

Effects of 2- vs 4-Week Attending Physician Inpatient Rotations on Unplanned Patient Revisits, Evaluations by Trainees, and Attending Physician Burnout

A Randomized Trial

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TRAINEES LEARN INPATIENT MEDICINE on the job, providing clinical care to patients as members of ward teams led by attending physicians. Although the structures of these ward teams vary by local educational heritage and hospital policy,^{1,2} a prevailing trait is that attending physicians are assigned to them for only 2 continuous weeks—a duration that is half of the previous standard.^{3,4}

Both trainees³ and educational leaders⁵ have decried short rotations as disruptive because they truncate student-teacher relationships. Shorter rotations may nonetheless benefit the psychological health of attending physicians, whose responsibilities are oversubscribed.^{4,6} In particular, if shorter rotations can lessen attending physician burnout, they may improve physicians' relationships with patients and the quality of care that patients receive.^{7,8}

Therefore, to weigh the effects of shorter rotations on patients, trainees, and attending physicians, we first assessed whether the outcomes most proximate to policy—effects on patients,⁹ as assessed by un-

Context Data are sparse on the effect of varying the durations of internal medicine attending physician ward rotations.

Objective To compare the effects of 2- vs 4-week inpatient attending physician rotations on unplanned patient revisits, attending evaluations by trainees, and attending propensity for burnout.

Design, Setting, and Participants Cluster randomized crossover noninferiority trial, with attending physicians as the unit of crossover randomization and 4-week rotations as the active control, conducted in a US university-affiliated teaching hospital in academic year 2009. Participants were 62 attending physicians who staffed at least 6 weeks of inpatient service, the 8892 unique patients whom they discharged, and the 147 house staff and 229 medical students who evaluated their performance.

Intervention Assignment to random sequences of 2- and 4-week rotations.

Main Outcome Measures Primary outcome was 30-day unplanned revisits (visits to the hospital's emergency department or urgent ambulatory clinic, unplanned readmissions, and direct transfers from neighboring hospitals) for patients discharged from 2- vs 4-week within-attending-physician rotations. Noninferiority margin was a 2% increase (odds ratio [OR] of 1.13) in 30-day unplanned patient revisits. Secondary outcomes were length of stay; trainee evaluations of attending physicians; and attending physician reports of burnout, stress, and workplace control.

Results Among the 8892 patients, there were 2437 unplanned revisits. The percentage of 30-day unplanned revisits for patients of attending physicians on 2-week rotations was 21.2% compared with 21.5% for 4-week rotations (mean difference, -0.3%; 95% CI, -1.8% to +1.2%). The adjusted OR of a patient having a 30-day unplanned revisit after 2- vs 4-week rotations was 0.97 (1-sided 97.5% upper confidence limit, 1.07; noninferiority $P = .007$). Average length of stay was not significantly different (geometric means for 2- vs 4-week rotations were 67.2 vs 67.5 hours; difference, -0.9%; 95% CI, -4.7% to +2.9%). Attending physicians were more likely to score lower in their ability to evaluate trainees after 2- vs 4-week rotations by both house staff (41% vs 28% rated less than perfect; adjusted OR, 2.10; 95% CI, 1.50-3.02) and medical students (82% vs 69% rated less than perfect; adjusted OR, 1.41; 95% CI, 1.06-2.10). They were less likely to report higher scores of both burnout severity (16% vs 35%; adjusted OR, 0.39; 95% CI, 0.26-0.58) and emotional exhaustion (19% vs 37%; adjusted OR, 0.45; 95% CI, 0.31 to 0.64) after 2- vs 4-week rotations.

Conclusions The use of 2-week inpatient attending physician rotations compared with 4-week rotations did not result in an increase in unplanned patient revisits. It was associated with better self-rated measures of attending physician burnout and emotional exhaustion but worse evaluations by trainees.

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planned revisit rates—differ between 2- and 4-week rotations. We then assessed how trainees’ ratings of attending physicians’ performance and the self-rated psychological health of attending physicians were affected by these rotation durations.

METHODS

Design Overview

We compared general medicine attending physicians’ outcomes from 2- vs 4-week rotations in a cluster randomized crossover noninferiority trial (FIGURE 1). Treating attending physi-

cians as clusters obviated allocation of individual patients to 2- or 4-week rotations¹⁰; a crossover design bolstered statistical power by using attending physicians as their own controls^{11,12}; and noninferiority acknowledged the potentially offsetting benefits of shorter rotations.³ No changes were made to the study design or outcomes after the trial commenced. The hospital institutional review board approved the study protocol without requirement for consent from participating attending physicians, trainees, or patients.

Setting and Participants

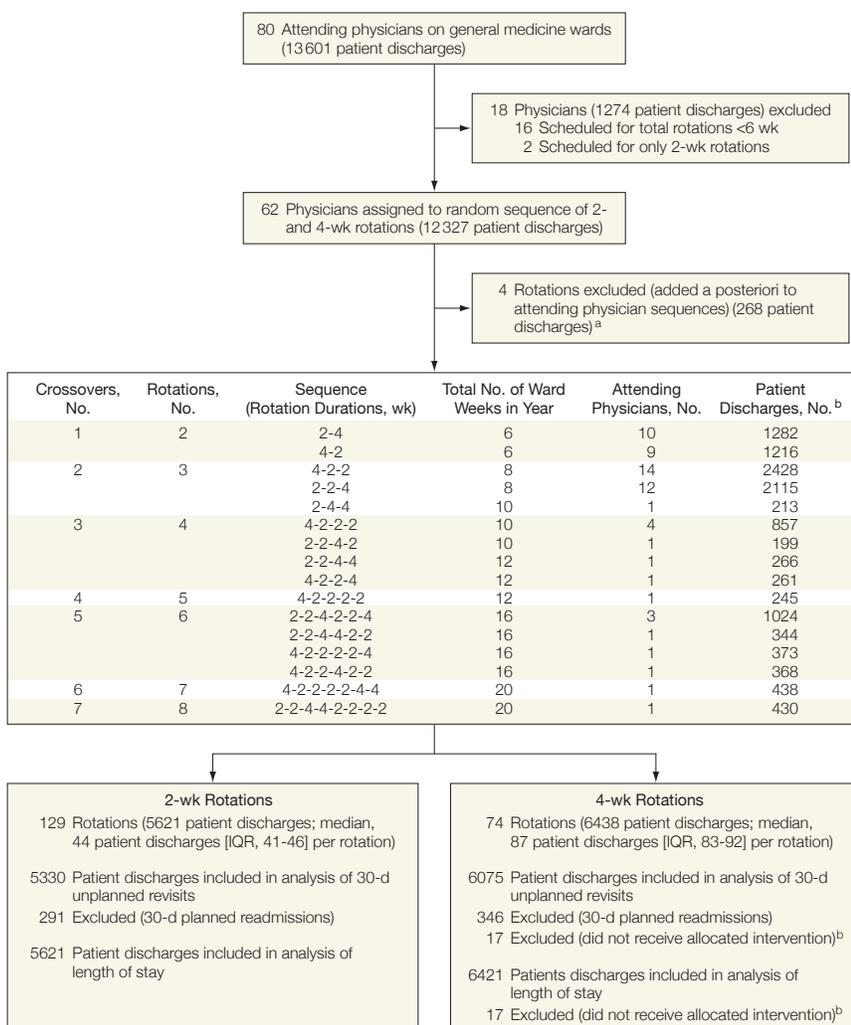
The study was conducted on the general medicine inpatient service of a 500-bed public teaching hospital in Chicago, Illinois, during 1 academic year, from July 2009 through June 2010. Attending physicians were eligible if they were scheduled for at least 6 weeks of service. Patients were eligible if they were discharged alive from eligible physicians’ services but were excluded from the analysis of unplanned revisits if they had a planned readmission within 30 days of discharge from the index hospitalization.

The study protocol did not affect the standard way that patients were allocated to the general medicine service, which comprised 12 teams. An attending physician led each team of 4 house staff (2 first-year and 2 second- or third-year postgraduates) and 0 to 3 medical students (0 to 2 third- and 0 or 1 fourth-year students). Every 4 days, each team admitted up to 14 new patients from a central electronic queue. The study protocol did not affect the hospital department of medicine’s expectations for attending physicians. Every day, attending physicians were expected to personally visit each patient, to review the care plan of each patient with the team, and to complete a note or cosign a senior house staff member’s note in the electronic medical record of each patient. Attending physicians were also expected to finalize all decisions regarding discharges and transfers.

Randomization and Interventions

Details of assignment of attending physicians to random sequences of 2- and 4-week rotations are provided in the eAppendix (available at <http://www.jama.com>). Stratified block randomization was used to achieve 2 goals: patients would have an equal chance of being admitted to a 2- or 4-week rotation and attending physicians and ward teams would have a balanced number of weeks from 2- and 4-week rotations throughout the academic year. Attending physicians were not blinded to their rotation assignments because the yearlong rotation schedule was distrib-

Figure 1. Study Flow Diagram



IQR indicates interquartile range.

^aFour rotations were added to attending physicians’ prespecified rotation sequences after the study began and therefore were excluded.

^bSeventeen discharges were carried out by an attending physician not assigned to the rotation.

uted 3 months before the study commenced. Attending physicians, trainees, and patients were, nonetheless, blinded to the study hypothesis.

To minimize the carryover effects of rotation types within attending physicians, prespecified washout durations were based on the opinions of administrative leaders at our hospital. Because outpatient-oriented attending physicians reduce their clinic schedules while staffing inpatient rotations, urgent backlogs of clinic appointments aggregate around these rotations, with volume proportionate to rotation lengths. Thus, we set the washout for a rotation staffed by an outpatient-oriented attending physician to be the sum of the preceding rotation duration plus half of the succeeding rotation duration. For example, the washout period between a 2-week rotation followed by a 4-week rotation was 4 weeks. For inpatient-oriented attending physicians, who generally do not staff outpatient clinics, the washout duration was 2 weeks regardless of rotation type.

Outcomes and Follow-up

Patient Outcomes. The primary outcome was any unplanned revisit to the same hospital within 30 days of discharge. This included visits to the hospital's emergency department or urgent ambulatory clinic, direct transfers from neighboring hospitals, and readmissions that were not planned.¹³ Length of stay, a secondary outcome, was measured as the duration of a patient's last uninterrupted stay on the general medicine service until discharge. Thus, length of stay for a patient initially admitted to another service was measured from the time of transfer to the general medicine service rather than the time of admission to the hospital. We chose this duration over one that includes time spent on other services to heighten the sensitivity of this outcome to attending physician behavior.

Trainee Evaluations of Attending Physician Performance. Evaluations of attending physicians by both house staff and medical students were confidential and self-administered. House staff received single electronic evaluations at the

end of each study rotation (eTable 1). Medical students received multiple paper evaluations for all relevant study rotations at the end of their clerkship rotations at our hospital (eTable 2). Because house staff rotations coincided with crossover periods, house staff evaluated attending physicians who supervised them for full 2- or 4-week durations. In contrast, medical student rotations did not coincide with crossover periods, so they evaluated attending physicians who had supervised them for varied fractions of 2- or 4-week durations. The house staff evaluation had been formally validated,¹⁴ whereas the medical student evaluation was developed de novo and a pilot study (2 groups of 12 medical students) was conducted to verify that the evaluation had face and content validity.

Both trainee evaluations had similar sets of domains. Mean summary scores were grouped for nonmissing items in each questionnaire domain into ordinal categories because of trainees' tendency to choose high response scores.¹⁴⁻¹⁶ A summary score was defined as perfect when individual scores for all nonmissing domain-specific items were the highest possible. A nonperfect summary score was defined as either low or high depending on whether the average domain-specific score was respectively below or above the median of all trainees' nonperfect evaluation scores for that domain.

Attending Physician Burnout. Four separate facets of attending physician burnout were assessed at the end of each rotation. Research assistants accessed a password-protected online questionnaire (eTable 3) when most convenient for attending physicians. The questionnaire was devised from a conceptual model of burnout^{17,18} that was refined among outpatient-oriented physicians in 2 large cross-sectional surveys.^{19,20} The model posits that workplace characteristics, most importantly physician control,²¹⁻²³ affect physicians' perception of stress and, in turn, their burnout.¹⁹ Therefore, measures of control and stress were included to substantiate their proximate roles in burnout: 8 items from Minimizing Error, Maximizing Outcomes²⁰

that were relevant to a hospital workplace control and 4 items from the short version of the Perceived Stress Scale.²⁴ Emotional exhaustion—the initial²⁵ and core²⁶ facet of burnout—was measured using 9 items from the Maslach Burnout Inventory Human Services Survey^{27,28} and a single-item measure from the National Job Burnout Survey that uses a personal definition of burnout.^{29,30}

Each facet of attending physician burnout was analyzed separately. *Facet* is used to refer to the components of the burnout assessment instead of *domain* because only emotional exhaustion is a burnout domain; the others are burnout contributors (inadequate workplace control and perceived control) and a single-item summary of burnout. Mean summary scores were grouped for nonmissing items from each facet into 3 ordinal categories depending on whether the mean domain-specific score was below the 25th percentile (low), between the 25th and 75th percentiles (intermediate), or above the 75th percentile (high) of the mean domain score of all attending physician assessments. For the single burnout question, a high severity score (3 or higher) represents burnout.^{23,30}

Statistical Analysis

The study was powered to assess the noninferiority of 30-day unplanned revisits after discharge from 2- vs 4-week rotations within attending physician. Based on retrospective data, it was estimated that 20% of patients discharged from general medicine teams had 30-day unplanned revisits and that the standard deviation of this estimate across attending physicians was 5.3%. It was judged a priori that, when 30-day unplanned revisits from 2- vs 4-week rotations are compared within attending physician, an absolute increase of 2 percentage points would be unacceptable.³¹ After converting this increase to a relative scale,³² noninferiority was established as an odds ratio (OR) of less than 1.13. Under 3 simplifying but conservative assumptions (eAppendix), it was estimated that a sample size of 55 attending physicians would provide a power of 80% to detect a noninferior dif-

Table 1. Characteristics of 62 Attending Physicians

| Characteristics | Attending Physicians ^a |
|---|-----------------------------------|
| Age, median (range), y | 38 (29-55) |
| Experience on general medicine wards of this hospital, median (range), y | 4 (0-25) |
| Women | 30 (48) |
| International medical graduate | 33 (53) |
| Clinical focus | |
| Nonhospitalist general internist | 39 (63) |
| Adult medicine hospitalist ^b | 16 (26) |
| Adult medicine specialist ^c | 7 (11) |
| Predominant clinical setting | |
| Outpatient | 30 (48) |
| Inpatient | 26 (42) |
| Evenly split between outpatient and inpatient | 6 (10) |
| Predominant focus of time at work ^d | |
| Patient care | 50 (81) |
| Administration | 13 (21) |
| Education | 10 (16) |
| Research | 2 (3) |
| Time during yearlong study as attending physician of record, median (range), wk | |
| Any inpatient service ^e | 8 (6-34) |
| General medicine wards | 8 (6-20) |
| Study rotations, median (range), No. | |
| Total | 3 (2-8) |
| 4-wk | 1 (1-3) |
| 2-wk | 2 (1-6) |

^aData are expressed as No. (%) of participants unless otherwise indicated.

^bHospitalists were general internists credentialed within the division of hospital medicine.

^cSpecialties were infectious disease (n=3), critical care medicine (n=2), gastroenterology (n=1), and nephrology (n=1).

^dPredominant focus of time at work was evenly spread across 2 or more areas for 12 attending physicians.

^eAttending physicians also staffed the short-stay unit (n=14), the human immunodeficiency virus service (n=3), and the medical intensive care unit (n=2).

ference between groups, assuming a 1-sided $\alpha = .025$.

Outcome variables were transformed to meet the assumptions of the statistical models and to improve interpretation of the estimates. For length of stay, rightward skew was accounted for with logarithmic transformation. For trainee evaluations and assessments of attending physician burnout, the ordinal score categories and severity assessments were transformed so that the direction of favorability was consistent across measurements: lower trainee evaluation score categories aligned with higher attending physician burnout severity assessments.

Mixed-effects regression was used to analyze the data; details of model specification and estimation procedures are provided in the eAppendix and the eFigure. Briefly, fixed effects were used to control for ward team and crossover period, thereby adjusting for potential differences in outcomes due to rotation

characteristics other than duration. Random effects were used to both incorporate repeated measurements (due to the crossover design) and account for correlations among members of groupings, such as patients discharged by the same attending physician during the same rotation. For construction of confidence intervals for unadjusted proportions and means, we used variances that account for correlations among repeat measurements on the same patients.³³ For model estimation, MLwiN software, version 2.25 (Centre for Multi-level Modeling) was run using the *runmlwin*³⁴ command within Stata, version 12 (StataCorp).

RESULTS

Baseline Characteristics and Study Groups

Among 80 attending physicians who staffed the general medicine wards during the yearlong study, 62 (78%) were as-

signed random sequences of 2- and 4-week rotations (Figure 1). Study attending physicians were mostly early- or mid-career general internist clinician-educators (TABLE 1). They collectively staffed 203 rotations (89% of the general medicine inpatient service) and individually staffed a median of two 2-week rotations and one 4-week rotation. Rotation types were evenly distributed over calendar quarters and admitting teams, and more than 97% of rotations met washout criteria (eTable 4). Of 12 327 patients discharged alive during 203 study rotations, 17 (0.1%) did not receive their allocated intervention and thus were not analyzed (Figure 1). In addition, 637 patients discharged alive (0.05% of 12 327) had 30-day planned readmissions and were not analyzed for 30-day unplanned revisits.

Patient Outcomes

The unadjusted percentage of unplanned revisits within 30 days of hospital discharge was 21.2% (95% CI, 20.0%-22.5%) among 2-week and 21.5% (95% CI, 20.3%-22.7%) among 4-week rotations (TABLE 2). Within attending physicians, the mean difference between rotation types (2- minus 4-week rotations) was -0.3% (95% CI, -1.8% to +1.2%). This corresponded to a within-attending-physician adjusted OR of 0.97 in favor of 2-week rotations, with a 1-sided upper 97.5% confidence bound of 1.07 that was within the noninferiority margin of 1.13 (FIGURE 2). Neither this point estimate nor its precision changed after adjusting for patient characteristics, which supports their observed balance across rotation types (Table 2).

Average length of stay was nearly identical among patients discharged alive in the 2-week (geometric mean, 67.2 hours; 95% CI, 65.9-68.6 hours) and 4-week (67.5 hours; 95% CI, 66.2-68.8 hours) rotations, corresponding to a nonsignificant adjusted relative difference within attending physician (2- vs 4-week rotations) of -0.9% (95% CI, -4.7% to +2.9%).

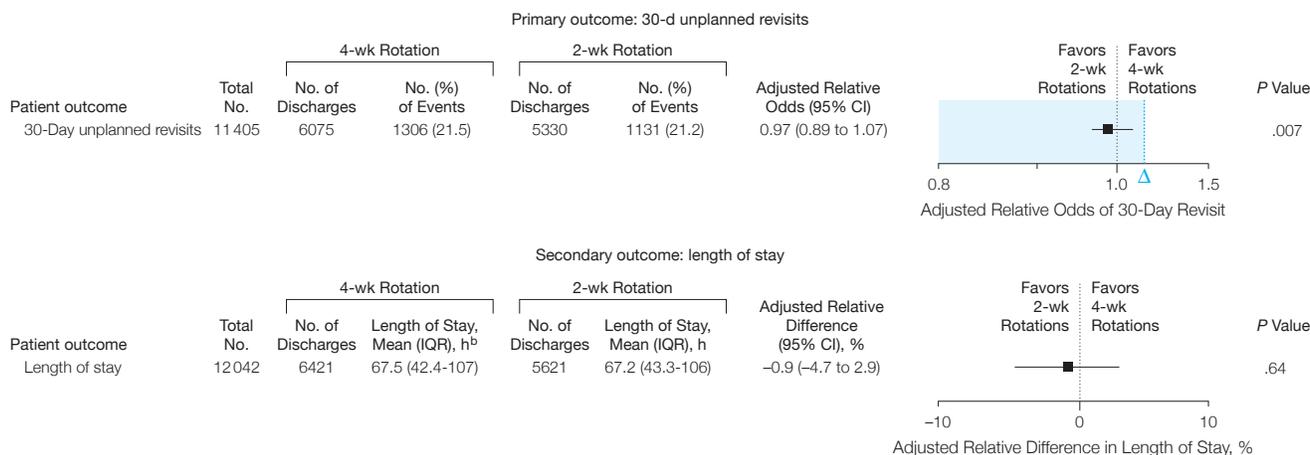
Trainee Evaluations of Attending Physicians

Among the 62 attending physicians, 60 and 62 were evaluated by house staff

Table 2. Baseline Characteristics and Unplanned 30-Day Revisits Among 11 405 Patients Discharged Alive From the General Medicine Service^a

| Characteristics | Patients Discharged Alive ^b | | |
|---|--|-------------------------------|-------------------------------|
| | Overall (n = 11 405) | 4-Week Rotation (n = 6075) | 2-Week Rotation (n = 5330) |
| Unique patients ^c | 8892 (78.0) | 5136 (84.5) | 4584 (86.0) |
| Age, mean (SD), y | 53 (15) | 53 (15) | 53 (15) |
| Women ^d | 4923 (43.2) | 2598 (42.8) | 2325 (43.6) |
| Race/ethnicity ^d | | | |
| Black | 5947 (52.1) | 3187 (52.5) | 2760 (51.8) |
| Hispanic | 2899 (25.4) | 1548 (25.5) | 1351 (25.4) |
| Not US citizen | 3043 (26.7) | 1613 (26.6) | 1430 (26.8) |
| Non-English speaking | 1771 (15.5) | 924 (15.2) | 847 (15.9) |
| Self-pay insurance | 7860 (68.9) | 4183 (68.9) | 3677 (69.0) |
| Currently married | 2819 (24.7) | 1512 (24.9) | 1307 (24.5) |
| Household income, median (IQR), \$ ^e | 35 034 (27 326-40 761) | 34 707 (27 326-41 339) | 35 034 (27 326-40 791) |
| Hospitalizations in prior year | | | |
| None | 6865 (60.2) | 3667 (60.4) | 3198 (60.0) |
| 1-3 | 3741 (32.8) | 1986 (32.7) | 1755 (32.9) |
| ≥4 | 799 (7.0) | 422 (7.0) | 377 (7.1) |
| Unplanned 30-day revisits [95% CI] ^f | | | |
| Total | 2437 (21.4) [20.5-22.3] | 1306 (21.5) [20.3-22.7] | 1131 (21.2) [20.0-22.5] |
| Readmissions ^g | 1364 (12.0) [11.2-12.7] | 731 (12.0) [11.1-13.0] | 633 (11.9) [10.9-12.9] |
| Emergency department visits | 946 (8.3) [7.7-8.8] | 507 (8.3) [7.6-9.1] | 439 (8.2) [7.5-9.0] |
| Urgent ambulatory clinic visits | 127 (1.1) [0.9-1.3] | 68 (1.1) [0.9-1.4] | 59 (1.1) [0.8-1.4] |
| None | 8968 (78.6) [77.7-79.5] | 4769 (78.5) [77.3-79.7] | 4199 (78.8) [77.5-80.0] |

Abbreviation: IQR, interquartile range.

^aAn additional 637 patients discharged alive were included in the analysis of length of stay; they were excluded from the analysis of 30-day unplanned revisits because of planned readmissions within 30 days of discharge.^bData are expressed as No. (%) of participants unless otherwise indicated.^cOf 8892 overall unique patients, 828 (9.3%) were discharged from both 4- and 2-week rotations.^dOf 5136 and 4584 unique patients from 4- and 2-week rotations, 2213 (43.1%) and 2008 (43.8%) were women, 2698 (52.5%) and 2365 (51.6%) were black, and 1276 (24.8%) and 1132 (24.7%) were Hispanic, respectively.^eObtained from the 2000 US Census by linking to the zip code of the patient's reported residence; data were missing for 10 patients discharged alive.^fUnadjusted proportions with 95% CIs that account for correlations between repeat live discharges among the same patients.^gAmong the 731 and 633 patients with live discharges from 4- and 2-week rotations that resulted in unplanned 30-day readmissions, 723 (98.9%) and 626 (98.9%) were readmitted through our hospital emergency department, 6 (0.8%) and 6 (0.8%) were transferred from other hospitals, and 2 (0.3%) and 2 (0.3%) were readmitted through our urgent ambulatory clinic, respectively.**Figure 2.** Patient Outcomes

Effect of rotation duration within attending physician, adjusting for ward team, crossover period, and the relatedness of grouped measures (details of mixed-effects models are shown in the eFigure). The *P* value for 30-day unplanned revisits is a test of inferiority vs noninferiority; *P* value for length of stay is a test of superiority. Outcomes with *P* < .003, a criterion for statistical significance that reflects a post hoc multiplicity adjustment for the 17 outcomes depicted here and in Figure 3 and Figure 4, are less likely to be chance findings. Error bars indicate 2-sided 95% CIs. The shaded area represents the noninferiority zone for the primary outcome, which is bounded only in the direction that favors 4-week rotations by a prespecified noninferiority margin (Δ , equal to 1.13).

and medical students, respectively (FIGURE 3). Trainees generally rated attending physicians higher during their 4-week rotations. For both medical students and house staff, 4-week rotations improved the perceived ability of attending physicians to fairly evaluate trainees.

Attending Physician Outcomes

All attending physicians had at least 1 burnout assessment after each rotation type (FIGURE 4). Comparing ratings after 2-week vs 4-week rotations, the OR for attending physicians reported burnout was 0.39 (95% CI, 0.26-0.58) and for severe emotional exhaustion was 0.45 (95% CI, 0.31-0.64).

COMMENT

In this study, the likelihood of a patient having an unplanned revisit within 30 days of discharge from an attending phy-

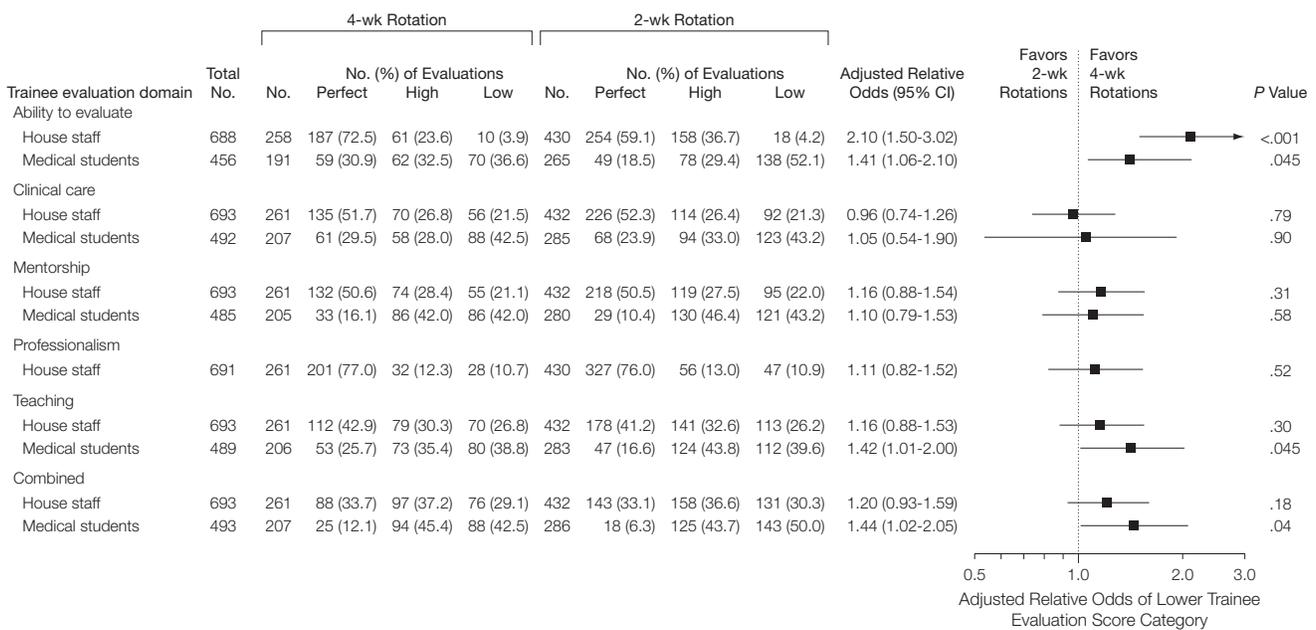
sician's 2-week rotation was noninferior to that from the same attending physician's 4-week rotation. For example, if a patient discharged during a 2-week rotation by an attending physician whose percentage of 30-day unplanned revisits during 4-week rotations was 20%, then that patient's likelihood of a 30-day unplanned revisit was less than 22%. Among the secondary outcomes, there was no statistically significant difference in length of stay on the general medicine service during 2- vs 4-week rotations. The 95% confidence intervals for both of these patient outcomes are sufficiently precise to exclude clinically important differences (Figure 2), suggesting that future trials that enroll even more patients would likely have similar conclusions.³⁵

Similar to others,³ we anticipated that shorter rotations might increase both 30-day unplanned revisits and lengths

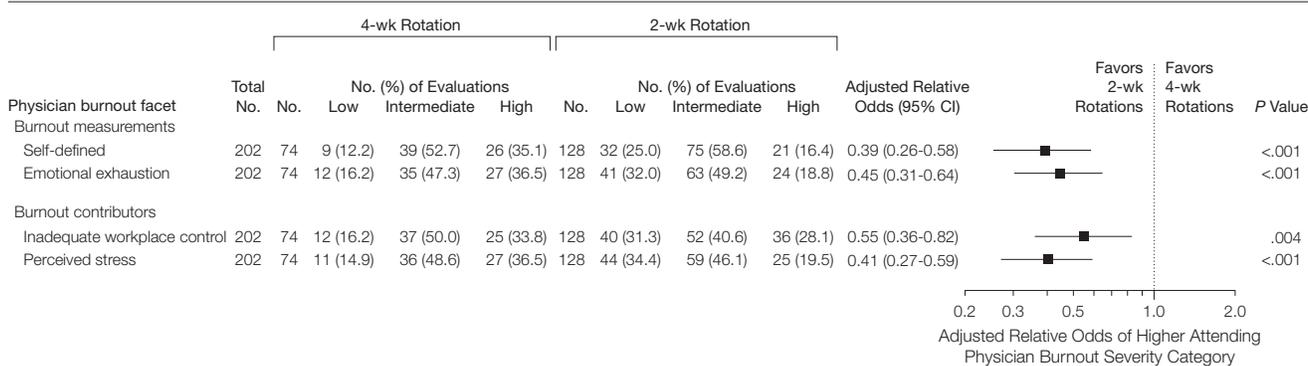
of stay by disrupting patient care because of more frequent attending physician service changes.³⁶ Yet relative to 4-week rotations, only patients handed off between 2-week rotations at the midpoint of a crossover period were subject to such changes. For example, given a total of 88 patients discharged during paired 2-week rotations (Figure 1), if 12 patients were handed off between attending physicians assigned to a consecutive 2-week pairing, then only 14% (12/88) of patients discharged would undergo an extra handoff relative to a single 4-week rotation. Moreover, the disruptive effects of attending physician service changes were likely diluted by house staff on our general medicine teams because the same house staff were present throughout paired 2-week rotations.

We also anticipated from others' work that shorter rotations may im-

Figure 3. Trainee Evaluations of Attending Physicians



Effect of rotation duration within attending physician, adjusting for ward team, crossover period, and the relatedness of grouped measures (details of mixed-effects models are shown in the eFigure). P values refer to superiority tests. Outcomes with P < .003, a criterion for statistical significance that reflects a post hoc multiplicity adjustment for the 17 outcomes depicted here and in Figure 2 and Figure 4, are less likely to be chance findings. Error bars indicate 2-sided 95% CIs. Percentages may not add to 100% because of rounding error. See eTable 1 and eTable 2 for the items that compose domains. Among 153 house staff and 253 medical students assigned to study rotations, 147 house staff (96%) and 229 medical students (91%) submitted a median of 6 (range, 1-11) and 2 (range, 1-5) evaluations; submitted 89% and 92% of all possible evaluations for 2-week study rotations and 88% and 89% of all possible evaluations for 4-week study rotations; and evaluated attending physicians a median of 12 (range, 4-30) times and 9 (range, 1-19) times, respectively. Two (3%) of 62 attending physicians were not evaluated by house staff. Medical students spent a median of 7 days (interquartile range [IQR], 4-14 days) on 2-week and 17 days (IQR, 7-21 days) on 4-week rotations. Missing domain scores (which occurred in 0.3%-0.7% and 0.2%-7.5% of domains from house staff and medical student evaluations, respectively) were not included in the denominators of score category percentages.

Figure 4. Facets of Attending Physician Burnout and Its Contributors

Effect of rotation duration within attending physician, adjusting for ward team, crossover period, and the relatedness of grouped measures (details of mixed-effects models are shown in the eFigure). *P* values refer to superiority tests. Outcomes with $P < .003$, a criterion for statistical significance that reflects a post hoc multiplicity adjustment for the 17 outcomes depicted here and in Figure 2 and Figure 3, are less likely to be chance findings. Error bars indicate 2-sided 95% CIs. Percentages may not add to 100% because of rounding error. See eTable 3 for the items that compose facets. A severity assessment from a 2-week rotation was missing from one attending physician who had completed 5 other assessments after 2-week rotations. Low, intermediate, and high overall raw mean scores were 5.8, 18.3, and 40.8 for emotional exhaustion; 1.0, 2.0, and 3.2 for the single-item summary of burnout; 14.6, 19.8, and 26.3 for inadequate workplace control; and 1.9, 5.6, and 9.0 for perceived stress, respectively.

prove some attending physician outcomes while worsening others. Smith et al⁴ retrospectively found that 2-week rotations generally worsened house-staff evaluations of attending physicians. Comparing composite evaluation scores from 2- vs 4-week rotations, the OR of a composite score below the median was 1.80 (95% CI, 1.34-2.41). In contrast, Elnicki and Cooper⁶ found few differences in medical student evaluations, but attending physicians favored 4-week rotations for having the time to evaluate students' overall performance. The average attending physician response on a 5-point scale was 1 point higher for 4-week rotations. Finally, Akl et al³ found that house staff thought shorter rotations would reduce attending physicians' ability to evaluate them (by 1 point on a 7-point scale), whereas attending physicians thought that shorter rotations would improve their private lives (by 1 point on a 7-point scale).

Trade-offs between stakeholders make research in medical education complex because although multiple outcomes and levels of analysis ought to be considered,^{37,38} interpretation of the relative importance and statistical significance of such findings is challenging. The study was powered for a single patient outcome, 30-day un-

planned revisits, reasoning that hospital policy was more likely to be driven by it than by any other.^{9,39} The statistical significance of the other secondary outcomes should therefore be interpreted in light of increased potential for chance findings. For example, under the conservative assumption that the 17 hypothesis tests presented in Figure 2, Figure 3, and Figure 4 were statistically independent, on average at least 1 of the observed statistically significant results would be expected to be a chance finding. Alternatively, a multiplicity adjustment could be made to the standard *P* value criterion for statistical significance, lowering it from $P = .05$ to $P = .003$ (Figure 2, Figure 3, and Figure 4).⁴⁰

Thus, although conclusions based on the secondary outcomes must be tentative, those outcomes can be cautiously used to help weigh the relative effects of rotation duration across the involved stakeholders. In contrast to patients, attending physicians were importantly affected by rotation duration—but in opposing ways. Whereas trainees generally evaluated attending physicians more favorably after 4-week rotations, attending physicians reported less burnout and emotional exhaustion after 2-week rotations. The adjusted ORs in Figure 3 and Figure 4 can

be applied to concretely weigh this trade-off. If house staff rate attending physicians' ability to evaluate them as imperfect in approximately 30% of 4-week rotations, a hospital policy that mandates all 2-week rotations would increase this by 17 percentage points to 47% (Figure 3; adjusted OR, 2.10). This negative effect, however, would be offset by an 18-percentage-point decrease in rotations in which attending physicians report burnout: if they report burnout after approximately 35% of 4-week rotations, they would be expected to report it after only 17% of 2-week rotations (Figure 4; adjusted OR, 0.39). Administrators and program leaders should expect that, if replacing an all-4-week with an all-2-week rotation calendar, the increase in rotations in which house staff perceive that they were not perfectly evaluated by their attending physicians will be offset in an approximate 1-to-1 ratio with a decrease in rotations in which attending physicians report burnout.

In addition to consideration of rotation duration, it may be beneficial to align the academic calendars of attending physicians and trainees to maximize shared time because we found support for the intuitive notion that attending physicians better evaluate trainees when they spend more time with

them. Our findings for medical students are most applicable to settings where medical student rotations do not align with attending physician rotations because medical students in our study spent a median of 7 days (interquartile range [IQR], 4-14 days) on 2-week and 17 days (IQR, 7-21 days) on 4-week rotations (Figure 4). Given such brief durations and the ongoing trend toward shorter ones, evaluation methods themselves may need retooling. Alternatively, for attending physicians who wish to maintain longer rotation durations for potential trainee benefit,⁶ other practice characteristics beyond rotation duration may help moderate burnout and its antecedents.¹⁹ Although rotation duration appeared to affect attending physicians during inpatient medicine wards, it was clearly not the sole factor because attending physicians reported burnout after 16% of 2-week rotations (Figure 4). Others have found, for example, that work-life balance⁴¹ and alignment with local administrative leaders⁴² may lessen burnout.

These findings should be interpreted in light of several limitations. First, the study was in a single center. The common structure of the ward teams,^{1,2} however, enhances the generalizability of the findings. Second, the trainee evaluations of attending physician performance were subjective. Differences between rotation types may therefore reflect trainees' perceptions, not actual differences in attending physician performance. Because the house staff evaluation was previously validated,¹⁴ however, we believe it is a reasonable surrogate for attending physicians' true performance. Third, the washout period was based on theory, not evidence, and carryover may still have affected attending physicians. Nevertheless, the proximities of preceding inpatient weeks were well-balanced across rotation types (eTable 4). Fourth, attending physicians' burnout assessments were not validated with a concurrent, objective measure. Given that attending physicians were not blinded to rotation duration, they may have

knowingly adjusted their responses in favor of their preferred rotation type. Workplace preferences, however, tend to align with workplace satisfaction, a moderator of burnout.²⁰

If the projected trend toward shorter rotations continues,⁶ a trial of 1-week rotations may be needed. If so, direct testing of trainees' skills and behaviors would be a more relevant measure of attending physician teaching performance than trainees' perceptions.⁹ In addition, to maximize uncovering important effects of rotation duration, future trials should consider patient-level outcomes that are both more reflective of care quality and more vulnerable to extra attending physician handoffs, such as preventable adverse events, patient treatment adherence, and patient satisfaction.^{43,44} As shown in this study (eTable 5) and as others have reported,⁴⁵ the variability of both 30-day unplanned revisits and lengths of hospital stay are determined more by patient-level than physician-level factors.

Although rarely collected, patient-level measurements should be a primary focus of medical education outcomes research.^{9,38,46} Randomization of patients, however, is often not feasible in such research, and justifiable concerns about patient-level confounding often arise. In the present study, these concerns are mitigated by the large patient sample, the assignment of patients to ward teams without regard to the attending physicians' rotation durations, the well-balanced distribution of patient characteristics across rotation types (Table 2), and the stability of the results after adjustment for patient characteristics within attending physicians. Nonetheless, as the present study shows, when patients are not substantively affected, the overall favorability of an intervention will rest on weighing its effects on other stakeholders.

Indeed, without evidence to suggest that patients were adversely affected by 2-week rotations, administrators and program leaders from our department of medicine decided to forego the potential negative effects of

2-week rotations on trainees in favor of reducing the potential for attending physician burnout. As a result of these present findings, therefore, attending physicians at our hospital now voluntarily choose between 2- or 4-week rotations.

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Author Contributions: Dr Lucas had full access to all of the data in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis.

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Online-Only Material: The eAppendix, eTables 1 through 5, and the eFigure are available at <http://www.jama.com>.

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