Physician-Ordered Respiratory Care vs Physician-Ordered Use of a Respiratory Therapy Consult Service*

Results of a Prospective Observational Study

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**Objective:** To assess the impact of a respiratory therapy consult service (RTCS) on practices and appropriateness of ordering respiratory care.  
**Design:** Nonrandomized prospective observational cohort study with concurrent controls.  
**Setting:** Adult non-ICU inpatient wards of an academic medical center.  
**Patients:** A convenience sample of 98 adult non-ICU inpatients at the Cleveland Clinic Hospital, representing 20 inpatient clinical services. Patients whose respiratory care plans were determined by respiratory care practitioners using sign and symptom-based algorithms to specify treatment comprised the treatment group (n=51, respiratory therapy consult group). The nonconsult group (n=47) were patients whose respiratory care plans were specified by their own physicians. 
**Intervention:** Specification of the respiratory care plan by the RTCS vs by the physicians themselves. Use of the RTCS was at the discretion of the managing physician.  
**Outcome measures:** Types and number of respiratory care treatments, length of hospital stay, costs of the respiratory therapy provided, appropriateness of respiratory care orders (based on comparison of the actual respiratory care orders with a reference respiratory care plan generated by a study investigator who was kept blind to the actual respiratory care plan), and adverse respiratory events.  
**Results:** Patients for whom the RTCS was requested by their physicians had a greater severity of respiratory illness based on having a lower triage score, but were otherwise similar at baseline. Fewer initial orders for respiratory care were discordant with the reference algorithms in RTCS patients (15%±26% [SD]) than in nonconsult patients (43%±36%; p<0.001), and a smaller fraction of RTCS patients received at least one discordant initial respiratory care order (37% vs 72%; p<0.001). Though provided to sicker patients with longer lengths of hospital stay, RTCS-directed care incurred similar respiratory care costs per patient ($335.63±$272.69 [RTCS] vs $349.06±$273.27; p=0.72). 
**Conclusions:** These results suggest that the RTCS can be an effective strategy to allocate respiratory care strategies appropriately while conserving the costs of providing respiratory care.  

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**Key words:** misallocation; respiratory therapy; respiratory therapy consult service; therapist-driven protocols

**Abbreviations:** AARC=American Association for Respiratory Care; BPH=bronchopulmonary hygiene; IPPB=intermittent positive pressure breathing; PEP=positive expiratory pressure; RTCS=respiratory therapy consult service

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Misallocation of respiratory care services is common in current practice, with available studies suggesting both overordering and underordering of respiratory treatments. In contrast to traditional physician-directed respiratory care (in which physicians specify orders for respiratory care treatment), therapist-driven protocols represent an alternate strategy for delivering respiratory care. Using therapist-driven protocols, respiratory care practitioners allocate respiratory care treatment while guided by specialized protocols or algorithms for respiratory care services that are based on practice guidelines and/or expert consensus.

Such therapist-driven protocols have become popular and are a promising solution to the problem of
misallocation, based on several available lines of evidence: (1) understanding of respiratory care modalities and implications for treatment by those currently ordering respiratory care is sometimes inadequate;5-7 (2) overordering of respiratory care services is currently common;1,8 and (3) implementation of protocols shows promise for lowering the frequency of inappropriate respiratory care orders, thereby promoting improved allocation of health-care resources.9-12

Early experience with a program of therapist-driven protocols at the Cleveland Clinic Foundation, which we have called our respiratory therapy consult service (RTCS), has suggested that such a service can be implemented effectively with a high degree of physician and nursing support.9 Having previously demonstrated the feasibility of such a service in a large, tertiary care institution,9,12 current attention turns to whether the rate of misallocated respiratory care orders and the cost of providing respiratory care services is lessened by such a consult service.

To address the effectiveness of the RTCS, the current research presents the results of an observational cohort study of physician-directed respiratory care vs physician-ordered use of the RTCS. The specific study purpose is to assess whether the rate of misallocated respiratory care orders is decreased by use of an RTCS. Secondary outcome measures include the amount and duration of respiratory care services provided to the compared patient groups, the hospital length of stay, and the costs and charges associated with respiratory care services rendered by the RTCS vs by physician-directed respiratory care.

MATERIALS AND METHODS

The design of the RTCS and the structure of the triage score have been described previously.12,13 Briefly, major elements of RTCS include the following: (1) a team of therapist evaluators, who see consult patients in a timely fashion and generate respiratory care plans based on algorithms that have been published previously and that comply with available clinical practice guidelines of the American Association for Respiratory Care (AARC);14-17 (2) a team of implementing therapists, who administer the respiratory care orders prescribed by the therapist evaluators; (3) a series of symptom and sign-based algorithms that use branching logic diagrams to help generate a respiratory therapy care plan that complies with practice guidelines;12,13 and (4) a triage score, by which patients are assessed with regard to severity of their respiratory illness and which is used to determine the frequency of formal reevaluation as well as the intensity and frequency of respiratory treatment.13,18

As in our earlier report,12 the RTCS was available by physician discretion on all adult non-ICU patient wards and was neither mandated nor allocated by randomization in this study. Also, as in our earlier pilot study,12 this study compares respiratory care practices when physicians request respiratory care management by the RTCS vs when physicians prescribe respiratory care treatment to their patients themselves.

Design of the Current Study

Over the interval of patient accrual for the current study (January 22, 1992 to July 14, 1993), the RTCS was available on all adult non-ICU wards at the Cleveland Clinic Hospital. New resident and fellow physicians had been made aware of the RTCS by written announcements, by receiving RTCS handbooks, and by presentations regarding the RTCS at house staff orientation sessions each July from 1991 to 1993. Therapists underwent extensive training about the RTCS and algorithms, including periodic lectures, discussion of algorithm-based respiratory care plans at each shift meeting, and completion of graded case studies every 3 months from which feedback was provided.

Patients were included in the study on 42 separate days when the senior therapist investigator (D.J.H.) was available for research activities. On these 42 days, all patients receiving new respiratory care orders (whether by the RTCS or by the managing physician) during the day shift for respiratory care were included in the study.

The primary outcome measure in this study was the rate of appropriate respiratory care orders, where orders were deemed appropriate if they agreed with an algorithm-based respiratory care plan prescribed by a blinded study investigator (D.J.H.). The study investigator, an experienced registered respiratory therapist who is highly familiar with the algorithms, conducted a full patient evaluation within 6 h of the ordering service, and generated an algorithm-based respiratory care plan that is considered the reference respiratory care plan in the current study. Respiratory care orders were considered "misallocated" only if an indicator for treatment was discordant with a treatment order, i.e., if a treatment was indicated by a sign or symptom specified in the algorithms but not ordered or, conversely, if a treatment was not ordered despite the presence of an indication. Furthermore, to make the rating lenient by explicit design, treatment was deemed appropriate as long as any component of appropriate treatment was ordered. For example, an order for bronchopulmonary hygiene (BPH) was deemed acceptable if any component of BPH was ordered, i.e., deep breathing, cough, or suctioning. Differences only in frequency or duration of respiratory treatment between the ordering service and the reference respiratory care plan were not grounds for rating care as misallocated.

Respiratory care costs and charges were assessed as secondary outcome measures. The cost for each service reflected a component of labor (based on time-motion analyses), variable costs (eg, equipment, medications), and fixed costs (overhead, etc). Total costs and respiratory care charges were calculated using the total numbers and types of respiratory care services recorded on a computerized management information system that is used by all therapists in our section (Climivision; Nellcor Puritan-Bennett, Carlsbad, Calif).

Adverse events were recorded and included death from any cause and readmission to an ICU for a respiratory cause (eg, respiratory failure, bronchospasm, need for respiratory monitoring, or more intensive respiratory therapy than was available on the regular nursing floor, development of nosocomial pneumonia, or pneumothorax).

Data are expressed as mean values±1 SD. Univariate statistical analyses were performed to compare RTCS and nonconsult patients. As many of the continuous parameters tended to not be normally distributed, nonparametric Wilcoxon rank sum analyses were performed. Categorical variables were analyzed by χ² test or Fisher's Exact Test where small cell sizes were present. Stepwise logistic analyses were performed to determine which variables were predictive of having an inappropriate initial order. In this procedure, significant variables are added to the model, accounting for the effect of variables already included in the model. Values of p≤0.05 (two-sided) were considered statistically significant.

RESULTS

Ninety-eight patients were studied as a convenience sample. Over the 19-month study period, approximately 23,209 non-ICU adult inpatients were ordered...
to receive respiratory therapy at the Cleveland Clinic Foundation. Table 1 compares the demographic and clinical features of the two patient groups: those ordered by the physicians to receive respiratory care prescribed by the RTCS (n=51) vs those receiving respiratory care prescribed by the physicians themselves (nonconsult) (n=47). For nonconsult patients, respiratory care orders were placed by 45 unique physicians representing 17 different inpatient clinical services. The 51 RTCS patients represented 14 different inpatient clinical services.

Triage points were higher and triage scores were lower for the RTCS group, suggesting a higher degree of respiratory severity of illness in these patients. No significant differences between the groups were observed regarding age, gender distribution, smoking status, or the frequency or type of surgery on the current admission.

Table 2 presents the types and numbers of respiratory care services prescribed for patients in the two groups. For the 47 nonconsult patients, initial orders were always written by resident physicians and no difference in the total number of respiratory care treatments provided was observed between the RTCS and nonconsult groups, although RTCS patients tended to receive a greater variety of respiratory care treatments and types (4.4±1.5 vs 3.9±1.4; p=0.14). A trend toward a larger number of changes in respiratory care orders made after the first 24 h of hospitalization was observed in the RTCS group (2.0±1.7 vs 1.5±1.7 changes; p=0.06).

Comparison of the frequency of individual types of respiratory diagnostic tests and treatments showed differences between the two groups. For example, aerosolized medications and BPH were ordered more frequently by physicians. In contrast, the RTCS group more frequently received intermittent pulse oximetry, incentive spirometry, intermittent positive-pressure breathing (IPPB), and positive expiratory pressure (PEP) therapy. That several treatments were omitted completely in the nonconsult group (ie, incentive spirometry with in-line nebulizer, continuous positive airway pressure, and PEP) suggests that these treatments were either unpopular or unfamiliar to the treating physicians.

Table 3 summarizes the frequency of initial respiratory care orders that were discordant with the reference respiratory care plan (ie, called "discordant" or "misallocated" orders) prescribed in both patient groups. The rates of discordant orders are summarized in two ways: (1) percent of total initial orders placed that were discordant, and (2) percent of patients in each group for whom at least one initial respiratory care order was discordant. For both of these outcome measures, misallocated respiratory care orders were less frequently placed by the RTCS (15%±26% vs 43%±36% [p<0.001] and 37% vs 72% [p<0.001]). Furthermore, stepwise logistic analysis was conducted
using each of these outcome measures of appropriate allocation as independent variables. Considering the following as independent variables, RTCS vs nonconsult status, gender, triage points, triage score, and acute physiology and chronic health evaluation (APACHE) II scores (when available), only use of the consult service was associated with a greater frequency of appropriately allocated orders (odds ratio = 4.15; p = 0.001).

Although not achieving statistical significance, the relationship between frequency of patients receiving at least one discordant initial order and triage score was opposite in the RTCS than in the nonconsult group (Fig 1). Specifically, although the frequency of patients receiving at least one discordant initial order was lower across all triage score groups in the RTCS, the rate of misallocation tended to increase among nonconsult patients with higher triage scores. For example, among patients with triage score 5, the frequency of patients receiving at least one discordant order was 33.3% among RTCS patients vs 84.2% among nonconsult patients (p = 0.19, overall Cochran Mantel-Haenszel). Overall, unlike the RTCS, physicians tended to misallocate more frequently to patients who were less sick, although differences failed to achieve statistical significance.

As shown in Table 4, RTCS patients’ mean length of stay exceeded that of the nonconsult patients (15.5 ± 14.0 days vs 11.1 ± 9.7 days; p = 0.033). Although total hospital charges were also higher among RTCS patients, the percent of total hospital charges due to respiratory care were lower among RTCS patients (5.1% ± 4.2% vs 17.6 ± 42.1%; p < 0.001) and the actual charges for respiratory care services showed a trend toward lower values ($1,627 ± $1,476 vs $1,792

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<th>Table 2—Respiratory Care (RC) Services Prescribed for Study Patients</th>
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<td><strong>RTCS (n=51)</strong></td>
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<td>Type of RC treatment modes per patient, mean ± SD</td>
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<td>Total RC treatments per patient</td>
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<tr>
<td>No. of days each patient received RC treatment, mean ± SD</td>
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<td>Modifications in RC orders after first 24 h of hospitalization, mean ± SD</td>
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<td>% of patients receiving</td>
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<td>Arterial blood gases</td>
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<td>Spirometry&lt;sup&gt;*&lt;/sup&gt;</td>
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<tr>
<td>Oximetry, intermittent</td>
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<td>Oximetry, continuous</td>
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<td>Aerosol therapy</td>
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<td>Metered-dose inhaler</td>
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<td>Incentive spirometry (alone)</td>
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<td>BPH†</td>
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<td>Supplemental oxygen</td>
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<td>CPAP&lt;sup&gt;‡&lt;/sup&gt;</td>
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<td>PEP</td>
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<tr>
<td>Tracheal suction</td>
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<td>Continuous nebulized bronchodilator</td>
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<sup>*</sup>Excludes FVC measurements made as part of RTCS assessment.
<sup>1</sup>Includes percussion, vibration, and/or postural drainage.
<sup>2</sup>Excludes continuous positive airway pressure.
<sup>3</sup>Wilcoxon rank sum test.
<sup>4</sup>Fisher’s Exact Test.
<sup>5</sup>X<sup>2</sup> test.

<table>
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<tr>
<th>Table 3—Allocation of Initial Respiratory Care Orders in Compared Groups</th>
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<tr>
<td><strong>RTCS (n=51)</strong></td>
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<tr>
<td>% of patients for whom at least one “discordant”* initial order was placed</td>
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<tr>
<td>% of initial orders that were discordant (SD)</td>
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<sup>*</sup>Discordant orders were defined as deviating from a standardized reference respiratory care plan that was generated by a study investigator (D.J.H.).
<sup>1</sup>This investigator assessed each study patient but was blind to the actual care plan prescribed by the RTCS or by the managing physicians.
<sup>2</sup>χ<sup>2</sup> test.
<sup>3</sup>Wilcoxon rank sum test.
±$1.471; p=0.42). The cost of providing respiratory care services per patient was similar for RTCS patients ($335.63±$272.69) and for nonconsult patients ($349.06±$273.27; p=0.72).

A total of five adverse events were recorded among the 98 patients in this study, including 4 deaths and 1 ICU readmission. No difference between the rate of adverse events was observed between the RTCS and nonconsult groups (3.9% among RTCS patients vs 6.4%; p=0.67).

**Discussion**

There are several main findings in this study.

1. Use of a physician-ordered RTCS was associated with fewer misallocated initial respiratory care orders than when physicians prescribed respiratory care treatment themselves. By design, orders were considered misallocated or discordant when they deviated significantly from a standardized reference respiratory care plan that was based on AARC clinical practice guidelines for respiratory care treatment. Furthermore, in a multivariate analysis, the only significant determinant of fewer misallocated initial orders was receiving RTCS-directed respiratory care.

2. The lower rate of discordant initial orders was observed despite greater severity of illness in the RTCS patients, using the triage score as a measure of respiratory severity of illness.

3. Although selected for sicker patients with longer lengths of hospital stay, RTCS-directed care incurred no higher respiratory care charges or costs.

4. The rate of adverse events, including death and ICU readmission for a respiratory cause, was similarly low among both compared groups. Thus, the RTCS provided the aforementioned benefits without more frequent adverse effects in this study.

The current research extends our earlier pilot experience with the RTCS, which was undertaken just after initiating the service in a cohort of patients who underwent colorectal surgery.\(^{12}\) The earlier report established the feasibility of implementing an RTCS in a large, tertiary, closed-staff model teaching institution

<p>| Hospital Length of Stay, Charges, and Costs for Respiratory Care Activities in Compared Groups* |
|-------------------------------------------------|-------------------------------------------------|---------------------------------|</p>
<table>
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<tr>
<th>RTCS (n=51)</th>
<th>Physician-Ordered Respiratory Care (Nonconsult) (n=47)</th>
<th>Comparison p Value</th>
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<tr>
<td>Hospital length of stay, d</td>
<td>15.5±14.0</td>
<td>11.1±9.7</td>
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<tr>
<td>Total hospital charges, $</td>
<td>42,165±38,674</td>
<td>25,943±32,280</td>
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<tr>
<td>Respiratory therapy charges as % of total hospital charges(^*)</td>
<td>5.1%±4.2%</td>
<td>17.6%±42.1%</td>
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<tr>
<td>Cost per patient to provide respiratory care(^1)</td>
<td>$335.63±272.69</td>
<td>$347.06±273.27</td>
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\(^*\)Includes a one-time charge of $39.50 for the RTCS.

\(^1\)Includes costs of evaluation time and initial set-up (mean $27.50 for consult vs $14.82 for nonconsult patients).

\(^1\)Wilcoxon rank sum test.
and the current study again shows that patients for whom physicians elected an RTCS appear to have more severe respiratory illness. The selection of sicker patients for respiratory therapy consultation in both studies is consistent with physicians’ inclination to self-manage patients with more straightforward problems but to seek consultative advice in treating more complex patients.

The current study also extends the earlier research by comparing the rates of misallocation of respiratory care services by the RTCS vs by physicians themselves. Our data show that respiratory therapy consultation was associated with significantly lower rates of misallocated initial respiratory care orders and with higher rates of patients for whom all respiratory care orders agreed with a standardized reference respiratory care plan.

Our findings also suggest that respiratory therapists can be effective allocators of respiratory care services, which is consistent with several earlier studies. For example, in an early study of the impact of guidelines for respiratory care on ordering practices, Zibtrak et al observed that implementing simple respiratory care policies (eg, using metered-dose inhalers rather than small-volume nebulizers whenever possible, automatically discontinuing respiratory care orders after 72 h, etc) was associated with a marked reduction in the number of respiratory care services without demonstrable adverse clinical effects. More recent evidence that therapists’ consultation enhanced the rate of appropriately allocated orders for IPPB and medicated aerosol therapy comes from a study by Hart et al. In a crossover study comparing the rate of inappropriate respiratory care orders when therapists discussed orders with managing physicians vs not, both surgeons and internists placed fewer inappropriate orders when therapists were actively involved as consultants. Strikingly, subsequent withdrawal of therapists’ consultation caused the frequency of misallocated orders to rise in both groups, suggesting that the benefits of therapist consultation were short lived and confined to periods when therapists were actively available. Although these and several other more recent studies suggest that therapists’ consultation and use of explicit algorithms for respiratory care can enhance respiratory care ordering and lessen misallocated respiratory care, shortcomings of earlier studies include the lack of formal review of appropriateness of ordering practices, lack of attention to blinded review of care plans to avoid biased interpretation (eg, “detection bias”), and limited analysis of outcomes. By using established algorithms that were based on AARC clinical practice guidelines and externally reviewed for accuracy as the standards for respiratory care, and by assuring that the reference respiratory care plans were made blind to the patient’s actual care plan, the current study more completely defends against potential bias.

At the same time, because the current study is an observational cohort study in which allocation to RTCS vs nonconsult care is made by physician discretion rather than a randomized controlled trial, several sources of bias could limit our conclusions. First, if physicians’ decisions to allocate patients to RTCS were somehow linked to making misallocated orders less likely, our study would be subject to a damaging type of “susceptibility bias.” Although RTCS and nonconsult patients differed with regard to baseline triage score (Table 1), we believe that because RTCS patients had more severe respiratory impairment based on their lower triage scores, susceptibility bias favoring the RTCS is unlikely. To the contrary, the imbalance in baseline triage scores might predispose to more frequent misallocated orders among the sicker RTCS group.

The lack of randomization and the relatively small number of subjects in each study group also pose risk for other biases in this study. Specifically, if selecting subjects in this convenience sample were tied to the likelihood of misallocated respiratory care orders, susceptibility bias could occur and cause imbalance in the rate of inappropriate respiratory care orders by means of selection alone. However, susceptibility bias is deemed unlikely because subject recruitment was virtually complete on days when the therapist investigator was available and the investigator’s availability to recruit study subjects was unlikely to be related to the rate of misallocating respiratory care orders. As another possible source of bias, the relatively small number of study subjects invites the risk that a high rate of misallocating by a small group of physicians could skew the nonconsult group’s performance. However, because the initial respiratory care orders for the 47 nonconsult patients were placed by 45 unique physicians representing 17 different inpatient clinical services, such bias is unlikely.

Because the current study shows that RTCS patients had a longer mean length of stay than nonconsult patients, it is reasonable to wonder whether the RTCS caused a longer length of stay. Two lines of evidence argue against this interpretation: (1) because RTCS patients appeared to have more severe respiratory illness than nonconsult patients at baseline (ie, lower triage scores), a longer mean length of stay might be expected, and (2) no difference was observed between RTCS and nonconsult patients regarding the number of respiratory therapy orders, the total number of respiratory therapy treatments administered, or the total number of days that patients received respiratory care treatments (Table 2). Thus, we suspect that the longer length of stay for RTCS patients was caused by base-
line imbalance between the compared groups and severity of illness rather than by the RTCS. However, because a successfully randomized controlled trial is more likely to eliminate baseline imbalances between the compared groups, we believe that this question warrants further study in a randomized controlled trial.

It might also be argued that our study is biased against physicians’ performance because it compares therapists’ performance after receiving intensive algorithm training to physicians’ usual care. Indeed, although our experience does suggest that training can enhance proficiency with the algorithms, the goal of the current study was to compare the RTCS with usual medical care. Furthermore, in an effort to enhance physicians’ prescribing of respiratory care services even before the study, RTCS handbooks containing all the algorithms were distributed to all incoming trainees beginning in July 1991.

Because we believe that the enhanced allocation of respiratory care services in this study results from the extensive algorithm training provided in the RTCS, our study also suggests that greater attention should be given to training medical students and residents about respiratory care. Certainly, until these medical educational goals have been achieved, the RTCS represents at least an effective interim strategy to assure appropriate allocation of respiratory care services. Furthermore, we believe that support materials for the RTCS can serve an educational mission by providing explicit guidelines to physicians in training and by encouraging interactions between therapists and physicians over respiratory care orders, although this impression deserves formal study.

Although our results show that the cost of actual respiratory care services prescribed by the RTCS was similar to those prescribed to nonconsult inpatients, this analysis of costs is incomplete. Indeed, fuller cost analysis would also compare some additional costs in both study groups, eg, the costs of training therapists about the algorithms, the costs of preparing and distributing the algorithms to both house staff and therapists, and the more exact labor costs of prescribing respiratory care to both study groups (which would tally the labor costs associated with physicians’ and therapists’ time in evaluating and specifying the patients’ respiratory care needs).

Notably, although the rate of discordant orders was lower for the RTCS in this study, RTCS-directed care still misallocated initial respiratory care orders, suggesting that our training and quality monitoring programs to assure therapists’ understanding and consistent application of the algorithms have been incomplete. Efforts are ongoing to address this shortcoming.

In summary, the current study shows that the RTCS can allocate respiratory care services effectively by misallocating less frequently to sicker patients at similar cost. These attributes of the RTCS recommend it as a useful strategy in the current cost-attentive environment of health care. At the same time, we believe that further research designed to examine the efficacy of therapist-driven protocols and to address the remaining limitations of the available research is warranted.

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