Changes in Outcomes for Internal Medicine Inpatients after Work-Hour Regulations

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Background: Limits on resident work hours are intended to reduce fatigue-related errors, but may raise risk by increasing transfers of responsibility for patients.

Objective: To examine changes in outcomes for internal medicine patients after the implementation of work-hour regulations.

Design: Retrospective cohort study.

Setting: Urban, academic medical center.

Patients: 14,260 consecutive patients discharged from the teaching (housestaff) service and 6,664 consecutive patients discharged from the nonteaching (hospitalist) service between 1 July 2002 and 30 June 2004.

Measurements: Outcomes included intensive care unit utilization, length of stay, discharge disposition, 30-day readmission rate to the study institution, pharmacist interventions to prevent error, drug–drug interactions, and in-hospital death.

Results: The teaching service had net improvements in 3 outcomes. Relative to changes experienced by the nonteaching service, the rate of intensive care unit utilization decreased by 2.1% (95% CI, −3.3% to −0.7%; P = 0.002), the rate of discharge to home or rehabilitation facility versus elsewhere improved by 5.3% (CI, 2.6% to 7.6%; P < 0.001), and pharmacist interventions to prevent error were reduced by 1.92 interventions per 100 patient-days (CI, −2.74 to −1.03 interventions per 100 patient-days; P < 0.001). Teaching and nonteaching services had similar changes over time in length of stay, 30-day readmission rate, and adverse drug–drug interactions. In-hospital death was uncommon in both groups, and change over time was similar in the 2 groups.

Limitations: The study was a retrospective, nonrandomized design that assessed a limited number of outcomes. Teaching and nonteaching cohorts may not have been affected similarly by secular trends in patient care.

Conclusions: After the implementation of work-hour regulations, 3 of 7 outcomes improved for patients in the teaching service relative to those in the nonteaching service. The authors found no evidence of adverse unintended consequences after the institution of work-hour regulations.


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Work-hour regulations, implemented in July 2003 by the Accreditation Council for Graduate Medical Education (ACGME) (1), have reportedly reduced housestaff fatigue (2), but often at the cost of increased transfers of patient care among residents (3). Each transfer of care requires the communication of patient information from the departing clinician to the arriving clinician. If this “sign-out” is performed imperfectly, with misunderstanding or loss of information, harm to patients may result (4–12). These risks of increased handoffs may mitigate the expected benefits of reduced housestaff fatigue, resulting in an uncertain net result for patients.

Literature on the impact of work-hour limits on patient outcomes is conflicting and has been hampered by small sample sizes, few clinical outcomes, and design limitations (13). Only 3 studies have included a control group to account for temporal trends in quality improvement (14–16). No study of the new ACGME regulations has included patients in an internal medicine ward, a high-volume group of complex patients.

Given the expense of this policy change (17), its broad effects on residency programs and residents (2), the statement by the ACGME that improving patient care was a “major impetus” for the regulations (18), and the lack of conclusive study before its wholesale enactment (13), the impact of the new work-hour regulations on patient outcomes is critical to evaluate. Randomized trials are not feasible because the change was mandated simultaneously for all residency programs. A simple comparison of patient outcomes in different years is subject to bias, however, because of changes in practice and quality of care over time. Lack of control for these temporal trends in outcomes is perhaps the most important limitation of most previous studies. To avoid this problem, we compared changes over time in outcomes of 2 cohorts at the same hospital, one cared for by housestaff (teaching service) and the other by hospitalists (nonteaching service). This approach allowed us to evaluate the association of work-hour regulations with changes in a broad range of outcomes for internal medicine inpatients while controlling for temporal trends by using a concurrent control group of similar patients whose caregivers were not directly affected by work-hour regulations.

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There was no transition period. Residents no longer stayed reorganized to better comply with work-hour limitations. On 4 weekdays, a patient typically experienced 8 transfers of them to the resident on night-float service at 8 p.m. Over to a different team’s on-call intern, who then relinquished from the team was on call, interns signed their patients out not on the on-call intern’s team. On days when no one float service arrived at 8 p.m. to assume care of the patients and briefly for those of 1 other team. A resident on night-fourth day, during which they cared for their own patients intern remained in the hospital overnight on call every 3) and 2 interns. Before 1 July 2003, the resident and 1 unusual.

Transfers between teaching and nonteaching services were care unit (ICU) were usually assigned to teaching teams. This policy was consistent throughout the study. Of note, patients transferred out of the intensive teaching service. This was restricted the database to include only those interventions as those of previous studies.

—The Editors

METHODS

We conducted a retrospective cohort study at Yale–New Haven Hospital, comparing outcomes before and after work-hour regulations in medical patients receiving care by housestaff and those receiving care by hospitalists. Patients were assigned to the teaching or nonteaching services on the basis of time of day. Each day, admitted patients were first assigned to teaching teams until the team caps were reached, regardless of severity of illness. All subsequent admissions for the day were assigned to the nonteaching service. This policy was consistent throughout the study. Of note, patients transferred out of the intensive care unit (ICU) were usually assigned to teaching teams. Transfers between teaching and nonteaching services were unusual.

Teaching System before Work-Hour Regulation

A team comprised 1 resident (postgraduate year 2 or 3) and 2 interns. Before 1 July 2003, the resident and 1 intern remained in the hospital overnight on call every fourth day, during which they cared for their own patients and briefly for those of 1 other team. A resident on night-float service arrived at 8 p.m. to assume care of the patients not on the on-call intern’s team. On days when no one from the team was on call, interns signed their patients out to a different team’s on-call intern, who then relinquished them to the resident on night-float service at 8 p.m. Over 4 weekdays, a patient typically experienced 8 transfers of care.

Teaching System after Work-Hour Regulation

On 1 July 2003, the teaching service schedule was reorganized to better comply with work-hour limitations. There was no transition period. Residents no longer stayed overnight; they were replaced by “nocturnalists”—non-resident physicians who did the work of the night resident. This position was filled by 2 hospitalists and a large pool of moonlighting fellows. In addition, a resident on day-float service was instituted to assist with postcall care of patients so that the postcall team could leave by noon. This reorganization added 1 extra transfer of care every 4 days and increased discontinuity because of the large number of rotating nocturnalists, the new resident on day-float service, and the absence of an on-call primary resident at night. The average patient had approximately 2 physicians added to the care team; patients with long lengths of stay saw a much greater increase. However, these changes also increased the average clinical experience of those supervising nighttime patient care because all nocturnalists had completed residency. Intermittent checks of time cards completed by housestaff showed that average weekly hours were within the 80-hour limits. No physician extenders were added to reduce housestaff workload, and housestaff on the wards was not extended beyond the addition of the resident on day-float service.

Nonteaching System

The nonteaching service did not change after work-hour regulation. The primary hospitalist team for each patient (comprising a physician and 1 or more physician assistants) was present during the day. Each night, including weekends, night staff was present in the hospital for coverage of the nonteaching service. Night physicians attempted to maintain continuity by covering the same patients each night, but this was not universally achieved. Day staff signed out directly to night staff every day of the week. Over 4 days, a patient typically experienced 8 transfers of care. In the year after work-hour regulations were enacted, the nonteaching service increased in both volume and number of providers, such that the number of patients per provider remained similar. (The Appendix, available at www.annals.org, contains full details of work schedules before and after work-hour regulation on both services.)

Data Sources

We obtained administrative claims data for all patients discharged from the medical wards between 1 July 2002 and 30 June 2004, excluding patients discharged from HIV and oncology wards, which were restricted to teaching service teams. We derived medication error data from 2 databases kept by the hospital pharmacy. One contained all automatically generated warnings of drug–drug combinations with potential for harm. The interaction list was dynamic: 53% of the interactions (323 of 615) were added on or after 1 July 2003. The other pharmacy database recorded all direct interventions made by pharmacy staff. Pharmacists themselves generated each intervention and categorized the intent of the intervention. For this study, we restricted the database to include only those interventions made to prevent an adverse event.
Independent Variables

Patients were stratified into the teaching or non-teaching cohorts on the basis of their team assignment at discharge. The unit of analysis was hospitalization; patients admitted more than once could be included in more than 1 cohort. We collected data on age, sex, race or ethnicity, insurance status, and admission source for each patient. To account for variability in case mix over time, we grouped the principal diagnosis codes into 259 clinically similar diagnosis categories by using the Clinical Classifications Software categorization (19) and then constructed a case-mix variable that included the most common or severe 21 diagnoses plus 1 for all other diagnoses. We used the International Classification of Diseases, Ninth Revision, Clinical Modification (ICD-9-CM), secondary diagnosis codes to assign a risk severity score to each patient by using the Deyo adaptation of the Charlson comorbidity index (20, 21). Analyses using the Elixhauser method of comorbidity adjustment yielded similar results (22).

Dependent Variables

Outcome measures were ICU stay, length of hospital stay, discharge disposition, 30-day readmission rate to Yale–New Haven Hospital, pharmacist interventions to prevent adverse events, and drug–drug interactions. We dichotomized discharge disposition as discharge to home or rehabilitation facility versus discharge elsewhere (including death), and we included only patients admitted from home or through the emergency department for analysis of this outcome. We also evaluated in-hospital death, but this was an exploratory analysis because of the small number of events.

Statistical Analysis

Because this was a retrospective, single-center study, our sample size was determined by hospital volume. We compared patients’ characteristics and outcomes before and after work-hour regulation within each group and between groups by using chi-square tests for categorical variables and t tests for continuous variables. We used the generalized linear model for length of stay, which has a long right tail. After testing several link functions and distributional assumptions, we found that a γ distribution with a logarithmic link (γ regression) best fit the data. For pharmacy interventions and medication interactions, we constructed generalized linear models by using a Poisson distribution and a logarithmic link function with an offset for log length of stay (Poisson regression).

We then constructed multivariable models to estimate the association of time with each outcome measure within each group while adjusting for patient characteristics (age, sex, race or ethnicity, insurance status, admission source, principal diagnosis, and comorbid condition). No independent variables had a bivariate correlation greater than 0.6 or a variance inflation factor greater than 2.0. To avoid overfitting, we prespecified the multivariable models to include all patient characteristics because of their clinical importance (23). However, in our exploratory model of in-hospital death, we included only 3 covariates (age, Deyo score, and admission source) because of the small number of events in each group (24). We used logistic regression for binary outcomes, γ regression with logarithmic link for length of stay, and Poisson regression with an offset for log length of stay for medication interactions and pharmacy interventions. For death, we used a generalized estimating equation to account for the nonindependence of death in repeated admissions of the same patient. We also performed the analysis by using a random-number generator to randomly select only 1 admission per patient, and we repeated the sampling 100 times (25). Both approaches yielded similar results, and we present the results of the first approach.

To determine the net association of work-hour regulations with outcomes on the teaching service, controlling for secular trends in outcomes observed in the nonteaching service, we constructed multivariable models of the general form:

\[ \text{Outcome} = \alpha + \beta_1(t) + \beta_2(\text{teaching status}) + \beta_3(t)\text{time*teaching status} + \beta_4(\text{covariate}_i) + \ldots + \epsilon \]

where time and teaching status were binary indicator variables set to 1 for the post–work-hour regulation period and teaching service, respectively, and \( \beta_3 \) is the coefficient for the interaction between them. A statistically significant time–service interaction indicates that the change in outcome over time was different for the 2 services. However, in nonlinear models, \( \beta_3 \) does not reliably represent the estimate for the net change associated with the interaction (26). Consequently, we elected to show outcomes for each cohort within each time period and derived net changes and CIs directly by bootstrapping (27). We estimated the net change associated with work-hour regulations by computing the difference over time in the teaching cohort minus the difference over time in the nonteaching cohort. This analysis thus corrects for any difference between groups at baseline (before work-hour regulation).

To test whether the disproportionate inclusion of patients with ICU stays on the teaching service was responsible for any findings, we performed a sensitivity analysis that excluded all patients with ICU stays from the data set. All outcomes were similar, and none changed in statistical significance. Two authors performed statistical analyses, with review by other study members. All statistical tests were 2-tailed and used a significance level less than 0.05. We used SAS, version 9.1.2 (SAS Institute, Cary, North Carolina), for all analyses.

Role of the Funding Sources

The Human Investigation Committee at Yale University School of Medicine deemed this study exempt from review and granted a waiver of patient consent and a Health Insurance Portability and Accountability Act...
waiver for utilization of administrative data. At the time the study was conducted, Drs. Horwitz and Kosiborod were Robert Wood Johnson Clinical Scholars, and Dr. Horwitz was supported by the U.S. Department of Veterans Affairs. Neither source had any role in the design, analysis, or interpretation of the study or in the decision to submit the manuscript for publication.

RESULTS

The study sample comprised 7018 patients discharged from the teaching service and 2954 patients discharged from the nonteaching service in the year before work-hour regulation, and 7242 and 3710 patients discharged from each service in the year after work-hour regulation. Admission source was missing for 95 discharges (56 teaching, 39 nonteaching); all other demographic information was available for every discharge.

Table 1 presents baseline characteristics of the cohorts. Daytime (7 a.m. to 7 p.m.) admissions to the teaching service increased from 80% before to 82% after work-hour regulation, and daytime admissions to the nonteaching service decreased from 43% to 38%.

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Teaching Cohort</th>
<th>Nonteaching Cohort</th>
<th>P Value</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean age (SD), y</td>
<td>62.9 (17.8)</td>
<td>62.7 (18.3)</td>
<td>0.63</td>
<td>62.5 (19.1)</td>
</tr>
<tr>
<td>Male, n (%)</td>
<td>3573 (51)</td>
<td>3603 (50)</td>
<td>0.166</td>
<td>1389 (47)</td>
</tr>
</tbody>
</table>
| Race or ethnicity, n (%) | White 4971 (71) 5031 (70) | 0.35 | 2001 (68) 2515 (68) | 0.97† | Black 1377 (20) 1480 (20) | 655 (22) 823 (22) | | Hispanic 535 (8) 588 (8) | 240 (8) 305 (8) | | Other 135 (2) 143 (2) | 58 (2) 67 (2) | | Source of admission, n (%) | Emergency department 4615 (66) 5102 (71) | <0.001 | 2569 (88) 3376 (91) | <0.001* | Home or other 1506 (22) 1380 (19) | 257 (9) 245 (7) | | Short-term care transfer 848 (12) 753 (10) | 91 (3) 87 (2) | | Insurance status, n (%) | Medicare 3703 (57) 3889 (54) | 0.023 | 1574 (53) 2001 (54) | | Medicaid 872 (12) 932 (12) | 393 (13) 469 (13) | | Medicare managed care 150 (2) 168 (2) | 47 (1.6) 90 (2) | | Self-pay 85 (1) 121 (1.7) | 47 (1.6) 72 (2) | | Other 2204 (31) 2132 (29) | 893 (30) 1078 (29) | | Deyo score, n (%) | 0 3701 (53) 3592 (50) | 0.002 | 1629 (55) 1877 (51) | | 1 1754 (25) 1956 (27) | 726 (25) 997 (27) | | 2 869 (12) 962 (13) | 318 (11) 473 (13) | | 3 694 (10) 732 (11) | 281 (10) 363 (10) | | Principal diagnosis, n (%) | Coronary artery disease 886 (13) 858 (12) | 0.002 | 168 (6) 141 (4) | | Dysrhythmia 547 (8) 599 (8) | 189 (6) 183 (5) | | Device, implant, or graft complication 382 (5) 330 (5) | 79 (3) 71 (2) | | Acute myocardial infarction 382 (5) 376 (5) | 112 (4) 101 (3) | | Pneumonia 362 (5) 328 (5) | 175 (6) 258 (7) | | Congestive heart failure 323 (5) 399 (6) | 183 (6) 201 (5) | | Chest pain 305 (4) 359 (5) | 253 (9) 312 (8) | | Asthma 224 (3) 200 (3) | 85 (3) 93 (3) | | Diabetes mellitus 158 (2) 160 (2) | 56 (2) 88 (2) | | Fluid or electrolyte disorder 150 (2) 187 (3) | 58 (2) 113 (3) | | Acute renal failure 148 (2) 184 (3) | 52 (2) 110 (3) | | Syncope 144 (2) 170 (2) | 110 (4) 126 (3) | | Urinary tract infection 137 (2) 148 (2) | 84 (3) 140 (4) | | Gastrointestinal hemorrhage 136 (2) 100 (1) | 53 (2) 59 (2) | | Conduction disorder 110 (2) 122 (2) | 12 (0.4) 10 (0.3) | | Skin infection 108 (2) 116 (2) | 69 (2) 94 (3) | | Pancreatic disease 107 (2) 82 (1) | 54 (2) 94 (3) | | Respiratory failure 80 (1) 103 (1) | 7 (0.2) 14 (0.4) | | Malignant condition 74 (1) 66 (0.9) | 24 (0.8) 51 (1) | | Sepsis 69 (1) 72 (1) | 32 (1) 38 (1) | | Aspiration pneumonia 66 (0.9) 80 (1) | 29 (1) 58 (2) | | Other 1979 (28) 2075 (29) | 1006 (34) 1285 (35) | | | * P < 0.001 for nonteaching cohort compared with teaching cohort in both periods. | | † P = 0.02 for nonteaching cohort compared with teaching cohort in the 2002–2003 period.
interaction between the time period and teaching status, admission source, comorbid conditions, and case mix, the decrease in deaths in the teaching service reached statistical significance (2.41% vs. 2.03%; P = 0.047). All other outcomes within both cohorts were similar to unadjusted outcomes. Table 3 shows adjusted differences in outcomes over time.

### Interaction Results

We found no statistically significant interaction between time period and teaching service status for adjusted length of stay, rate of 30-day readmission to Yale-New Haven Hospital, or drug–drug interactions. Three differences were statistically significant, all showing improvement in the teaching service relative to the nonteaching service after work-hour regulation: ICU utilization, discharge to home or rehabilitation versus elsewhere, and pharmacist interventions to prevent error (Table 3). The exploratory analysis of in-hospital death revealed no statistically significant interaction between time period and teaching service status.

### Discussion

We compared outcomes in patients cared for by housestaff and those cared for by a nonteaching hospitalist service. We found that, relative to what would have been expected without the regulation, work-hour limits were associated with statistically significant improvements in 3 outcomes: ICU stay (decrease, 2%), discharge to home or rehabilitation versus elsewhere (increase, 5%), and pharmacist interventions to prevent errors (decrease, 1.9 interventions per 100 patient-days). We did not find statistically significant differences in length of stay, 30-day readmission rate to the study hospital, drug–drug interactions, or in-hospital death. Overall, the regulations were associated with neutral or positive changes in all of the outcomes we studied.

The effect size of the improvements was substantial for pharmacy interventions and was more modest for ICU admissions and discharge disposition. In terms of the number expected without the regulation, work-hour limits were associated with neutral or positive changes in all of the outcomes we studied.

There are several possible mechanisms by which work-hour regulations might have improved patient outcomes. First, reduced fatigue among housestaff may have made a real difference to clinical care. Second, the increase in discontinuity may not have been substantial enough to affect outcomes. Third, clinical involvement by more senior physicians—such as fellows and attending physicians—may have increased to compensate for discontinuity of care and frequent turnover of housestaff. Fourth, the use in the teaching service of nocturnlists with more clinical experience than residents may have improved outcomes even though they had less knowledge of the patients. Finally, the dramatic changes to workflow may have—at least tempo-

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### Table 2. Unadjusted Outcomes before and after Work-Hour Regulation, by Teaching Status*

<table>
<thead>
<tr>
<th>Variable</th>
<th>Teaching Cohort</th>
<th>Nonteaching Cohort</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Admitted to ICU, n (%)</td>
<td>867 (12.4)</td>
<td>93 (3.2)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Mean length of hospital stay (SD), d</td>
<td>5.21 (9.3)</td>
<td>4.51 (6.6)</td>
<td>0.033</td>
</tr>
<tr>
<td>Discharged to home or rehabilitation facility, n (%)†</td>
<td>4947 (80.8)</td>
<td>2316 (82.0)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Readmitted to Yale–New Haven Hospital within 30 d, n (%)</td>
<td>1152 (16.4)</td>
<td>563 (19.1)</td>
<td>0.004</td>
</tr>
<tr>
<td>Mean pharmacist interventions per 100 patient-days (SD), n</td>
<td>5.96 (16.7)</td>
<td>3.33 (12.6)</td>
<td>0.001</td>
</tr>
<tr>
<td>Mean medication interventions per 100 patient-days (SD), n</td>
<td>3.95 (16.46)</td>
<td>3.69 (15.11)</td>
<td>0.007</td>
</tr>
<tr>
<td>In-hospital mortality, n (%)</td>
<td>170 (2.4)</td>
<td>40 (1.4)</td>
<td>0.105</td>
</tr>
</tbody>
</table>

* ICU = intensive care unit.
Table 3. Changes in Adjusted Outcomes in Teaching Service Compared with Nonteaching Service*

<table>
<thead>
<tr>
<th>Variable</th>
<th>Mean Adjusted Change (after vs. before) (95% CI)</th>
<th>Mean Net Adjusted Change (Teaching vs. Nonteaching) (95% CI)</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>ICU stay, %</td>
<td>−2.35 (−3.36 to −1.31)†</td>
<td>−0.23 (−1.09 to 0.57)</td>
<td>0.002</td>
</tr>
<tr>
<td>Length of hospital stay, d</td>
<td>−0.05 (−0.29 to 0.19)‡</td>
<td>0.10 (−0.18 to 0.38)</td>
<td>0.37</td>
</tr>
<tr>
<td>Discharge to home or rehabilitation facility, %</td>
<td>0.62 (−0.76 to 2.21)</td>
<td>−4.67 (−6.46 to −2.84)‡</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Readmission to Yale–New Haven Hospital within 30 d, %</td>
<td>1.87 (0.65 to 3.12)†</td>
<td>3.86 (1.92 to 5.92)‡</td>
<td>0.097</td>
</tr>
<tr>
<td>Pharmacists interventions per 100 patient-days, n</td>
<td>−1.50 (−2.12 to −0.86)‡</td>
<td>0.42 (−0.13 to 0.97)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Medication interactions per 100 patient-days, n</td>
<td>0.45 (0.10 to 0.81)§</td>
<td>0.14 (−0.31 to 0.61)</td>
<td>0.30</td>
</tr>
<tr>
<td>In-hospital mortality, %</td>
<td>0.06 (−0.49 to 0.60)§</td>
<td>0.31 (−0.23 to 0.85)</td>
<td>0.50</td>
</tr>
</tbody>
</table>

* The adjusted 95% CIs were obtained from bootstrapping and were adjusted for age, sex, race or ethnicity (black, Hispanic, other vs. white), insurance type (Medicare, Medicaid, managed Medicare, self-pay vs. other), admission source (home or other, transfer vs. emergency department), principal diagnosis, and Deyo score (1, 2, 3 vs. 0) unless otherwise indicated. ICU = intensive care unit.
‡ P < 0.05 for comparison of 2003–2004 vs. 2002–2003.
| Adjusted for age, admission source, and Deyo score only. |
cern about possible adverse effects of discontinuity. These findings demonstrate the importance of rigorously evaluating policy changes implemented without previously proven benefit or harm.

From the Center for Outcomes Research and Evaluation, Yale–New Haven Hospital, and Yale University School of Medicine, New Haven, Connecticut, and Mid America Heart Institute and University of Missouri, Kansas City, Missouri.

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References

On 1 July 2003, the teaching service schedule was reorganized to better comply with work-hour limitations. There was no transition period. The call cycle remained 4 days long, and on-call interns continued to stay overnight as they had under the old system. However, residents no longer stayed overnight, and they were asked to leave by 8 to 10 p.m. Their place was taken by “nocturnalists”—nonresident physicians who did the work of the night resident. The position of nocturnalist was filled by 2 hospitalists and a large pool of moonlighting fellows.

The cap for on-call admissions to interns was reduced from 6 to 5 patients; the total caseload cap remained at 12. If the team had not yet reached their caseload cap by the time the resident left, the nocturnalist admitted any further patients with the on-call intern. Patients arriving after 1 a.m. or after the teams had reached their cap were no longer held over for the following morning’s on-call team, but they were sent directly to the non-teaching service. The only exceptions were patients who had just been discharged from the teaching service; if the team that had cared for the patient during his or her first admission were still on the wards, the patient was returned to the teaching service in the morning as a “bounce back.” In addition to admitting with the on-call intern, the nocturnalist assisted with the care of the team’s patients and cross-coverage of patients belonging to teams that were not on call.

On the postcall day, the resident returned and spent a full day in the hospital, but interns were asked to leave by noon. To facilitate this, a resident on day-float service was instituted to assist with postcall care of patients.

There was no addition of physician extenders to reduce housestaff workload nor any expansion of housestaff on the wards besides the resident on day-float service.

Intermittent checks of time cards completed by housestaff showed that average weekly hours were within the 80-hour limits.

**Non-teaching System**

Patients admitted after the teaching teams had reached their caseload cap were sent directly to a large nonteaching service staffed by physicians and physician assistants. This service had no contact with housestaff, and patients were not transferred between services. There was no attempt made to distribute patients among teaching and nonteaching services according to illness severity, “teaching value,” or any criteria other than time of day.

The nonteaching service did not change schedules after work-hour regulation. The primary hospitalist team for each patient (comprising a physician and 1 or more physician assistants) was present during the day. Each night, including weekends, night staff was present in the hospital for coverage of the nonteaching service. Night physicians attempted to maintain continuity by covering the same patients each night, but this was not universally achieved. Day staff signed out directly to night staff every day of the week. Over 4 days, a patient typically experienced 8 transfers of care.

**Appendix: Work Schedule for Teaching and Nonteaching Teams**

**Teaching System before Work-Hour Regulation**

A general medical team comprised 1 resident (postgraduate year 2 or 3) and 2 interns. Before 1 July 2003, the resident and 1 intern remained in the hospital overnight on call every fourth day, during which they cared for their own patients and briefly for those of 1 other team. While on call, an intern could admit up to 6 new patients; the overall caseload cap for interns was 12 patients. A resident on night-float service arrived at 8 p.m. to assume care of the patients who were not on the on-call intern’s team. If a patient without a private attending physician arrived before 1 a.m. and the on-call team had already reached their caseload cap, the resident on night-float service admitted the patient as a holdover for the on-call team for the following day. Each on-call team was allowed 1 holdover patient.

On the postcall day, the team members remained until they had completed their work for the day and were then free to sign out and leave. On days when no one from the team was on call, interns remained in the hospital until approximately 5 p.m. and then signed their patients out to that day’s on-call intern. The on-call intern then relinquished the patients to the resident on night-float service at 8 p.m.

Over 4 weekdays, a patient typically experienced 8 transfers of care.

**Teaching System after Work-Hour Regulation**

On 1 July 2003, the teaching service schedule was reorganized to better comply with work-hour limitations. There was no transition period. The call cycle remained 4 days long, and on-call interns continued to stay overnight as they had under the old system. However, residents no longer stayed overnight, and they were asked to leave by 8 to 10 p.m. Their place was taken by