

The Influence of Intern Home Call on Objectively Measured Perioperative Outcomes

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Hypothesis: In July 2011, surgical interns were prohibited from being on call from home by the new residency review committee guidelines on work hours. In support of the new Accreditation Council for Graduate Medical Education work-hour restrictions, we expected that a period of intern home call would correlate with increased rates of postoperative morbidity and mortality.

Design: Prospective cohort.

Setting: University-affiliated tertiary Veterans Affairs Medical Center.

Patients: All patients identified in the Veterans Affairs National Surgical Quality Improvement Program database who underwent an operation performed by general, vascular, urologic, or cardiac surgery services between fiscal years (FYs) 1999 and 2010 were included.

Main Outcome Measures: During FYs 1999-2003, the first call for all patients went to an in-hospital intern. In

the subsequent period (FYs 2004-2010), the first call went to an intern on home call. Thirty-day unadjusted morbidity and mortality rates and risk-adjusted observed to expected ratios were analyzed by univariate analysis and joinpoint regression, respectively.

Results: Unadjusted overall morbidity rates decreased between 1999-2003 and 2004-2010 (12.14% to 10.19%, $P = .003$). The risk-adjusted morbidity observed to expected ratios decreased at a uniform annual percentage change of -6.03% ($P < .001$). Unadjusted overall mortality rates also decreased between the 2 periods (1.76% to 1.26%; $P = .05$). There was no significant change in the risk-adjusted mortality observed to expected ratios during the study.

Conclusions: The institution of an intern home call schedule was not associated with increased rates of postoperative morbidity or mortality.

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JULY 1, 2011, MARKED THE ENACTMENT of the first major revisions to the resident work-hour restrictions initially introduced in 2003. The new regulations put forth by the Accreditation Council for Graduate Medical Education (ACGME) represented an important effort to improve both patient care and resident education. However, given the relative void of evidence supporting both recent and past work-hour policies, further restrictions have been met with skepticism by surgical faculty and house staff alike.^{1,2}

See Invited Critique at end of article

The new ACGME restrictions prohibit interns from being on call from home. The effects of this rule are being felt specifically within small training programs or affiliated hospitals, which typically have

just a few residents to cover multiple inpatient services and/or hospitals. Unlike the new rule limiting intern shifts to 16 hours, which does have some controversial empirical evidence supporting its inclusion,³ to our knowledge, there exists no objective evidence in the medical literature to support the hypothesis that intern home call leads to higher patient morbidity or mortality.

The purpose of the current study was to identify any potential correlation between intern home call and postoperative outcomes. The setting for this study was a single university-affiliated Veterans Affairs (VA) Medical Center. Data collection spanned 12 years (fiscal years [FYs] 1999-2010) during which surgical interns took either in-hospital call (FYs 1999-2003) or call from home (FYs 2004-2010). In support of the new ACGME work-hour restrictions, we expected that the period of intern home call would cor-

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relate with increased rates of postoperative morbidity and mortality.

METHODS

The Stanford University institutional review board deemed this study exempt from review. All patients who underwent a surgical procedure performed by general, vascular, urologic, or cardiac surgery services at a single hospital between FYs 1999 and 2010, and who were captured in the VA National Surgical Quality Improvement Program (NSQIP) database, were included. Data were collected prospectively according to VA-NSQIP protocol, which has been described in detail previously.⁴⁻⁶

Patients were divided into 2 groups. During FYs 1999-2003, the first call for all patients went to a surgical intern spending the night in the hospital. During FYs 2004-2010, a home call policy was enacted to ensure compliance with the recently implemented 80-hour workweek restrictions. During that period, the first call for all ward issues went to a surgical intern on call from home. Emergent issues on ward patients were evaluated by an in-house code team consisting of intensive care unit (ICU) interns and residents. In such situations, deemed emergent by the nursing staff, the first surgical team member notified was the intern on call—either in the hospital (FYs 1999-2003) or at home (FYs 2004-2010)—who would then evaluate the situation and alert the senior resident if necessary. In FY 2004, a rapid response team (RRT) consisting of the same ICU interns and residents was implemented to handle urgent non-code situations in a similar fashion. Surgical ICU patients were cared for by the ICU team consisting of a combination of medicine and surgery interns and postgraduate year 2 residents. Issues arising overnight regarding ICU patients were communicated directly to the senior surgical resident by the ICU team. With the exception of the RRT implementation, these arrangements did not change during the study.

The interns were in their first year of postgraduate training and came from a variety of categorical and preliminary surgical residency programs including general, plastic, vascular, cardiac, neurologic, otolaryngologic, urologic, and orthopedic surgery. The intern on call was responsible for making the assessment of whether the issue could be dealt with by telephone or direct patient evaluation was required. Second-year surgical house officers covered at most 2 home-call shifts per week during both periods and were subject to the same institutional call policies and restrictions as the interns. No other changes to house staff work hours were implemented during this period and no additional staffing changes (ie, the incorporation of nurse practitioners or physician assistants) were made. With the implementation of the home-call schedule, the post-call interns were able to participate in morning clinics and/or surgical procedures following call shifts, obviating the need for additional staffing.

Baseline patient characteristics were collected according to the VA-NSQIP risk-adjustment models. The characteristics that were collected continuously during the study were aggregated for the 2 patient cohorts (FYs 1999-2003 and FYs 2004-2010). Mean patient age in years; percentage of patients who were male; mean preoperative albumin in grams per deciliter; and mean annual percentages of patients undergoing emergency operations with disseminated cancer, documented do not resuscitate orders, weight loss of greater than 10%, sodium level of less than 136 mEq/L or greater than 145 mEq/L, hematocrit of less than 39%, platelet count of less than 151 000/ μ L or greater than 400 000/ μ L, white blood cell count of less than 4.6 k/cm² or greater than 11.0 k/cm², or functional status of 1 through 3 (independent, partially dependent, and totally dependent, respectively) were calculated for each cohort (**Table 1**).

Table 1. Preoperative Patient Characteristics^a

Characteristic	Fiscal Year, % (SD)	
	1999-2003	2004-2010
Age, mean (SD), y	59.95 (0.89)	61.55 (0.53)
Male	94.59 (0.67)	94.79 (1.10)
Albumin, mean (SD), g/dL	3.60 (0.07)	3.79 (0.02)
Emergency operation	5.75 (0.89)	4.12 (0.93)
Disseminated cancer	0.88 (0.66)	1.30 (0.17)
Documented do not resuscitate order	0.89 (0.32)	0.45 (0.08)
Weight loss >10%	0.91 (0.49)	0.76 (0.35)
Sodium, mEq/L		
<136	17.10 (4.71)	13.10 (1.90)
>145	0.51 (0.34)	0.20 (0.11)
Hematocrit <39%	28.07 (2.73)	25.74 (2.99)
Platelet count, / μ L		
<151 000	7.15 (1.32)	6.90 (2.12)
>400 000	5.14 (1.22)	4.60 (1.54)
White blood cell count, k/cm ²		
<4.6	5.08 (0.77)	5.92 (0.66)
>11.0	11.70 (1.28)	9.09 (1.30)
Functional status		
1, independent	94.27 (1.36)	92.00 (2.75)
2, partially dependent	5.30 (1.46)	6.69 (1.82)
3, totally dependent	0.42 (0.31)	1.31 (0.98)

^aAnalysis includes data for general, vascular, and urologic surgery services. Preoperative patient characteristic data from the cardiac surgery service were not available for this analysis.

SI conversion factors: To convert albumin to grams per liter, multiply by 10; hematocrit to proportion of 1.0, multiply by 0.01; and sodium to micromoles per liter, multiply by 1.0.

Unadjusted morbidity and mortality rates were compared using χ^2 analysis in SAS Enterprise Guide version 4.3 (SAS Institute Inc). Changes in risk-adjusted observed to expected (O:E) ratios over time were analyzed using joinpoint regression analysis (Joinpoint Regression Program version 3.5; Statistical Methodology and Applications Branch and Data Modeling Branch, Surveillance Research Program, National Cancer Institute).⁷ Joinpoint regression modeling was applied to both a cumulative set (general, vascular, urologic, and cardiac surgery services) and service-specific set of annual O:E ratios. Changes in the trend for each set of data were determined by performing several permutation tests with significance defined at a baseline $P < .05$. P values were calculated by Monte Carlo simulation in combination with Bonferroni correction for multiple comparisons. All tests of significance were 2-tailed.

RESULTS

The preoperative characteristics of the 2 patient cohorts were quite similar (Table 1). Unadjusted overall morbidity rates decreased between FYs 1999-2003 and FYs 2004-2010 (12.14% vs 10.19%; $P = .003$), while unadjusted mortality rates showed a similar trend (1.76% vs 1.26%; $P = .05$; **Table 2**). Of the 19 individual complications recorded continuously throughout the study by VA-NSQIP, there were significant decreases in the rates of superficial wound infections (1.79% vs 1.05%; $P = .002$), unplanned intubations (1.68% vs 1.16%; $P = .03$), and failure to wean from a ventilator at 48 hours (2.70% vs 1.93%; $P = .01$; Table 2). The rate of postoperative sepsis was the only complication with a statistically signifi-

Table 2. Unadjusted Mortality and Morbidity Rates^a

	Fiscal Year, No. (%)		P Value ^b
	1999-2003	2004-2010	
Total mortality	69 (1.76)	72 (1.26)	.05
Total morbidity	476 (12.14)	581 (10.19)	.003
Specific complication ^a			
Superficial wound infection	55 (1.79)	56 (1.05)	.002
Deep wound infection	29 (0.84)	30 (0.63)	.23
Wound disruption	11 (0.43)	30 (0.60)	.28
Pneumonia	59 (1.81)	117 (2.05)	.40
Unplanned intubation	60 (1.68)	55 (1.16)	.03
Pulmonary embolism	2 (0.05)	9 (0.18)	.09
Failure to wean at >48 h	91 (2.70)	95 (1.93)	.01
Renal insufficiency	14 (0.51)	17 (0.32)	.14
Acute renal failure	8 (0.26)	14 (0.30)	.70
Urinary tract infection	40 (1.15)	59 (1.19)	.84
Cerebral vascular accident	4 (0.13)	10 (0.18)	.56
Coma at >24 h	0 (0.05)	0 (0.00)	.09
Peripheral nerve injury	1 (0.03)	1 (0.02)	.79
Cardiac arrest	11 (0.31)	15 (0.26)	.70
Myocardial infarction	7 (0.18)	9 (0.16)	.81
Bleeding >4 U	7 (0.26)	6 (0.11)	.08
Graft/flap failure	2 (0.05)	9 (0.16)	.13
Deep vein thrombosis	7 (0.23)	10 (0.18)	.56
Sepsis	29 (0.87)	120 (2.11)	<.001

^aSpecific complication analysis includes data for general, vascular, and urologic surgery services. Data from the cardiac surgery service were not available for the complications listed in this table.

^bP values obtained by χ^2 test.

cant increase between the 2 periods of interest (0.87% vs 2.11%; $P < .001$; Table 2).

The risk-adjusted morbidity O:E ratios decreased at an annual percentage change (APC) of -6.03% ($P < .001$; **Figure 1**). There was no significant change in the risk-adjusted mortality O:E ratio (Figure 1). Joinpoint regression revealed no significant change in the rate of change (no inflection points) throughout the study.

Service-specific analysis of trends in morbidity O:E ratios revealed APCs of -9.04% for general surgery ($P < .001$), -3.52% for vascular surgery ($P = .07$), and -7.65% for urologic surgery ($P = .01$) (**Figure 2**). A single inflection point was identified in 2003 for cardiac surgery with an APC1/pre-2003 of $+15.98\%$ ($P = .12$) and an APC2/post-2003 of -8.75% ($P = .06$), although this difference in the rate of change failed to reach statistical significance (Figure 2).

COMMENT

The aim of this study was to provide evidence in support of the recently enacted ACGME intern call restrictions by identifying a correlation between intern home call and postoperative morbidity or mortality. However, during a 12-year span during which interns took either in-hospital call (FYs 1999-2003) or home call (FYs 2004-2010), the overall unadjusted morbidity and mortality rates improved (Table 2). More importantly, risk-

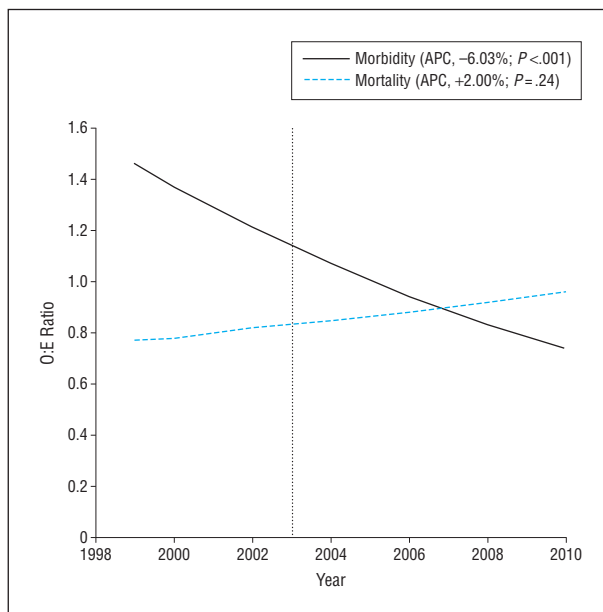


Figure 1. Analysis of the trends of risk-adjusted morbidity and mortality observed to expected (O:E) ratios by year. The vertical dotted line indicates the institution of intern home call. APC indicates annual percentage change.

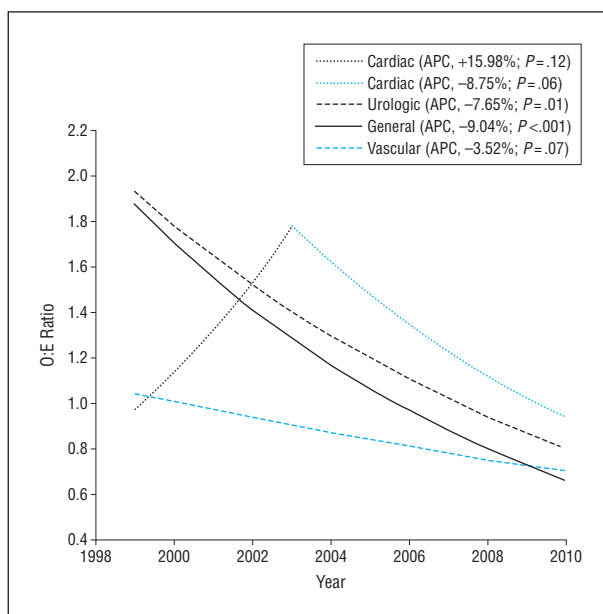


Figure 2. Service-specific analysis of the trends of risk-adjusted morbidity observed to expected (O:E) ratios. APC indicates annual percentage change.

adjusted morbidity O:E ratios improved at a constant 6% per year, while mortality O:E ratios remained stable (Figure 1). Furthermore, analysis of service-specific risk-adjusted morbidity O:E ratios revealed constant improvement for both general and urologic surgery, while both vascular and cardiac surgery showed similar, nonstatistically significant, improvement during the period of intern home call (Figure 2).

This study highlights the importance of using objective evidence to develop regulatory policy. In 2008, the American Medical Association put forth a statement calling for further data collection and research on the issue of home call.⁸ In the same document, it was noted that

the appropriateness of home call was likely related to service-specific and program-specific factors and that governing bodies should consider “. . . allowing for flexible solutions from one specialty to the next.”⁸ Despite these recommendations, a recent search of the existing literature revealed just 6 survey-based studies touching on the topic of home call, none of which evaluated the impact of home call on patient outcomes or resident education.⁹⁻¹⁴

Worthy of discussion is the possibility that the patients studied were becoming less sick over time, which could explain the improvements in unadjusted overall morbidity and mortality. Importantly, the preoperative characteristics listed in Table 1 are the consistently collected patient factors used in the VA-NSQIP risk-adjustment regression for the calculation of the O:E ratio.^{5,6} Therefore, any difference between cohorts shown in Table 1 was controlled for in the regression used to calculate the O:E ratios used in Figure 1 and Figure 2. Furthermore, throughout the period studied, the VA national office monitored the number of complex surgical procedures being performed at every VA hospital facility across the United States. The Palo Alto VA was and remains a tertiary referral center for complex cases such as pancreas surgery, esophagectomy, hepatic resections, and complex urologic cancer. The transfer of complex cases from intermediate-level facilities was implemented May 7, 2010, per Veterans Health Administration Directive 2010-018, titled “Facility infrastructure requirements to perform standard, intermediate, or complex surgical procedures,” and data show that the number of complex patients undergoing surgery was increasing during the study period (<http://www.patientcare.va.gov/20100518a1.asp>).

An alternative explanation for the continued decline in morbidity throughout the study could be the incorporation of systemwide patient safety efforts initiated by the VA. In FY 2005, RRTs were implemented to manage near-code situations on the general medical and surgical wards. However, analysis of complication-specific data revealed no significant improvement in the rates of complications for which a RRT would be of potential benefit. There was no significant change in the rates of cardiac arrest, myocardial infarction, cerebral vascular accident, or bleeding of more than 4 units (Table 2). The 1 exception to this finding was the observed decrease in the rate of unplanned intubation (1.92% vs 1.13%; $P = .004$; Table 2).

Interestingly, sepsis was the only complication to show a statistically significant increase in incidence during the study. However, notably, a number of population-based studies have described an increase in the incidence of sepsis during the last 2 decades across both teaching and non-teaching hospitals.¹⁵⁻¹⁸ This national trend suggests that the increased incidence of sepsis found in the FYs 2004-2010 cohort is representative of a systemic, as opposed to local, problem.

The current study made use of a large sample of cross-sectional patient outcomes data to assess trends in morbidity and mortality over time. To our knowledge, this is the first comprehensive assessment of intern home call as it relates to patient outcomes. With no correlation iden-

tified, these findings should inform important future resident work-hour policy regulations because many programs previously relied on home call as a means of ensuring compliance with the 80-hour workweek.^{9-12,14} Our institution continues to struggle with the coverage void left by the restrictions on home call in combination with the restrictions on unsupervised in-hospital call for interns. Surgical residency programs that train in multiple hospital settings simply do not have the manpower to staff overnight call with senior residents in a supervisory role. The current solution at our hospital has been to involve senior residents, midlevel residents in dedicated research years, and newly hired medical and surgical hospitalists in the overnight call pool. This unsustainable practice has required additional salary spending equivalent to 3 full-time employees.

The limitations of this study include the single-institution design and the use of observational, cross-sectional data. The results are not necessarily representative across other institutions and causality could not be established. Therefore, we can conclude only that the period of intern home call was not associated with increased rates of risk-adjusted morbidity or mortality at our institution. Despite these limitations, this article represents the first data-driven study describing the lack of association between intern home call and postoperative outcomes. It is not meant as a definitive report but rather as a basis for further research on this and related topics.

The primary goal of any new work-hour regulation should be to improve patient care. We found no correlation between intern home call and increased rates of morbidity or mortality in postoperative patients. This study illustrates the need to incorporate objective evidence into the design of future resident staffing policy. Just as evidence-based practice has become the doctrine of modern medicine, so too should evidence dictate the policies governing our surgical training programs.

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