



Residency/Fellowship Training and the Complication

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Introduction

Complications occur in medicine and lead to myriad losses, ranging from years of independent living to economic productivity and ultimately also including insurance and hospital costs. Hospitals and practitioners endeavor to minimize complications with strategies such as preoperative checklists, “hard stops” built into electronic medical records, and conferences devoted to the discussion of complications. Teaching hospitals embrace challenges beyond providing quality care and effectively avoiding complications; they also bear responsibility for training future physicians and surgeons. The need to effectively train residents and fellows introduces new challenges into complication prevention schemes. Greater experience understandably may lead to fewer complications; however, the experience necessary for complication avoidance and safe practice must be acquired during residency. Thus, training programs and teaching hospitals grapple with the challenge of providing minimally experienced residents with the experience necessary for independent practice while not exposing patients to undue complication risks. This chapter examines the connection between physicians in training and complications, the impact of hour restrictions and burnout on complications, as well as the resident liability in malpractice cases.

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Trainees and the Impact on Complication Rates

The relationship between resident/fellow participation and complications has long been a topic of speculation and investigation. A study specifically considering the impact of experience on complications and adverse outcomes compared error rates in June, the end of the medical year when residents are considered most experienced in their given roles, with error rates in July, the month when residents are newly promoted and thus least experienced in a particular function [1]. The study was prospective and identified errors through routine patient encounters, rounds, and daily patient chart audits; errors included any instance where incorrect medical care was administered, whether an incorrect action was performed, or if there is a failure to act. Errors involving a resident were specially categorized. The incidence of errors, calculated as a percentage of total patient days, did not differ significantly between June and July, months in which resident experience ostensibly maximally diverges. In June, the error rate was 7.1%, slightly but not significantly lower than the error rate of 7.5% identified in the preceding month of July. However, residents were involved in 52.5% of errors in June, compared with only 39.7% in July, a statistically insignificant difference. Furthermore, in the aforementioned study, 80–90% of errors did not result in adverse outcomes [1]. This study thus suggests that less experienced residents do not make significantly more errors than their more experienced counterparts. Furthermore, the finding that most errors do not adversely impact outcomes suggests that various system checks effectively identify initial errors and prevent their escalation.

Subsequent studies considered the impact of resident participation on surgical outcomes, an especially relevant inquiry given that the experience of the surgeon is widely understood to directly correlate with the probability of a positive outcome. Thus, the direct surgical experience obtained in residency is essential to later successful practice, but one must question whether its acquisition has ever had a negative impact on patient outcomes. A recent study considered this question in the context of one of neurosurgery's most intricate and technically demanding procedures, aneurysm surgery. The study specifically deliberated upon the impact of resident involvement on outcomes in patients undergoing surgical treatment of aneurysms and retrospectively contrasted outcomes of procedures featuring resident participation with those of surgeries involving only an attending. Notably, the study restricted its focus to aneurysms less than 1 cm in size and located in the internal carotid artery, with the understanding that these are simpler aneurysms more likely to permit substantial contributions from an assisting resident [2]. Indeed, authors noted that advanced participating residents were expected to perform critical maneuvers within the case, including dissection of the Sylvian fissure and aneurysm neck, along with clip placement. After the authors reviewed 355 operative cases, 196 involving residents and the remaining 159 performed without residents, they identified no statistically significant difference in the incidence of permanent adverse outcomes [2]. This study supports the idea that resident education, for the benefit of future patients, and effective care of current patients may be pursued in tandem.

A larger, recent retrospective review of resident impact echoed earlier studies in finding no significant risk associated with the presence and participation of training residents in surgical care. This study compared patients who had undergone neurosurgical procedures with only an attending to those operated on by a team

including a resident and an attending with regard to 30-day postoperative morbidity and mortality. Notably, patients whose team included residents experienced both a significantly higher complication rate and mortality rate, at 20.12% and 2.07%, respectively. These rates unfavorably contrast with the attending-only rates of 11.70% and 1.22%. However, upon multivariate analysis, there was no significant difference in either 30-day morbidity or mortality between the groups [3]. Thus, resident participation, as an independent variable, did not correlate with an increased risk of complications or death; rather residents may have been more likely to play a role in the care of patients with more significant comorbidities or those patients who were undergoing riskier procedures [3].

Fatigue, Burnout, and Restricted Work Hours

Despite no strong evidence that resident participation directly leads to more complications and worse outcomes, residents are indeed in training and thus lack the experience and procedural memory that often enable practiced attendings to deftly perform complex procedures. Where experience is necessarily lacking and cannot itself protect against complications, supervisors and mentors must look to other strategies for preventing complications in care administered by residents. Thus, burnout and fatigue due to long hours and sleep deprivation have emerged as rectifiable potential contributors to complications.

Burnout has been characterized as a chronic stress-induced syndrome resulting in depersonalization, emotional exhaustion, and perceived incompetence in the workplace [4, 5]. Medical and surgical residents are particularly at risk for burnout due to the demanding nature of their job, lack of autonomy, and long irregular hours that they often work [5, 6]. In a study published in 2002, which surveyed residents in an internal medicine residency program, nearly 76% were found to have met the criteria for burnout [7]. These rates can, however, vary from one study to another based on the matrices used in the evaluation of burnout.

Performance deficits are a serious consequence of emotional exhaustion and can result from sleep deprivation and long working hours. Friedman et al. reported that interns were less likely to detect arrhythmias on electrocardiograms when sleep deprived as compared with well rested [8]. Grantcharov and colleagues further demonstrated that a single night on call had profound effects on psychomotor performance during laparoscopic surgery (as assessed via a simulator), resulting in decreased accuracy and increased error rates [9]. Among neurosurgical residents, Ganju and colleagues reported a 13.1% average decrease in performance after a call shift. Variables these authors collected and factored into their analysis included elapsed time for procedures, incidence of cognitive errors, and tool handling/smoothness [10].

Seeking to mitigate the effects of long work hours on residents' performance in the clinical setting, the Accreditation Council for Graduate Medical Education (ACGME) mandated an 80-h work week for residents in 2003. The ACGME also established that residents were to work for no longer than 24 h at a time with an additional 6 h allotted for educational activities and continuity of patient care [11, 12]. In a prospective study evaluating the effects of these changes on surgical residents' job satisfaction, motivation, and quality of life, the researchers found decreased

rates of burnout and an increased motivation to work; however, they identified no statistically significant differences in the quality of patient care administered [11]. Similar results were observed in a study surveying internal medicine residents at the University of Colorado before and after implementation of the ACGME's work hour restrictions [13]. A prospective study conducted by Dumont et al. [14] contrasted outcomes before and after implementation of the ACGME work hour restrictions on a neurosurgical service and obtained results similar to the previously cited studies [15]. Their study focused upon both morbidity and mortality and subdivided complications within each category into preventable and unpreventable complications. They report a statically significant increase in both overall morbidity and morbidity deemed preventable by the researchers and collaborating attendings. However, the mortality rate was decreased, albeit not significantly, and there was no notable change in preventable mortalities. Furthermore, notable changes in the case mix occurred during the study, with significantly more atraumatic subarachnoid hemorrhages presenting in the years following implementation of work restrictions, and these changes may have had an impact on experienced morbidities and mortalities. The authors cite increased sign-outs and an inferred lack of familiarity with each patient as a possible explanation for the increased morbidity. While this study indicates that hour restrictions are no panacea in the realm of complication prevention, it demonstrates a need for more in-depth and lengthy review.

While addressing burnout in medical residency training programs is of paramount importance, the effects of a reduction in working hours across different medical and surgical specialties remain poorly understood. Proponents of policy changes argue that enhanced resident satisfaction and decreased fatigue will lead to improved performance within the clinical setting. Furthermore, residents working a maximum of 80 h may find themselves with more time to both maintain familiarity with the literature and become academically productive, both of which may improve the quality of patient care delivered in the near future. Critics counter that these policies may affect the quality of education at training programs and can disrupt the continuum of patient care. A common criticism holds that residents will gain exposure to fewer cases under work hour restrictions and thus forfeit the expertise that follows from multiple, repeated exposures. Results from the few early available studies on work hour restrictions are inconsistent, with some supporting a reduction in working hours, others associating such a restriction with an unexpectedly negative impact on patient care, and many finding no significant difference in outcomes. There exists a real need for further investigation, particularly long-term investigation, into the effects of various interventions aimed at reducing physician burnout and avoiding the complications potentially accruing from burnout.

Legal Implications of Trainee-Associated Complications

The manner in which the legal system deals with complications incurred through care delivered by residents is also of relevance, given that legal rulings often alter practice patterns as physicians endeavor to avoid unfavorable rulings. Notably,

in-training status does not afford residents' protection from malpractice claims, and estimates hold that approximately 22% of lawsuits name a resident among other possible defendants [15]. Malpractice claims must incorporate four key elements for success before a court; there must exist a duty to provide care, the duty must be breached, there must be a poor outcome, and finally the poor outcome inspiring the suit must be attributable to the breach of duty [16]. The breach of duty represents the most frequently contested element of a malpractice claim and typically requires a deviation from the accepted standard of care. However, the standard of care becomes especially difficult to identify in the case of residents, and courts have grappled with whether to compare residents to their resident peers, to licensed general practitioners, or to attendings within the relevant specialty. Although courts have remained cognizant of the societal value of medical training and aware that experience occurs on a continuum, recent decisions have tended to move from holding residents to a standard of care expected of residents to measuring residents' work against the standards applicable to fully trained specialists [17]. Courts and scholars justify the gradual shift on several grounds: residents may present themselves as physicians to patients who in turn reasonably assume that the standard of care associated with a fully trained specialist physician will be met. Furthermore, residents operate under the supervision of experienced specialists, and this supervision functions to ensure that a higher standard of care is attainable [17]. It follows that residents may improve their position before a court by fully disclosing their resident status to patients; however, even such disclosure does not mollify expectations that a specialist standard of care will be satisfied given the expectation of supervision.

Liability for complications incurred by residents generally extends to their immediate designated supervisors and also to the employing facility. The theory of vicarious liability finds application and permits claims of negligence or of failure to meet a given standard of care to be filed against supervising attendings even when those claims are reference actions of resident physicians [17]. Attendings become liable due to an implied failure to provide adequate supervision. Notably, supervising attendings assume the duty necessary for application of vicarious liability through contracts, on-call schedules, and discussions pertaining to consults and plans for care. Similarly, hospitals necessarily assume a duty to provide care for patients, and upon operating as teaching hospitals, they undertake a responsibility to implement and ensure adequate supervision. Thus, residents may be, and often are, named in claims of medical malpractice and can generally expect to be held to the standard of care associated with a fully trained specialist. However, accountability often extends to specialist supervisors and even teaching hospitals via vicarious liability.

Conclusion

In applied specialties such as neurosurgery and neurointerventional surgery, experience is of paramount importance. However, it is precisely experience that resident physicians lack. Several studies have queried a connection between resident care and complications and discovered no definite evidence that resident involvement causes more complications. Efforts to reduce complications,

however, are always relevant and warranted. Work hour restrictions have emerged as a means of preventing complications, yet the necessarily short-term studies available suggest that restrictions have had little impact on complications. When complications do occur, residents' in-training status does not exempt them from legal action. Rather courts generally hold residents to the standard of care expected of a fully trained specialist. Furthermore, vicarious liability extends to supervising specialists and teaching hospitals, given the duty to provide adequate supervision.

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