10.14715/cmb/2023.69.11.16. PMID: 38015534.

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