# A Pneumonia Practice Guideline and a Hospitalist-Based Reorganization Lead to Equivalent Efficiency Gains

*Josina C. Reddy, MD, PhD; Patricia P. Katz, PhD; Lee Goldman, MD; and Robert M. Wachter, MD*

**Objective:** To compare the impact of a practice guideline for a common inpatient disorder with that of a hospitalist-based reorganization of an academic medical service.

**Study Design:** Retrospective cohort study.

**Patients and Methods:** In July 1995 we introduced a clinical practice guideline for the treatment of community-acquired pneumonia at University of California San Francisco Moffitt-Long Hospital. Simultaneously, we implemented a structural change for half of the inpatient medical service, requiring earlier and more intensive faculty intervention, primarily by hospitalists. For 1 year, we studied the effect of these interventions on hospital costs, length of stay, and resource use.

**Results:** As reported previously, the hospitalist-based intervention resulted in significant decreases in average adjusted cost ($7777 vs $7007, $P = .05$) and length of stay (4.9 days vs 4.3 days, $P = .01$) compared with both concurrent and historical controls. For patients with community-acquired pneumonia, a similar savings occurred when fiscal year 1996 was compared with fiscal year 1995 ($8164 vs $6282, $P = .015$; 5.0 vs 4.2 days, $P = .04$). However, the effect was identical for the hospitalist and nonhospitalist groups. The reduced length of stay was associated with a borderline significant reduction in readmission rates (from 4.8% to 0.7%, $P = .055$) and no change in mortality rates.

**Conclusions:** In this study, a hospitalist-based reorganization improved efficiency, with its greatest impact on the care of patients with disorders not covered by a practice guideline. The introduction of a guideline for a common diagnosis improved efficiency on both hospitalist- and nonhospitalist-based services. For common diagnoses amenable to practice guidelines, successful implementation of and compliance with guidelines may be an alternative to major organizational change.

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Changes in the American healthcare system challenge hospitals to decrease costs while maintaining quality of care. Many payers, including managed care organizations and Medicare, pay hospitals a fixed amount of money for inpatients, regardless of the use of resources.[1] Academic medical centers are particularly vulnerable to fixed caps because they often serve populations with severe illnesses and bear the additional costs of training students and house staff.[2]

Hospitals striving to improve efficiency while maintaining quality often consider 2 options: implementation of clinical practice guidelines and use of hospitalists. Clinical practice guidelines attempt to improve the performance of all physicians caring for patients covered by the guidelines. Hospitalist systems concentrate responsibility for inpatient care among a smaller number of dedicated inpatient physicians. On the general medical service of the University of California San Francisco (UCSF) Moffitt-Long Hospital, both of these interventions have been instituted. We previously reported that implementation of a hospitalist system in July 1995



From the Department of Medicine (JCR, LG, RMW) and the Institute for Health Policy Studies (PPK), University of California San Francisco Medical Center, San Francisco, CA. Part of this research was performed while 1 of the authors (JCR) was a 4th-year medical student at the Mount Sinai School of Medicine, New York, NY.

The results of the hospitalist-based reorganization were reported previously (Wachter RM, Katz P, Showstack J, Bindman AB, Goldman L. Reorganizing an academic medical service: Impact on cost, quality, patient satisfaction, and education. *JAMA* 1998;279:1560-1565). This article and the areas of overlap are described in the manuscript.

Address correspondence to: Robert M. Wachter, MD, University of California, San Francisco, Box 0120, Room M-994, San Francisco, CA 94143-0120. E-mail: bobw@medicine.ucsf.edu.

led to a significant decrease in both cost and length of stay compared with both historical and concurrent controls, with no change in clinical outcomes or patient satisfaction.[3] Subsequent studies of the hospitalist model have demonstrated similar improvements in efficiency without an adverse impact on quality.[4-7]

At the same time, a practice guideline was also instituted for community-acquired pneumonia (CAP), the most common diagnosis on the service. This simultaneous implementation provided a natural experiment to measure the relative effects of each approach on the delivery of medical care.

## ··· METHODS ···

Moffitt-Long Hospital is a 520-bed teaching hospital of the UCSF Medical Center and serves as both a community hospital and a tertiary referral center. Medical patients are either admitted to a general medicine service or to the specialty cardiology, oncology, or liver transplant services, as appropriate. Our study population was drawn solely from the general medical service, which includes patients on the regular medical floor and the intensive-care unit (ICU). At the time of this study, most (85%) patients were admitted by staff teams led by a full-time faculty member (attending physician). The team also included a resident, 1 to 2 interns, and 0 to 3 students. The remainder of the inpatients were cared for by their primary physicians during their hospital admission. Each of the 4 medical teams admitted patients every 4th night. Before the 2 interventions, the house staff team typically admitted the patient without advising the attending physician. They conferred with the attending physician on the morning after admission, although he or she was available at any time for consultation.[3] In addition, no clinical practice guidelines were in use.

### Interventions

*Creation of the Managed Care Service (Restructuring).* In July 1995 the inpatient medical service was split into 2 parts. On the traditional service, no intervention was made: attending physicians, who served in this role for 1 month per year, generally first became involved in the process of care on the day after admission. Teams were not given any specific charge regarding cost containment. On the managed care service, attending physicians and house staff were specifically encouraged to contain costs without compromising quality of care. In addition, the attending physician was more involved in initial treatment decisions, seeing the patient with the team if the patient was admitted during the day and continuing discussions by telephone during the night. Managed care service attending physicians also served for more months during the year than traditional service attending physicians (most months were covered by faculty who met the definition of hospitalist; ie, they spent more than 25% of their time caring for inpatients of other primary physicians).[8] This intervention is described in greater detail by Wachter et al.[3] Fully capitated patients were preferentially admitted to the managed care service; otherwise, patients were allocated to the services based on an every-other-day distribution, which resulted in comparable numbers of patients on the managed care service and the traditional service.

*Clinical Practice Guidelines.* A clinical practice guideline for CAP was implemented just before the start of the managed care service intervention. The Moffitt-Long CAP guideline was written by a multidisciplinary panel of UCSF clinicians and is largely based on the American Thoracic Society guideline[9] and on previously published work on the identification of low-risk patients with pneumonia.[10,11] The guideline encouraged early empiric antibiotic use and discouraged routine use of sputum Gram stain and culture because of poor positive and negative predictive values. The guideline recommended that low-risk patients be switched to oral antibiotics on day 3 and discharged on day 3 or 4. The intention was to provide more effective treatment while decreasing cost, length of stay, and resource utilization. The use of this guideline was highly recommended but not mandatory. It was distributed to faculty and house staff and discussed at house staff teaching conferences. The guideline was equally available to physicians on both the managed care service and the traditional service, as well as to physicians in the emergency department.

### Measurements

Data on each patient admitted during fiscal year 1995 (FY95; July 1, 1994, to June 30, 1995) and fiscal year 1996 (FY96; July 1, 1995, to June 30, 1996) were obtained from the hospital's Transitions Systems International computer database, which tracks the costs of services. The variables assessed were total cost, length of stay, cost by department (eg, laboratory, radiology), and use of specific tests and services (eg, blood counts, X rays).

Diagnosis-related groups (DRGs), as well as demographic characteristics and clinical outcomes (in-hospital mortality, readmission), also were abstracted from the Transitions Systems International database.

**Subject Selection**

Patients with a diagnosis of CAP were identified by *International Classification of Diseases, 9th Revision* (ICD-9) principal diagnosis codes 480.x, 481, 482.xx, 483.x, 485, or 486. To ensure that our sample of patients included only those for whom the CAP guideline was intended, we excluded patients with a secondary diagnosis of cystic fibrosis, bronchiectasis, interstitial lung disease, aspiration pneumonia, human immunodeficiency virus infection or other immunodeficiency, or a current diagnosis of malignancy. For all cohorts, we excluded patients transferred from another acute care or skilled nursing facility, because the appropriateness of their care before transfer could not be assessed and because of the possibility that their pneumonia might be institutionally rather than community acquired.

**Data Analysis**

We performed multiple linear regression analyses to examine differences in continuous variables (eg, hospital costs, length of stay, number of specific tests) and multiple logistic regression analyses to examine differences in dichotomous outcome variables (eg, 10-day readmissions and mortality). All regression analyses were initially performed including only the year of admission, the admission service, and the diagnosis group as independent variables. To control for differences in patient characteristics and case-mix across the different years and services, subsequent analyses of length of stay, total costs, readmissions, and mortality also included patient age and sex, payer, and both the highest-frequency DRGs (DRGs 89, 489, 395, 174, 88, 79, 296, 475, 320, and 96) and the highest- cost DRGs (DRGs 483, 76, 416, 144, 20, 202, 468, 415, 488, 14, 423, 240, 207, and 467), as was done in the previous study.[3] Other than the pneumonia DRG (89), the only high-frequency DRGs that appeared in the CAP group were DRG 79 (respiratory infections and inflammations with complicating condition) and DRG 475 (respiratory system diagnosis with ventilator support); the only high-cost DRG in the CAP group was DRG 483 (tracheostomy). Therefore, analyses were conducted separately within the CAP and non-CAP groups, controlling only for these 3 DRGs within the CAP group analyses.

Costs were standardized to 1995-1996 dollars. Length of stay and total cost outliers (more than 3 standard deviations above the mean) were truncated by reclassifying their data back to 3 standard deviations above the mean.[3]

For analyses of resource use within specific departments and numbers of specific services used by CAP patients, analyses were adjusted for age, sex, payer, and ICU admission.

## ··· RESULTS ···

**Demographic Characteristics of the Study Populations**

A total of 1624 patients were admitted to the medical service in FY96, 817 on the traditional service and 807 on the managed care service, compared with 1707 patients admitted in FY95 (**Table 1**). One hundred thirty-two patients met our criteria for CAP in FY95, compared with 157 in FY96 (81 on the traditional service and 76 on the managed care service). Since fully capitated patients were preferentially admitted to the managed care service in FY96, such patients were excluded from all further analyses.

**Resource Utilization**

Patients diagnosed with CAP had significantly lower costs and shorter lengths of stay in FY96 than in FY95 (**Table 2**). This decrease occurred equally on the managed care service and the traditional service. For patients with diagnoses other than pneumonia, smaller differences in cost and length of stay were observed when FY95 and FY96 were compared, and the differences were largely attributable to the effect of the managed care service.

Changes in practice for CAP were congruent with guideline recommendations (**Table 3**). The number of sputum cultures per patient decreased dramatically between FY95 and FY96, in keeping with the guideline. Interestingly, there were significantly fewer sputum cultures performed on the traditional service than on the managed care service. Consistent with these findings, overall microbiology costs also decreased significantly between FY95 and FY96, with both services showing significant savings. Significantly fewer blood cultures were performed on the traditional service compared with historical controls (mean 1.88 vs 2.44, $P = .04$), though the guideline did not discourage these tests. There were no other significant differences in resource use between the 4 groups (FY95, FY96, MCS, TS).

**Clinical Outcomes**

No significant differences in mortality rates were observed between FY95 and FY96 among the patients with pneumonia or with all other diagnoses. There was a significantly lower 10-day readmission rate in FY96 than in FY95 among the CAP patients (4.8% vs 0.7%, $P = .05$), but not among patients with other diagnoses (6.2% in FY95 vs 7.1% in FY96, $P = .33$).

## ··· DISCUSSION ···

One of the drivers of the growing hospitalist movement is the need to deliver cost-effective and high-quality inpatient medical care.[8] Likewise, practice guidelines have been promoted as a way to decrease costs while maintaining or improving quality of care.[12] Practice guidelines can take many forms, from simple flowcharts to lengthy reviews of the literature. Well-designed and well-implemented practice guidelines have been demonstrated to be effective tools for improving the value of care in the inpatient setting.[13] Internists have been shown to trust guidelines that are endorsed by major organizations, contain brief recommendations, summarize the available evidence on the topic, and quantify the benefits of the recommendations.[14]

On both the hospitalist-based managed care service and the traditional service, patients with CAP cared for after the guideline was introduced consumed fewer resources than similar patients hospitalized before the guideline. The differences observed were congruent with specific guideline recommendations. First, sputum cultures were discouraged because of their poor positive and negative predictive values. Fewer sputum cultures were performed on both the managed care service and traditional service compared with the historical control group. Second, the guideline recommended that low-risk patients be discharged on day 4, and the average length of stay for patients with pneumonia on both services decreased from more than 5 days to approximately 4 days after introduction of the guideline. The overall decrease in patient cost after guideline introduction appears to be largely attributable to a decreased number of hospital days, since the most significant difference in nonbed resource use (microbiology) only accounted for about $150 in savings. This suggests that the practice guideline produced specific changes in physician behavior that correlated with decreased costs, and care by hospitalists per se yielded no increased savings for patients with pneumonia. There were no differences in mortality between the historical control group and either medical service group. We noted a trend toward decreased readmission rates after the guideline's introduction, suggesting that these practice changes did not adversely affect outcomes.

The Moffitt-Long CAP guideline was similar to one evaluated by Weingarten and colleagues.[15,16]

**Table 1.** Patient Demographic Characteristics

| Characteristic | FY95 | FY96 | | |
|---|---|---|---|---|
| | | Total | MCS | TS |
| No. | 1707 | 1624 | 807 | 817 |
| Age, y (mean ± SD) | 54.5 ± 20.4 | 55.2 ± 20.6 | 55.5 ± 20.7 | 54.8 ± 20.5 |
| Female, % | 42.5 | 42.5 | 41.6 | 43.3 |
| Payer, % | | | | |
| Medicare | 43.3 | 46.6 | 45.6 | 47.5 |
| Medicaid | 29.3 | 27.2 | 26.0 | 28.3 |
| Capitated* | 4.4 | 4.7 | 6.2 | 3.3 |
| Other | 23.0 | 21.6 | 22.2 | 20.9 |
| No. diagnosed with pneumonia (% of admissions) | 132 (7.7) | 157 (9.7) | 76 (9.4)* | 81 (9.9)* |

FY95 = fiscal year 1995; FY96 = fiscal year 1996; MCS = managed care service; TS = traditional service.
*Because capitated patients were preferentially admitted to the MCS, they were excluded from all further analyses.

Interestingly, in 2 prospective studies, they found no change in hospital length of stay between the preguideline and postguideline patient groups (3.5 vs 3.6 days and 4.0 vs 4.2 days). Hospital costs were not assessed. In addition, they found no significant outcome differences between the 2 groups, as measured by in-hospital mortality, readmission, and health-related quality of life. It is not entirely clear why the Moffitt-Long CAP guideline had more impact than the guidelines studied by Weingarten and colleagues. Our baseline length of stay (4.98 days) was significantly higher than that in Weingarten's studies, leaving more room for improvement. The relatively short baseline lengths of stay in Weingarten's studies also may reflect practice patterns that already adhered to guideline recommendations before the interventions.[15] Finally, in contrast to Cedars-Sinai Medical Center (the site of the Weingarten studies), medical patients at Moffitt-Long Hospital are almost exclusively cared for by full-time faculty/house staff teams, making it easier to change practice patterns than it would be in a hospital with a wider array of primary physicians serving as inpatient physicians of record.

Pneumonia practice guidelines also have been published by a number of medical societies. Marras and Chan studied adherence by house staff to CAP guidelines developed by the American Thoracic Society, the Canadian Infectious Diseases Society, and the Canadian Thoracic Society.[17] They found that adherence was frequent (approximately 80%) in both a retrospective control group of house staff who had not been reminded of the guidelines and in a prospective group who had filled out a questionnaire on admitting patients with CAP. Moreover, length of stay and in-hospital mortality did not differ among patients cared for by the 2 groups. Again, this result suggests that in a setting where physicians already adhere to guidelines, reminders do not increase adherence, reduce costs, or lead to better clinical outcomes.

Hospitals might favor introduction of practice guidelines rather than the reorganization of medical services for many reasons. Practice guidelines may be appropriate in various hospital settings, from academic medical centers to community hospitals. This "portability" may be more attractive than reorganization strategies, which must be tailored to the indi-

**Table 2.** Cost and Length of Stay*

| | FY95 | FY96 | MCS | TS | Comparison | *P* |
|---|---|---|---|---|---|---|
| **Pneumonia** | | | | | | |
| Patients, n | 126 | 151 | 73 | 78 | | |
| Length of stay, days | 4.98 | 4.17 | 4.19 | 4.16 | FY95 vs FY96 | .04 |
| | | | | | FY95 vs MCS | .10 |
| | | | | | FY95 vs TS | .08 |
| | | | | | MCS vs TS | .95 |
| Cost, $ | 8164 | 6282 | 6310 | 6256 | FY95 vs FY96 | .015 |
| | | | | | FY95 vs MCS | .05 |
| | | | | | FY95 vs TS | .04 |
| | | | | | MCS vs TS | .96 |
| **All other diagnoses** | | | | | | |
| Patients, n | 1506 | 1396 | 684 | 712 | | |
| Length of stay, days | 5.00 | 4.64 | 4.34 | 4.93 | FY95 vs FY96 | .02 |
| | | | | | FY95 vs MCS | .0007 |
| | | | | | FY95 vs TS | .73 |
| | | | | | MCS vs TS | .008 |
| Cost, $ | 8076 | 7511 | 7089 | 7914 | FY95 vs FY96 | .05 |
| | | | | | FY95 vs MCS | .006 |
| | | | | | FY95 vs TS | .64 |
| | | | | | MCS vs TS | .04 |

FY95 = fiscal year 1995; FY96 = fiscal year 1996; MCS = managed care service; TS = traditional service.
*Costs and length of stay are adjusted for age, sex, payer, and high-frequency and high-cost diagnosis-related groups. Capitated patients were not included in these analyses.

vidual hospital milieu. Guidelines can be updated periodically in response to new data. In addition, guidelines can be incorporated into the practice of the existing staff, whereas reorganization (especially with the hospitalist model) might require the hiring of new staff or the retraining of existing staff, both of which entail an initial increase in hospital costs and potentially ongoing hospital support.[18] The change from a traditional model of care to one in which inpatient specialists predominate also might cause dissent among the medical staff, especially if the change is forced on unwilling primary care physicians.[19]

On the other hand, despite the proven effectiveness of well-designed guidelines,[13] some physicians are concerned about possible "side effects": namely, increase in costs, reduction in physician satisfaction, and disciplinary action against physicians who do not follow the recommendations.[20,21] Many physicians fear guidelines will promote "cookbook medicine." Finally, not all guidelines are effective in achieving their stated goals,[22] and anecdotal evidence suggests that some institutions have begun to decrease their commitment to guidelines as a cost- or quality-improvement strategy.

In contrast, there are attractive aspects to reorganization. While CAP is a common, well-studied disease that lends itself well to a practice guideline, quality and efficient care of patients with other diseases might require more flexible and dynamic decision making. In our study, the hospitalist intervention was clearly effective for medical patients as a whole[3] and for patients with diagnoses other than pneumonia. If the guideline had not been introduced, it is possible—perhaps likely—that the managed care service intervention would have had an impact on the care of patients with pneumonia as well. Hospitalists may increase quality and decrease costs across a wide range of diagnoses (as well as for the most medically complex patients), saving the considerable time and cost of developing and trying to implement guidelines for a wide array of illnesses.

Other types of reorganization also have been shown to be effective, including the creation of a nonteaching service run by attending physicians,[23] the replacement of community attending physicians by staff attending physicians for inpatient care,[24] and the conversion from an open ICU format, where primary physicians direct patient care, to a closed ICU fomat, where critical care specialists direct patient care.[25] All of these interventions seek to place highly skilled, more specialized physicians at the point of care, thereby improving quality and efficiency and decreasing variation. We found that the hospitalists were able to provide this increased oversight without compromising the house staff's perceived autonomy or satisfaction.[3]

## ··· CONCLUSION ···

In conclusion, for patients with CAP, development and successful implementation of a practice guideline led to striking improvements in efficiency, and no additional savings were produced by reorga-

**Table 3.** Costs and Resource Use for Pneumonia Patients*

| | FY95 | FY96 | *P* (FY95 vs FY96) | MCS | TS | *P* (TS vs MCS) |
|---|---|---|---|---|---|---|
| **Resource Use, n** | | | | | | |
| CBCs (per day) | 1.42 | 1.34 | .23 | 1.35 | 1.33 | .79 |
| Blood cultures | 2.44 | 2.13 | .17 | 2.39 | 1.88 | .09 |
| Sputum cultures | 1.10 | 0.67 | .01 | 0.90 | 0.45 | .04 |
| Chest X rays | 3.50 | 2.77 | .31 | 3.17 | 2.41 | .43 |
| Arterial blood gas | 6.22 | 3.17 | .06 | 3.50 | 2.86 | .77 |
| **Cost, $** | | | | | | |
| Hematology | 124 | 131 | .76 | 145 | 118 | .43 |
| Chemistry | 203 | 171 | .32 | 190 | 153 | .39 |
| Microbiology | 327 | 183 | .0008 | 222 | 146 | .18 |
| Pharmacy | 572 | 353 | .08 | 394 | 314 | .64 |
| Radiology | 641 | 464 | .26 | 552 | 381 | .42 |
| Chest X ray | 262 | 221 | .48 | 239 | 205 | .67 |
| Respiratory therapy | 668 | 395 | .20 | 554 | 244 | .28 |

CBC = complete blood count; FY95 = fiscal year 1995; FY96 = fiscal year 1996; MCS = managed care service; TS = traditional service.
*All costs and utilization measures were adjusted for age, sex, payer, and intensive-care unit admission. Adjusted means were calculated by using results of multiple regression analyses. Capitated patients were not included in these analyses.

nization of the medical service. In contrast, for patients with all other diagnoses, the restructuring produced a marked decrease in average hospital cost and length of stay. This suggests that for academic medical centers, introduction of practice guidelines for common diagnoses may be a cost-effective way of responding to the mandate to improve efficiency, with or without reorganization of the medical service.

Further research is needed to determine whether the guideline or reorganization improvements are sustainable; whether the guideline intervention is as effective for other, less common diagnoses; and whether the results are generalizable to nonteaching hospitals.

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