Effects of Physician Experience on Costs and Outcomes on an Academic General Medicine Service: Results of a Trial of Hospitalists

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Abstract

Context: Hospitalists are believed to decrease costs and possibly improve outcomes but existing evidence is limited and has not identified mechanisms for such effects.

Objective: To prospectively study the costs and outcomes of patients on an academic general medicine service effectively randomized to teams led by hospitalists and non-hospitalists.

Design, Setting, and Participants, and Intervention: A prospective study of 6511 patients admitted to an academic general medicine service from July 1997 - June 1999. All patients admitted every fourth day were assigned to hospitalists who cared for inpatients 6 months each year versus non-hospitalists who cared for inpatients 1 or 2 months each year.

Main Outcomes Measures: Length of stay, costs and 30-, 60-, and 365-day mortality.

Results: 24.8% of admissions were to hospitalists and 75.2% to non-hospitalists. Hospitalist and non-hospitalist patients did not differ in age, race, gender, diagnosis-mix, or Charlson index score. Average adjusted length of stay was 0.29 days shorter for hospitalists than non-hospitalists in year 1 (95% C.I. (-0.66,0.06), $p<0.06$), and the difference increased to 0.49 days by year 2 (95% C.I. (-0.79,-0.15), $p<0.01$). Hospitalists did not have significantly different costs than non-hospitalists in year 1, but had average adjusted costs $782 below non-hospitalists in year 2 (95% C.I. (-1313,-187), $p<0.01$). 30-day mortality was not lower for hospitalists in year 1, but was 4.2% for hospitalists versus 6.0% for non-hospitalists in year 2 (95% C.I. for difference (-3.1,-0.1), $p<0.04$); adjusted relative risk 0.63, 95% C.I. (0.42, 0.93), $p<0.02$).

Findings were similar for 60-day mortality. Trends in other outcomes also favored the hospitalists. In multivariate analyses, resource use and mortality decreased with the number of patients with the same primary diagnosis seen to date.

Conclusions: Hospitalists decreased resource use and acute mortality, with improvements increasing over time with increased disease-specific experience. Disease-specific physician experience can reduce resource use and improve outcomes and may be an important determinant of the effectiveness of hospitalists.

In many countries, patients hospitalized with general medical problems are usually cared for by physicians who specialize in inpatient care.[1, 2, 3] In the United States, primary care physicians have commonly served this role historically, but there has been a recent surge of interest in the care of inpatients by "hospitalists", by which is meant physicians who devote at least 25% of their time to the care of hospitalized patients.[4,5]

Key to the growth of hospitalist medicine has been the belief that hospitalists will be better suited to contain costs and maintain or improve patient outcomes. Although this belief has been supported by several recent studies[6, 7, 8], only two of these were based on a randomized design. The first of these randomized studies showed cost savings, but could not demonstrate improved outcomes.[9] Moreover, many of the "hospitalist" physicians in that randomized study practiced inpatient medicine for only 1 or 2 months per year. The second study showed no effects on either costs or outcomes.[10]

Why the findings of these studies differ is not known. These disparate results highlight that we do not know by what mechanism hospitalists may affect costs or outcomes if they do affect them. This makes it difficult to know whether the results of these or other studies will generalize to other settings. One potential hypothesis is that the greater experience of hospitalists in the inpatient setting may be an important determinant of any improvements in costs and outcomes. However, while a large literature supports volume-outcomes relationships elsewhere in medicine[11], such a relationship has never been demonstrated in inpatient general medical care. Moreover, any benefits of hospitalists might also stem from intrinsic differences in practice style, provision of more focused physician clinical leadership through the development of practice guidelines, or greater expenditure of effort on inpatient care, such as special efforts to see patients on the day of admission. Hospitalists may also have broad effects on practice patterns in the institutions in which they operate by providing a pool of highly experienced inpatient clinicians to whom other physicians (including any housestaff present) can turn for advice. Understanding the importance of these factors is crucial to the design, evaluation, and improvement of hospitalist programs.

This paper reports the results of a two-year quasi-randomized trial comparing hospitalist care to care by traditional academic internists on the general medicine service at the University of Chicago. In addition to examining the effects of hospitalists on costs and outcomes, this study examines whether greater overall or disease-specific experience with hospitalized patients are important determinants of the effects of hospitalists on costs and outcomes.

Methods:

Intervention: In July 1997 a hospitalist service was established within the general medicine service at the University of Chicago with the goals of improving the educational environment and containing costs. Two general internists in practice for 2 and 10 years respectively agreed to each serve as inpatient attending for 6 months of the year, alternating with each other every month between the inpatient service and a shared ambulatory general medicine practice. This hospitalist team alternated in a 4-day call cycle with three teams led by traditional academic internists who served as inpatient attending 1 or 2 months per year. The 4-day call cycle was arranged so that all patients admitted on a day were assigned to the on call team except for the first 4 patients admitted on weekdays before 5pm. These patients were given to the "short call" team for that day which was on day 3 of its call cycle at the time. Thus all patients were assigned to teams based only on their position in the call cycle, without regard to whether the attending was a hospitalist or non-hospitalist. To minimize hospitalist fatigue, all weekend days on the hospitalist service (except when the hospitalist team was post-call) were covered by the pool of traditional general internists. The traditional attendings had no weekend days off when they were on service. Hospitalists and non-hospitalists also differed in that non-hospitalists generally saw ambulatory patients on weekday afternoons, while the hospitalists did not have clinic with the expectation that they would be more available to see patients on the day of admission. Housestaff were randomly assigned to the hospitalist and non-hospitalist teams. This study was approved by our Institutional Review Board.

Study Sample and Data Collection: All 6511 admissions to the general medicine service from July 1, 1997 through June 30, 1999 were studied. Hospital administrative data provided information concerning age, race, primary and secondary diagnoses, length of stay, and costs assessed using an activity-based accounting system produced by Transitions Systems Incorporated.[12] Physician fees were not included. Length of stay was defined from the date a patient was admitted to general medicine to their discharge from the hospital, even when the patient was transferred to another service before discharge.

Hospitalized patients were asked to consent to a 15-minute interview to collect detailed health and socioeconomic information, and contact information for a follow-up telephone interview 1 month after discharge. Proxy respondents were sought for patients unable to complete or consent to the interview. Of the 6511 admissions, 4119 (63%) were approached for interviews.

941 (14%) were not interviewed because the patient was being readmitted within 60 days. The remaining 1451 (22%) admissions were not interviewed because the patient was discharged or died before an interview could be completed, but the fraction of admissions not interviewed was the same on the hospitalist and non-hospitalist services. Of the patients approached for interview, 3866 (94%) agreed to be interviewed (including 12% by proxy), and 253 (6%) refused to be interviewed.

Mortality at 30, 60, and 365 days from admission was assessed by linkage to the Social Security Death Index.[13] A telephone survey of patients or designated proxies who agreed to be interviewed was done at least 1 month following discharge to assess re-hospitalization, emergency room use, reported physical function, and patient satisfaction. Of the 3866 patient interviews performed in the hospital, 1-month follow-up surveys were completed for 2844 (74%).

Patient satisfaction with the hospitalization and with the care provided by the attending physician was assessed using questions from the Picker-Commonwealth patient satisfaction survey.[14,15] Health status was assessed using the self-rated health status and health limitation questions of the SF-12.[16] Rehospitalization and emergency utilization were assessed by respondent recall of all emergency room visits and hospitalizations during the month following discharge.[17] We measured case-mix using Diagnosis Related Group weights and comorbidity using a claims-based Charlson index with a one-year look-back.[18,19,20] Provider experience was measured by counting the total number of cases and the total number of cases with the same diagnosis (measured by 3-digit ICD-9 code) that the attending had cared for up to and including the date of admission of the patient in question.

Statistical Analysis: We tested for differences in the baseline health and demographic characteristics of the patients assigned to hospitalists and non-hospitalists and for hospitalist and non-hospitalist characteristics (such as experience) using t-tests for continuous variables and exact binomial tests for binary variables. We tested for differences in length of stay, costs, mortality, emergency room utilization, and readmission using t-tests with corrections for the clustering of patients by attending. We used Pearson chi-squared to test for differences in physical function and patient satisfaction. Comparisons for length of stay, costs and outcomes were also made for the first and second year to assess changes over time.

The effects of hospitalists were also assessed using regression models of length of stay, costs and mortality controlling for primary diagnosis using DRG weight, for comorbidities using the Charlson index, for weekend admission, age, race, and whether the patient was admitted directly to the general medicine service or transferred from another service (transfer status). To account for the non-negativity and skewness of the distribution of costs and length of stay and to address heteroskedasticity present in simple linear models, we used generalized linear models of length of stay and costs with a gamma error structure assuming that the effects of the covariates were proportional (i.e. a logarithmic link function).[21, 22] To address the clustering of patients by attendings, we performed the statistical tests based on robust standard errors with a cluster correction for the attending physician. These regression analyses were used to develop estimates of length of stay and costs controlling for DRG weight, Charlson index, race, age, weekend admission, and transfer status. Statistical tests and confidence errors for these adjusted values were calculated using the bootstrap method. Logistic regression analyses were performed for 30-, 60-, and 365-day mortality, and also controlled for DRG weight, Charlson index, race, age, weekend admission, and transfer status, and included cluster corrections for attending physician.

To explore the mechanism by which hospitalists might effect outcomes, these regression analyses were also expanded to include overall and disease-specific attending experience during the study date. In order to interpret the estimates of the effects of case counts as the percentage effect of a doubling of experience on the outcome in question, we measured the case count variables as the natural log of the case counts. To avoid possible confounding of disease-specific experience by diagnosis frequency, we also controlled for the natural log of total 2-year case count within each 3-digit ICD-9 code. To more precisely control for seasonal effects and time trends that could affect both services, we included an indicator variable for each month in the study in these regressions.

Results:

Characteristics of the hospitalist and non-hospitalist services

Of the 6511 patients admitted to the general medicine service, 4898 (75.2%) were admitted to the non-hospitalist service and 1613 (24.8%) to the hospitalist service. Consistent with the effective randomization of patients to these services following the call-cycle, patients admitted to these services were very similar in demographic characteristics, mix of primary diagnoses, DRG weight, and Charlson index (Table 1).

Because the hospitalists spent more time on the inpatient service over the study period, their average overall and disease-specific experience over the study period was substantially greater than that of the non-hospitalists (Table 1). Hospitalists saw 35% of patients on the day of admission versus 27% for non-hospitalists. This difference was due completely to their greater likelihood to see patients admitted weekdays on their day of admission; hospitalists were not more likely than non-hospitalists to see patients admitted on weekends on their day of admission.

Effects on length of stay and costs

Over the study period, adjusted average length of stay was 4.78 days on the non-hospitalist service and 4.46 days on the hospitalist service (Difference -0.32 days, 95% C.I. (-0.61, -0.03)), $p<0.03$). Interestingly, adjusted average length of stay for the hospitalists was only 0.29 days less than for non-hospitalists in year 1 (95% C.I. (-0.66, 0.06), $p<0.06$), but the difference widened to 0.49 days by year 2 (95% C.I. (-0.79, -0.15), $p<0.01$) (Table 2). This occurred despite a 0.44 day decrease in adjusted length of stay on the non-hospitalist services between years 1 and 2. The increase in the difference between the hospitalist and non-hospitalist services between year 1 and the difference between them in year 2 was not quite statistically significant in either these adjusted analyses (Difference 0.20 days, 95% C.I. (-0.65, 0.30), $p=0.23$), or unadjusted ones (Difference 0.50 days, 95% C.I. (-1.08, 0.11), $p=0.11$), though in both analyses there was a trend towards increasing differences.

Over the 2 years, adjusted average costs on the non-hospitalist service were $8746 versus $8320 on the hospitalist service (Difference -$426, 95% C.I. (-912, -31), $p<0.03$). As with length of stay, there was no statistically significant difference in average costs between the services in the first year, but the mean cost for the hospitalists was \$782 below that for non-hospitalists in year 2 (95% C.I., (-1313, -187), P<0.01). Compared to the pattern for length of stay, the increase in the difference in costs between the hospitalist and non-hospitalist services between years 1 and 2 was more highly significant in both the adjusted analysis (Difference \$729, 95% C.I. (-1642, 166), p<0.06), and the unadjusted analyses (Difference \$1,537, 95% C.I. (-2948, -126), p<0.03).

Effects on outcomes

Table 3 shows unadjusted and adjusted effects on mortality. Unadjusted analyses show no statistically significant effects on mortality over the two years combined, though there are trends towards lower mortality at both 30 and 60 days that are no longer apparent at 365 days. These reductions in short-term mortality are shown graphically through Kaplan-Meier survival curves in Figure 1. Examining mortality by year, these findings are seen to result from the combination of no effect on mortality in the first year, but about 2 percentage point decreases in the absolute probability of mortality at 30 and 60 days in the second year that are statistically significant.

Results were similar in the adjusted analyses of mortality. These show clear trends towards lower mortality for hospitalist patients at 30 days (Adj. RR = 0.79, p<0.09) and 60 days (Adj. RR = 0.83, p<0.11) over the 2 years. As in the unadjusted results, these reflect the lack of any significant effects in year 1, but large statistically significant effects at 30 days (Adj. RR = 0.63, p<0.02), and 60 days (Adj. RR = 0.72, p<0.05) in year 2. There were no significant differences in in-hospital mortality or 30-day readmission, emergency department utilization, reported health status, or patient satisfaction in either year or over the two years combined. However, the trend over the two years favored the hospitalists in almost all of these measures (Table 4).

Effects of experience on length of stay, costs, and mortality

Table 5 reports the regression analyses of length of stay, costs, and mortality. In basic models controlling for primary diagnosis with DRG weight, secondary diagnoses with Charlson index, and time trends using month–specific dummy variables, hospitalists have 8.0% shorter length of stay, 4.8% lower costs, and trends towards 19% (RR=0.81) and 15% (RR=0.85) lower relative risk of 30- and 60-day mortality. Including measures of overall and disease-specific experience eliminates these independent effects of hospitalists. Only the effects of disease-specific experience on resource use are statistically significant, with a doubling of prior case volume decreasing length of stay by 4.7%, and costs by 4.8%. There is also a tendency for mortality to fall with increasing disease-specific experience. This is statistically significant only for mortality at 1 year, but the point estimates of about a 10% reduction in mortality with a doubling of disease-specific experience are similar at 30 and 60 days, only with much wider confidence intervals.

Comment:

Although we found more modest differences in year 1 of our study, by year 2 the hospitalists reduced average adjusted length of stay by almost 0.5 days, average adjusted costs by $782, and adjusted mortality at 30 and 60 days by 37% and 28%, respectively. This provides important evidence for the potential for hospitalists to reduce inpatient resource use while improving outcomes.

Because our findings reflect the experience of a small number of clinicians at one institution, it is important to compare them to the findings of the other two published studies that effectively randomized patients to hospitalists. Interestingly, the lack of resource savings in year 1 is consistent with the lack of savings suggested by Kearns et al., who performed a one-year study of new hospitalists with annual hospitalist case volumes similar to ours.[10] It is also interesting that the resource savings we found in year 2 are similar to the 0.6 day shorter length of stay and $770 lower costs found in the first published randomized study of hospitalists, which was performed by Wachter et al. at the University of California-San Francisco (UCSF). Why our initial savings were lower than those at UCSF and why our later savings were similar is not clear, but possible explanations for the greater initial savings at UCSF include the more careful selection of hospitalists for their underlying practice styles there[23] and the discontinuities of care present in our system due to the hospitalists' weekend coverage system. On the other hand, the two-year duration of our study compared to only one year at UCSF and the fact that our hospitalists both attended six months annually while several of the UCSF hospitalists attended less than the minimum 25% percent proposed to define hospitalists may explain why our hospitalists were eventually able to achieve similar resource savings to those at UCSF.

Even more striking than these substantial cost savings are the large and statistically significant reductions in mortality we found at 30 and 60 days in year 2. Although the increases in survival in our study are present only over a modest period of time following discharge, they may nevertheless be important to both patients and their families. To our knowledge, this is the first demonstration of statistically significant reductions in mortality due to hospitalists in a study without observable differences in baseline characteristics of patients cared for by hospitalists and non-hospitalists that would suggest non-random assortment of patients. It will be important to confirm these findings in future studies involving larger numbers of clinicians and patients. Nevertheless, these results add credence to findings of improved outcomes in a recent non-randomized study of hospitalists.[24]

As these comparisons suggest, it is important to better understand the mechanisms by which hospitalists may have their effects so that hospitalist programs can be designed that maximize their performance. In examining possible mechanisms by which our hospitalists had their effects, we found that resource savings increased over time in relation to disease-specific experience. We also found that mortality improved over time for the hospitalists relative to the non-hospitalists. Though the association with increased disease-specific experience is statistically significant only at 365 days, there is a similar trend but with wider confidence intervals at 30 and 60 days. To the extent that the changes in mortality over time are not associated with increased disease-specific experience, it will be important to determine why these changes occur. One hypothesis is that the hospitalists' overall experience and greater physical presence on the wards leads to greater awareness of clinical instability and more timely ICU transfer of unstable patients regardless of specific clinical diagnosis. Further work will be required to test these and other hypotheses about the mechanisms for these effects on mortality.

Whether the effects of hospitalists on costs and outcomes operate through overall or disease-specific experience, our findings suggest that even experienced clinicians, such as our hospitalists, can benefit from greater experience treating conditions that they regularly encounter. Although such "volume-outcomes" relationships for providers have been demonstrated for wide range of surgical procedures,[25,26,27] and for treatment of patients with HIV in an ambulatory setting,[28] to our knowledge this is the first demonstration of this phenomenon for patients with general medicine conditions commonly treated by general internists. Moreover, because patients are assigned to attendings without consideration of their diagnoses, these findings about the effects of disease-specific experience are not subject to the interpretation that providers with lower costs or better outcomes may attract larger numbers of patients, so that the "volume-outcomes" relationship is actually due to the effects of volume on outcomes, rather than the reverse.[29]

Given the diversity of diagnoses treated by general internists, these findings about the importance of disease-specific experience highlight a number of challenges for general internal medicine with importance extending beyond hospitalists. Because no single diagnosis represents more than a small percent of the admissions treated by general internists, the development of a few critical pathways or practice guidelines is unlikely to be as effective within general internal medicine as in specialties whose practice is focused in a smaller number of diagnoses. If indeed patient volume itself is important, the greater use of hospitalists is one way to increase the experience of physicians caring for hospitalized patients. However, provider experience might also be increased by encouraging clinicians with little inpatient exposure to increase their clinical inpatient work, or focusing general internal medicine practice on a smaller number of diagnoses with greater referral to sub-specialists. Our study cannot assess the merits of these options but does suggest the potential value of exploring them and the importance of considering disease-specific experience in evaluating such approaches.

That improvements in costs and outcomes occurred primarily in the second year of our study suggests that hospitalist programs are most likely to be beneficial when staffed by experienced physicians. This is an important concern because the recent rapid growth in the use of hospitalist physicians has created a relative shortage of experienced hospitalists. This problem is compounded by the fact that many such jobs are designed as transient ones to be staffed by recent residency graduates and lack clear paths for long-term career development. At our medical center, we have addressed this challenge by taking some of the financial savings generated by the hospitalists, and using part of those savings to support protected time to promote the long-term career development of our hospitalists. Since our hospitalist service cares for about 800 patients per year and savings with experienced hospitalists appear to be about $780 per patient, we estimate that the annual savings from our hospitalist service is over $600,000 annually. Because these savings are due to reductions in length of stay and costs that largely benefit our hospital, using the savings to create protected time for hospitalists has required negotiating agreements in which the hospital supports this protected time for hospitalists. The hospitalists then use this protected time to work on hospital systems improvements and pursue academic research agendas. In this way, we hope to ensure both retention of experienced hospitalists and enhanced roles for the hospitalists as leaders in clinical systems development.

That much of the direct effects of hospitalists is reduced when overall and disease-specific experience are controlled for in Table 5 suggests that these factors could explain much of how hospitalists have their effects, but do not exclude the possibility that other factors may also be important. Other such possible factors include the selection of physicians with more resource-conscious practice styles as hospitalists, and aspects of experience or effort not captured by our analyses. The finding that resource savings for hospitalists at the beginning of our study were present but substantially smaller suggests that selection of resource-conscious physicians may explain some but not most of our results. These basic findings were unchanged when we also included measures of physician inpatient attending experience prior to the start of our study. Though hospitalists were more likely than non-hospitalists to see patients on the day of admission, this difference fell from 15% in year 1 to 3% in year 2 ($p<0.01$ for change in difference), suggesting that greater effort to see the patient on the day of admission does not explain the advantages of hospitalists over non-hospitalists in resource use or outcomes in year 2.

Yet another possible explanation of the effects of hospitalists is that the hospitalists were more likely to develop or benefit from the development of critical pathways. However, the only pathways active on our general medicine service at this time were for pneumonia and the treatment of deep venous thromboses with low molecular-weight heparin, and omitting these patients from our analysis did not substantially alter our findings.

Hospitalists may have also positively affected practice patterns of other clinicians, including housestaff. If so, our analysis may underestimate their total benefits. Because attendings and housestaff are randomly assigned to each other each month, it may be possible to trace such effects in future analyses. In our current analysis, the reduction in length of stay for the non-hospitalists between years 1 and 2 could be consistent with such effects, though they could also reflect a secular decline in length of stay for other reasons.

Because our study is based on a small number of hospitalists at only one institution, it is clearly important to attempt to replicate these findings with larger numbers of clinicians and institutions. Moreover, while our findings and those at UCSF certainly support the potential for savings by hospitalists in the context of an academic general medicine service, future work should also study hospitalists in community settings. Effects there may be very different since hospitalists may displace patients' primary care physicians and since housestaff are generally not present for 24-hour coverage.

Finally, while we found statistically significant evidence of reductions in mortality at 30 and 60 days, and trends towards improvement in almost all our other outcomes measures, we note that the relative infrequency of adverse outcomes leaves considerable uncertainty surrounding our estimates of effects on outcomes. The same is true of all previous studies of hospitalists[30,31,32] and again indicates the continuing need for far larger studies of the effects of hospitalists.

Table 1: Admission Characteristics			
	Non-Hospitalist Service	Hospitalist Service	P-value for difference
Baseline Patient Characteristics			
Number of Patients (% total)	4898 (75.2%)	1613 (24.8%)	
Age (years)	58	58	0.79
Female (%)	61	63	0.11
African American (%)	82	83	0.23
DRG Weight	1.15	1.19	0.27
Charlson Index	2.64	2.69	0.48
Primary Diagnosis (ICD- 9 code) (%)			
Asthma (493.20, 493.90 – 493.91)	7.80	7.94	
Pneumonia (486)	6.02	6.08	
Congestive Heart Failure (428.0)	3.16	3.47	
Urinary Tract Infection (599.0)	2.78	3.60	
Sickle Cell Disease (282.62)	2.89	2.91	
Hypovolemia (276.5)	2.29	2.11	
Cellulitis of Leg (682.6)	2.02	1.80	
COPD (491.21)	1.92	1.36	0.72*
Venous Thrombosis (453.8)	1.61	1.55	
Acute Pancreatitis (577.0)	1.37	1.05	
GI Bleeding (578.9)	1.10	1.55	
Aspiration Pneumonitis (507.0)	1.20	1.18	
HIV w/ Opportunistic Infct. (042)	1.20	0.80	
Systemic Lupus Erythematosus (710.0)	1.12	0.93	
Hypertens. Renal Dis. w/ Ren. Failure (403.91)	1.08	0.87	
All Other	62.43	62.80	
Admitted on Weekend (%)	23	23	0.79
Attending Characteristics			
Attending Experience in Study Period to Date (# of Cases)	64	410	<0.001
Disease-Specific Attending Experience in Study Period to Date (# of Cases)	2.4	10.1	<0.001
Attending sees Patient on Day of Admission (%)	27	35	<0.001
Seen Day of Admission - Weekday	27	38	<0.001
Seen Day of Admission - Weekend	27	24	0.35

* Pearson $\chi^2(15)=12.5$

Table 2: Length of Stay and Costs					
Length of Stay (days)		Year 1	Year 2	Difference Year 2 vs. Year 1	P-value for Difference
	Non-Hospitalist Service	4.97	4.60	-0.37	0.03
	Hospitalist Service	4.93	4.06	-0.87	<0.01
	Difference Hosp. vs. Non-Hosp.	-0.04	-0.54		
	P-value for Difference	0.77	0.02		
Adjusted Length of Stay (days)	Non-Hospitalist Service	5.03	4.59	-0.44	<0.01
	Hospitalist Service	4.74	4.10	-0.64	<0.01
	Difference Hosp. vs. Non-Hosp.	-0.29	-0.49		
	P-value	0.06	<0.01		
Total Costs ($)	Non-Hospitalist Service	8295	8795	470	0.19
	Hospitalist Service	9072	8005	-1067	0.10
	Difference Hosp. vs. Non-Hosp.	777	-760		
	P-value	0.13	0.13		
Adjusted Total Costs ($)	Non-Hospitalist Service	8701	8801	100	0.67
	Hospitalist Service	8648	8019	-629	0.05
	Difference Hosp. vs. Non-Hosp.	53	-782		
	P-value	0.42	<0.01		

Table 3: Effects on Mortality

	Years 1 and 2			Year 1			Year 2		
	30-day	60-day	365-day	30-day	60-day	365-day	30-day	60-day	365-day
Unadjusted Mortality (%)									
Non-Hospitalist	5.4	7.9	18.6	4.7	6.9	17.4	6.0	8.8	19.8
Hospitalist	4.6	6.9	18.7	5.1	7.1	18.8	4.2	6.8	18.6
Difference (95% C.I.)	-0.8 (-2.1, 0.4)	-1.0 (-2.5, 0.5)	0.1 (-2.1, 2.3)	- 0.4 (-1.4, 2.1)	0.2 (-1.9, 2.2)	1.4 (-1.7, 4.5)	- 1.9 (-3.6, -0.1)	-2.0 (-4.1, 0.01)	-1.2 (-4.2, 1.9)
p-value	0.20	0.21	0.94	0.72	0.89	0.23	0.04	0.07	0.46
Relative Risk (Hospitalist vs. Non-Hospitalist)									
Unadjusted RR (95% C.I.)	0.84 (0.65,1.09)	0.87 (0.69,1.08)	1.01 (0.87,1.16)	1.07 (0.74,1.56)	1.02 (0.74,1.41)	1.10 (0.89,1.36)	0.68 (0.47,0.98)	0.76 (0.56,1.02)	0.93 (0.76,1.13)
p-value	0.20	0.21	0.94	0.72	0.89	0.23	0.04	0.07	0.46
Adjusted RR (95% C.I.)	0.79 (0.60,1.04)	0.83 (0.66,1.04)	0.99 (0.84,1.15)	1.02 (0.69,1.51)	0.98 (0.70,1.37)	1.08 (0.85,1.35)	0.63 (0.42,0.93)	0.72 (0.53,0.99)	0.92 (0.74,1.38)
p-value	0.09	0.11	0.87	0.92	0.89	0.54	0.02	0.05	0.44

Table 4: Effects on Patient Outcomes

	In-Hospital Mortality Rate (n=6511)	30-day Readmission Rate (n=2672)	30-day E.R. Visit Rate (n=2659)	30-day Reported Health Status* (n=2765)	Overall Patient Satisfaction* (n=2689)
Non-Hospitalist	109 (2.2%)	245 (12.2%)	164 (8.2%)	2. 73	4.08
Hospitalist	31 (1.9%)	71 (10.8%)	50 (7.6%)	2.78	4.08
Difference (95% C.I.)	- 0.3% (-1.1, 0.5)	- 1.4% (- 4.2, 1.4)	- 0.6% (-3.0, 1.8)		
p-value**	0.47	0.34	0.62	0.20	0.53

* Measured on a scale of 1-5; 1 Poor, 5 Excellent.

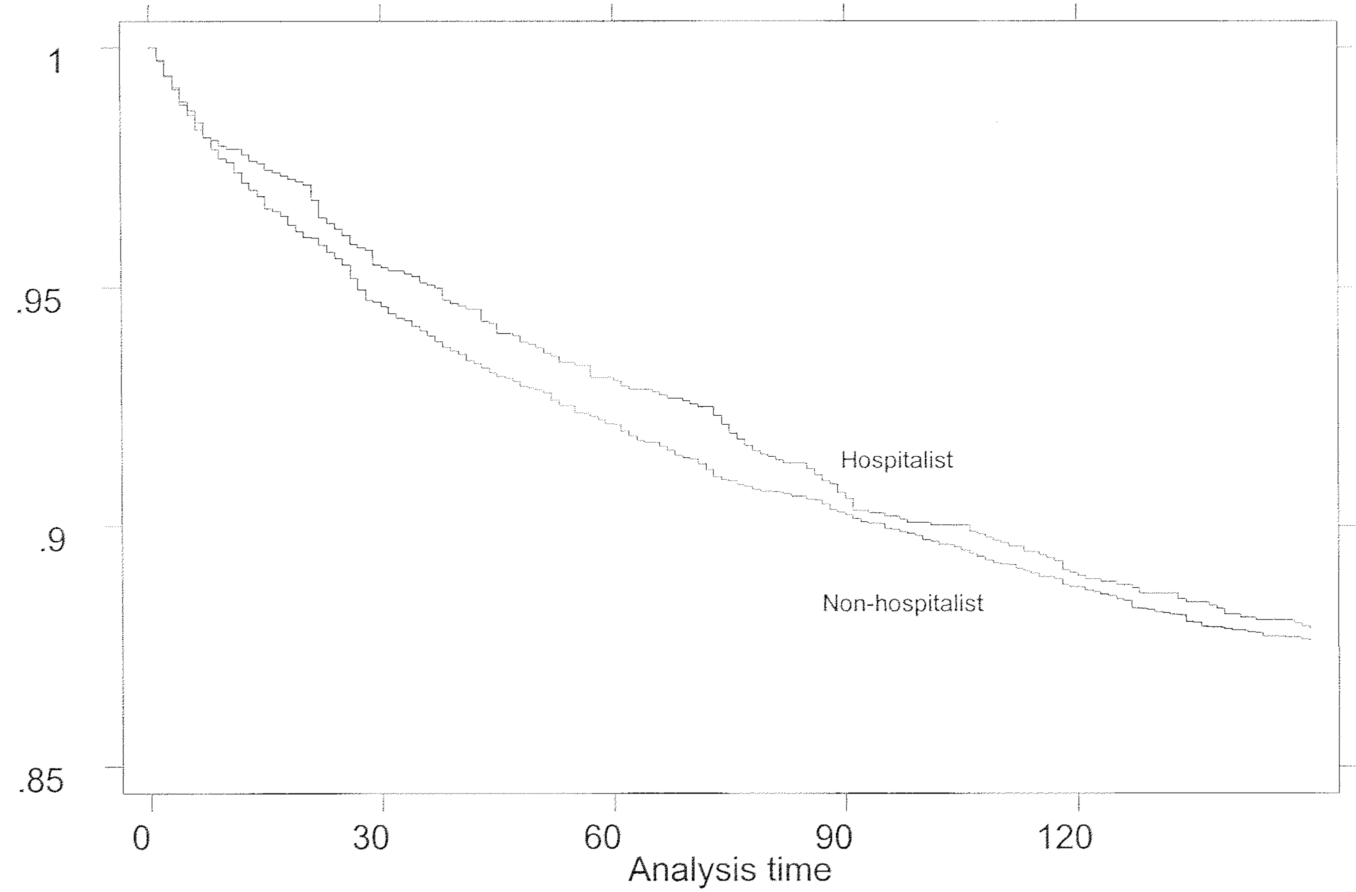
** p-values are for t-tests except for health status and patient satisfaction that report p-values for Chi-squared tests.

Table 5: Multivariate Analysis of Effects on Length of Stay and Costs
(Percent effect on outcome variable of hospitalist variable or doubling of experience variables, with 95% C.I. in parentheses)

	Length of Stay		Total Costs		30-Day Mortality		60-Day Mortality		365-Day Mortality	
	Basic Model	Model with Experience Variables	Basic Model	Model with Experience Variables	Basic Model	Model with Experience Variables	Basic Model	Model with Experience Variables	Basic Model	Model with Experience Variables
Hospitalist	-8.0* (-12.1, -3.8)	0.3 (-7.6, 8.3)	-4.8† (-10.0,0.3)	1.2 (-5.9,8.3)	0.81 (0.61,1.07)	0.96 (0.66,1.39)	0.85 (0.67,1.06)	0.97 (0.71,1.31)	1.00 (0.85,1.17)	1.07 (0.87,1.32)
Total cases to date		-1.8 (-4.7, 1.1)		-0.4 (-2.3, 2.5)		0.97 (0.86,1.09)		0.98 (0.88,1.08)		1.03 (0.96,1.11)
Cases with same 3 digit ICD-9 code to date		-4.7* (-9.1, -0.2)		-4.8* (-9.0, -0.7)		0.90 (0.73,1.10)		0.91 (0.77,1.08)		0.87* (0.77,0.97)

All regressions also include month-specific indicator variables, 3-digit-ICD9-specifc indicator variables for primary diagnosis, natural log of DRG weight, Charlson co-morbidity index, patient age, race (African American vs. other), and indicator variables for weekend admission and whether patient was admitted directly to the general medicine service vs. transferred to the service from another service.
†P<0.10, *P<0.05, **P<0.01

Figure 1: Kaplan-Meier Survivor Curves for Hospitalist and Non-hospitalist Patients



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