

Changing Patterns of Inpatient Respiratory Care Services Over a Decade at The Cleveland Clinic: Challenges Posed and Proposed Responses

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INTRODUCTION: Changing characteristics of hospitalized patients over the last decade have created challenges for all health-care providers in delivering optimal care. In the specific case of respiratory care, trends that hospitalized patients have generally become sicker over time and that average lengths of stay have generally become shorter have posed the challenge of meeting demands for more services delivered with greater immediacy. We undertook the current analysis to assess how the delivery of respiratory care services at a tertiary-care academic medical center, the Cleveland Clinic Foundation Hospital, has evolved over the decade 1991 to 2001. In this observational study, we examined concurrent departmental trends and speculated that the capability to increase clinical activity with maintained or improved clinical outcomes, preserved costs, and a lower turnover rate among respiratory therapists reflects features of the professional environment within our Section of Respiratory Therapy. **METHODS:** This analysis compares patterns of respiratory care service delivery in two 5-year intervals: from 1991 to 1996 and from 1996 to 2001. Data were collected using a respiratory care information-management system and an inpatient hospital information system, which track the volume and actual cost of services provided. These analyses accounted for the actual time-based cost of the services, including labor (with benefits), necessary equipment and supplies, medications, and equipment maintenance and depreciation. Hospital case-mix index values were determined according to guidelines from the Centers for Medicare and Medicaid Services, as the weighted average of resource allocation scores assigned to diagnosis-related-group categories of hospitalized patients. **RESULTS:** From 1991 to 2001, there were important expansions in the scope of respiratory care practice by our Section of Respiratory Care, while the volume of respiratory care services delivered per year increased 1.96-fold (from 339,600 to 665,921 services/y). The number of respiratory therapy consults performed yearly, beginning in 1992 when the service was first implemented, rose to over 10,000/y by 2001. At the same time, the cost of respiratory therapy services delivered per patient decreased by 4.2%. Regarding staffing trends, the number of full-time-equivalent employees increased by 50% (from 65 to 97.5). However, the percent turnover rate among respiratory therapists decreased by 2.3-fold (from 11.5% to 5%). In the face of these trends, the hospital mortality rate for patients with diagnosis-related group 088 (high users of respiratory care services) decreased by 53%, and the length of hospital stay for all patients receiving respiratory treatments decreased by 30%. **CONCLUSIONS:** This analysis shows that trends of growing demands for respiratory care services have been accompanied by generally improving clinical outcomes and favorable retention of respiratory therapists in our section. We believe that a focus on the process of care, including enhanced professionalism, communication, and participation, has permitted a favorable response to these rising demands. *Key words:* respiratory care, respiratory therapy, employee turnover. [Respir Care 2005;50(8):1033–1039. © 2005 Daedalus Enterprises]

Introduction

Changing characteristics of hospitalized patients over the last decade have created challenges for all health-care providers in delivering optimal care. In the specific case of respiratory care, trends that hospitalized patients have generally become sicker over time¹ and that average lengths of stay have generally become shorter have posed the challenge of meeting demands for more services delivered with greater immediacy to generally sicker patients.

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Faced, like many institutions, with these trends, we undertook the current analysis to assess how the delivery of respiratory care services at a tertiary-care academic medical center, the Cleveland Clinic Foundation Hospital, has evolved over the decade 1991 to 2001. To the extent that these trends reflect a generalizable experience at large academic medical centers, we suggest that this analysis has value for others who are also addressing the issues of optimizing the delivery of respiratory care services. In analyzing concurrent temporal trends in the department, we speculated that the observed trends in delivery of respiratory care services, clinical outcomes, and costs reflect emerging characteristics of the professional environment in our Section of Respiratory Therapy. Finally, in reviewing strategies by which we have addressed these challenges, we hope to offer useful experience to others confronting similar issues.

Methods

As previously described,²⁻⁴ a Respiratory Therapy Consult Service was initiated at the Cleveland Clinic Foundation in 1992 and was implemented hospital-wide for determining non-intensive-care-unit (non-ICU) adult inpatients' respiratory care plans in 1994. The Section of

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Respiratory Therapy, in the Department of Pulmonary, Allergy, and Critical Care Medicine, currently provides respiratory care services for patients on the inpatient regular nursing units (approximately 990 beds), as well as for patients in 6 ICUs, which subsume a total of 87 ICU beds (18-bed medical ICU, 8-bed neurosurgical ICU, 24-bed coronary ICU, 14-bed pediatric ICU, 17-bed neonatal ICU, and a 6-bed Respiratory Special Care Unit for intermediate-term weaning), as well as a 50-bed off-site subacute care unit.

To assess trends in delivering respiratory care, this analysis considered 2 categories of respiratory services, which have been used consistently over time in tallying respiratory services at our institution and in an earlier analysis of respiratory care services:⁵

1. "High-volume" treatments: aerosolized medications via small-volume nebulizer (SVN) or metered-dose inhaler (MDI), oxygen therapy, bronchopulmonary hygiene, and incentive spirometry.

2. "Low-volume" treatments, which subsumed all other respiratory care services: bi-level positive airway pressure breathing, intermittent positive-pressure breathing, suctioning, tracheostomy changes, continuous nebulization, arterial-blood-gas sampling, and pulse oximetry.

To extend earlier work, in which we evaluated changing patterns in respiratory care services in response to implementing a respiratory care consult service,⁵ the current analysis compares patterns of respiratory care service delivery in two 5-year intervals: from 1991 to 1996 and from 1996 to 2001. Data were collected using a respiratory care information-management system that was in place prior to 2003 (CliniVision, Tycos-Puritan-Bennett, Carlsbad, California) and an inpatient hospital information system that tracks the volume and actual cost of services provided (Transition Systems, Eclipsys, Boca Raton, Florida). These analyses accounted for the actual time-based cost of the services, including labor (with benefits), necessary equipment and supplies, medications, and equipment maintenance and depreciation.

Hospital case-mix index values were determined according to guidelines from the Centers for Medicare and Medicaid Services, as the weighted average of resource allocation scores assigned to diagnosis-related-group (DRG) categories of hospitalized patients.⁶ These values reflect the intensity of resources expended for inpatients' illness, with higher values indicating greater resource allocation.

Results

Type of Respiratory Care Services Provided

Since 1991, there have been important expansions in the scope of respiratory care practice by our Section of Re-

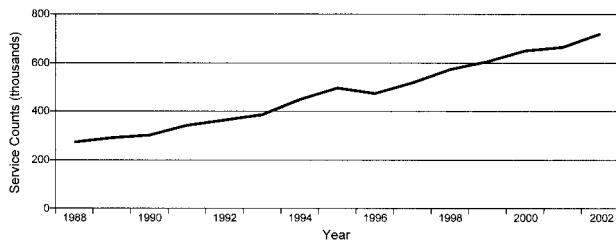


Fig. 1. Number of gross service counts (see text) administered by the Section of Respiratory Therapy at the Cleveland Clinic Foundation Hospital, 1988–2002.

spiratory Care, including the assumption of Cardiac Care Unit respiratory care responsibilities in 1995, and of bronchoscopy assisting in 2000, and the opening or expansion of 6 care venues, including the Pediatric ICU in 1992, the Respiratory Special Care Unit^{7,8} for intermediate-term weaning in 1993, the Subacute Care Unit in 1994, a Birthing Services Unit in 1995, a 6-bed expansion of the Medical ICU (to 18 beds) in 1996, and a Neonatal ICU in 2000.

Volume of Respiratory Care Services Provided

Figure 1 presents the trend in total respiratory care services delivered at the Cleveland Clinic Hospital between 1991 and 2001, consistently measured in units of “gross service counts” over that interval, where 1 gross service count equals 1 respiratory care service, regardless of complexity or time needed to deliver. For example, both 1 ventilator day and a single MDI treatment were counted as 1 gross service count. Notably, over this decade, the volume of respiratory care services delivered per year increased 1.96-fold (from 339,600 to 665,921), attributable to expansion in the scope of services provided (ie, more therapies in new venues) and to a 1.4-fold increase in the number of inpatients receiving respiratory care services annually (Table 1), from 16,989 in 1991 to 25,117 in 2001. As shown in Figure 2, delivery of respiratory care services to patients in ICUs and to non-ICU inpatients have both increased between 1991 and 2001, with a 2.4-fold rise in ICU services and a 1.76-fold rise in non-ICU respiratory care services.

Trends in the Type of Respiratory Care Services Provided

The total number of 5 “high-volume” therapies administered showed a 2% decrease from 1991 to 2001, and the proportion of all respiratory therapies that were among these five decreased dramatically (from 83.7% to 55.7%), thereby challenging our earlier designation of “high-volume” therapies. Examination of individual therapies (Table 1) shows the greatest growth in MDI use (60%), fol-

lowed by growth in incentive spirometry use (22%). Notably, in the face of an overall increase in total bronchodilator use (MDIs and SVN together), the proportion of bronchodilators administered via MDI increased from 24.9% to 33.1% in 2001.

As shown in Table 2, the number of respiratory care services other than the 5 high-volume therapies (ie, the “low-volume” therapies) increased 4-fold (from 39,471 to 158,488 per year), with increases in all categories except continuous nebulizers (which decreased from 5,524 to 4,120). These increases partly reflect the increase in the number of patients receiving respiratory care therapy from 1991 to 2001. The 2 categories with the largest increases were arterial blood gases (from 873 to 4,000) and pulse oximetry (from 21,718 to 134,546, a 6-fold increase).

Figure 3 presents the number of respiratory therapy consults performed yearly from 1992 (when the service was first implemented) to 2001. As shown by an inflection point in the curve, implementation in 1994 of a hospital policy that most respiratory care services administered to non-ICU adult inpatients would be directed by the Respiratory Therapy Consult Service was associated with a steep increase in the annual number of consults delivered (eg, from 1,282 in 1993 to 4,678 in 1995).

Considering all respiratory care services administered on the regular nursing units over the decade, the number of respiratory treatments per patient receiving respiratory care increased slightly (from 14.3 to 14.6). As evidence that the growth in pulse oximetry accounted completely for this increase, omission of pulse oximetry from the calculation caused the number of treatments per patient to decrease from 13.0 treatments in 1991 to 8.9 treatments in 2001. The number of high-volume treatments per patient decreased by 34% between 1991 and 2001 (from 11.9 to 7.9).

Regarding staffing trends, Table 3 shows the number of respiratory therapy full-time equivalents in our Section over time and the annual percent turnover rate among respiratory therapists (RTs) (tallied as the number of RTs leaving over the mean number of full-time equivalents per year). In keeping with the expansion of respiratory care services and the doubling of service counts between 1991 and 2001, the number of full-time equivalents increased by 50% (from 65 to 97.5). At the same time, the percent turnover rate among RTs decreased by 2.3-fold (from 11.5% to 5%).

Cost of Respiratory Care Services

Analysis of the cost of respiratory therapy services per patient receiving respiratory therapy over the decade (calculated as total respiratory care costs divided by the total number of patients receiving respiratory care services) showed a 4.2% decrease (from \$112.44 to \$107.76). Com-

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Table 1. Type and Trends of High-Volume Respiratory Care Services Delivered

Service	Number of Treatments by Year			Change in Total Services, 1991–2001 (%)
	1991	1996	2001	
Small-volume nebulizer	68,029	47,498	72,692	7 ↑
Metered-dose inhaler	22,513	26,371	36,005	60 ↑
Oxygen	50,067	40,316	51,624	3 ↑
Incentive spirometry	22,199	19,018	27,045	22 ↑
Bronchopulmonary hygiene	39,990	13,898	11,542	71 ↓
Total therapies	202,728	147,101	198,908	2 ↓
Total patients on respiratory treatments	16,989	16,556	25,117	48 ↑
Therapies per patient	11.9	8.9	7.9	34 ↓

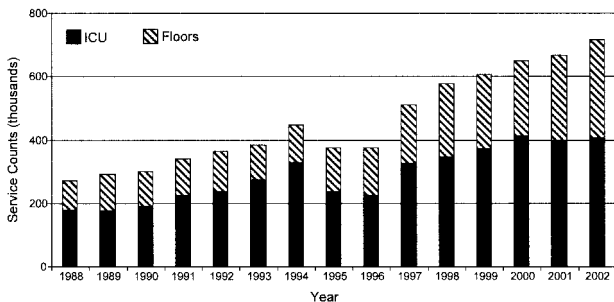


Fig. 2. Number of gross service counts administered by the Section of Respiratory Therapy at the Cleveland Clinic Foundation Hospital, stratified by site of delivery (intensive care unit [ICU] versus regular hospital floor), 1988–2002.

pared with 1996 values, the cost of respiratory treatments per patient in 2001 decreased by 3.3% (from \$111.40 to \$107.76).

In the face of a rising number of total therapies delivered, the decreasing cost per patient reflects a changed procedure mix per patient. For example, examination of trends indicates a marked reduction in use of bronchopulmonary hygiene treatments and a trend toward increased use of less expensive MDI therapy instead of SVN. More specifically, the increased use of MDIs for administering bronchodilator medications from 1991 to 2001 produced a clear cost savings. Based on 1991 cost data from an earlier analysis,⁹ in which the cost for initial instruction and treatment with an MDI (in 1991 figures) was \$3.75, versus \$5.86 for an SVN, and the cost for subsequent remedial instruction and treatment with an MDI was \$1.46, compared to \$3.57 with an SVN, the increased proportion of MDI use contributed to the overall decrease in patient costs from 1991 to 2001, by \$56,341.

Trends in Patient Outcomes

Finally, to understand these trends in providing respiratory care services in the context of patient characteristics and outcomes, we assessed overall acuity and resource

intensity (by the Center for Medicare and Medicaid Services case-mix index), length of hospital stay, and both hospital mortality and 30-day re-admission rate for all patients receiving respiratory therapy services and for the subset of patients with a DRG classification of 088 (chronic obstructive pulmonary disease). Hospital case-mix index values over the interval 1996 to 2001 reflected a consistently high acuity (ie, 1.93 in 1991, 2.02 in 1996, and 1.96 in 2001). To place these values in context, the mean hospital case-mix index for 2,612,620 patients discharged from urban hospitals of > 500 beds in 1999 was 1.6872.⁶

Over the decade of study, the mean length of hospital stay for all Cleveland Clinic Hospital patients declined by 32%, from 8.3 days in 1991 to 5.6 days in 2001; mean length of stay for the subset of patients receiving respiratory care services over this interval declined by 30%, from 9.96 days to 6.95 days.

Over the decade from 1991 to 2001, the rate of hospital mortality for all patients receiving respiratory therapy services increased slightly, from 3.8% to 4.1%. For the subset of patients with a DRG 088 classification, the 30-day re-admission rate increased from 7.3% to 9.97% and the mortality rate decreased from 3.6% in 1991 to 1.7% in 2001.

Discussion

In this analysis of changing patterns in delivering respiratory care services at the Cleveland Clinic Foundation Hospital over the decade between 1991 and 2001, the main trends are:

1. The volume of respiratory care services more than doubled while the number of inpatients receiving respiratory care services increased by 48%.
2. Considerable expansion was observed in the number of ICU beds and types of ICUs serviced by our Section of Respiratory Therapy.
3. In keeping with other reports, a trend toward increasing resource intensity among hospitalized patients was observed, despite which hospital length of stay decreased.

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Table 2. Type and Trends of Low-Volume Respiratory Care Services Delivered

Service	Number of Treatments by Year			Change in Total Services, 1991–2001 (%)
	1991	1996	2001	
Intermittent positive-pressure breathing	2,457	5,342	6,043	146 ↑
Suctioning	8,899	12,788	9,779	10 ↑
Pulse oximetry	21,718	69,110	134,546	519 ↑
Arterial blood gas sample	873	3,839	4,000	358 ↑
Continuous nebulizers	5,524	5,600	4,120	25 ↓
Total therapies	39,471	91,337	158,488	301 ↑
Total patients receiving respiratory care	16,989	16,556	25,117	48 ↑
Therapies per patient	2.3	5.5	6.3	174 ↑

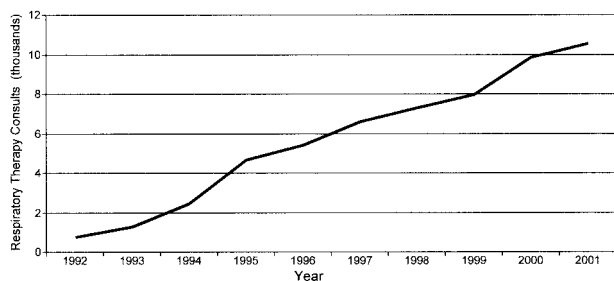


Fig. 3. Number of respiratory therapy consults (including new consults and re-evaluations) performed by the Section of Respiratory Therapy at the Cleveland Clinic Foundation Hospital, 1992–2001.

4. In the face of these trends, the number of “high-volume” respiratory therapies administered to inpatients decreased and the cost of respiratory therapies delivered per patient also decreased. On the other hand, the number of “non-high-volume” treatments quadrupled, primarily reflecting substantial growth in the use of pulse oximetry.

5. Even as the volume of respiratory care services and the number of RTs on the staff grew, the rate of turnover among RTs diminished from a peak value of 11.5% in 1991 (and up to 22.9% in 1987) to recent rates of 2% and 5% since 2000.

6. The cost of respiratory therapy services delivered per patient decreased slightly (by 4.2%) over the decade of study.

7. In the face of these trends, the hospital mortality rate for patients with DRG 088 (who were high users of respiratory care services) decreased by 53%, while the 30-day readmission rate increased slightly and the length of hospital stay for all patients receiving respiratory treatments decreased by 30%.

The overarching trend in our analysis was that in the face of a rising demand for respiratory care services (which sometimes can outstrip the availability of RTs), treatments per patient were stable, cost per patient declined, and overall clinical measures for patients receiving respiratory care services, assessed by hospital mortality and length of stay for patients with chronic obstructive pulmonary disease,

Table 3. Percent Yearly Turnover Rate for Respiratory Therapists in the Section of Respiratory Therapy at the Cleveland Clinic Foundation, 1987–2001

Year	Total FTEs	Turnover (%)
1987	70	22.9
1988	64	17
1989	64	12.5
1990	63.5	9.5
1991	65	11.5
1992	71.5	14
1993	71.5	9.7
1994	76.5	10.5
1995	84.5	11.2
1996	85.5	10
1997	85.5	10.5
1998	95.5	4
1999	95.5	12
2000	95.5	2
2001	97.5	5

FTE = full-time equivalent

improved. Also, in the face of an increasingly frenetic pace of providing respiratory care services, the rate of turnover among RTs in our Section declined to recent values of 2% to 5%. Associated benefits of low turnover included decreased costs of new employee training (estimated to be \$3,447.11 per new employee in an earlier analysis¹⁰) and less disruption to the teamwork among RTs and to the flow of work between shifts.

These trends of increasing activity with preservation of cost and generally constant or improving clinical metrics invite explanation. With the understanding that temporal correlation does not establish causality, we believe that the observed trends in delivering respiratory care services reflect 3 themes that have guided our approach to managing our Section of Respiratory Therapy over the decade of study. These themes are:

1. Enhancing professionalism among RTs
2. Assuring communication

3. Creating a participatory climate in our Section

In the sections that follow, we discuss the specific interventions that underlie these themes, in order to share our experience with others who are confronting and trying to respond to these same trends.

Our focus on enhancing professionalism attempts to assure that RTs are empowered to practice within the full scope of their training and to exercise professional judgment in providing respiratory care. As previously described, we believe that the single most important intervention to establish professionalism has been the implementation of a respiratory care evaluate-and-treat program, which we have called the Respiratory Therapy Consult Service. By allowing RTs to allocate respiratory care plans within the scope of explicit protocols that use branched logic algorithms, the Respiratory Therapy Consult Service requires RTs to exercise care and judgment and so both requires and reaffirms their professionalism. Other demonstrated benefits of the Respiratory Therapy Consult Service that may contribute to the observed favorable trends are enhanced allocation of respiratory care services, by providing only those services that are indicated and likely to confer benefit. Prior studies have shown that use of the Respiratory Therapy Consult Service was associated with improved allocation of respiratory care, compared with physician-directed care,^{4,11} though, with the exception of selected audited patients in our ongoing quality-assurance program, appropriateness of respiratory care services delivered was not measured in all patients receiving respiratory care over the decade of this analysis.

Optimizing communication at all levels of the Section of Respiratory Care has been another critical success factor to achieve the observed trends in this analysis. Certainly, a focus on communication has enhanced retention and RTs' professional satisfaction. Specific measures to assure communication in our Section have included:

1. Frequent shift meetings, attended at least quarterly by the medical director, with an invitation to bring forward good ideas and experiences to enhance care
2. Implementation of a variety of methods for disseminating information of broad interest to RTs, including:
 - a. Television with a scrolling marquis of announcements shown continuously in the RTs' report room
 - b. Weekly meetings of all supervisors, the education coordinator, and manager with the medical director to identify issues and report on progress of ongoing activities
 - c. Organization of an annual facilitated retreat, in which all RTs with supervisory responsibility come together for a half-day off-site meeting for the purpose of bringing forward solutions to current problems, and developing action plans based on the retreat findings, with a commitment to re-visit the action-item list to assure complete implementation.¹²

d. Use of e-mail through our information-management system to broadcast to all RTs issues of common interest

Finally, our focus on creating a participatory climate has been the third factor that, we believe, underlies the observed trends and reflects widely held views¹³ that individuals perform best in organizations when they are most engaged and that individuals are most engaged when they exercise input into how their work is and should be done. Indeed, in a survey of RTs in Nebraska, Blake and Stoller recently showed that RTs favor a participatory environment over more authoritarian or delegative approaches.¹⁴ Manifestations of the participatory environment in our Section of Respiratory Therapy include some of the aforementioned interventions (eg, weekly open meetings between the supervisors and the medical director, use of an annual retreat to develop solutions to common problems, a commitment to follow through on good ideas, and the desire for RTs to function with autonomy and accountability).

Conclusions

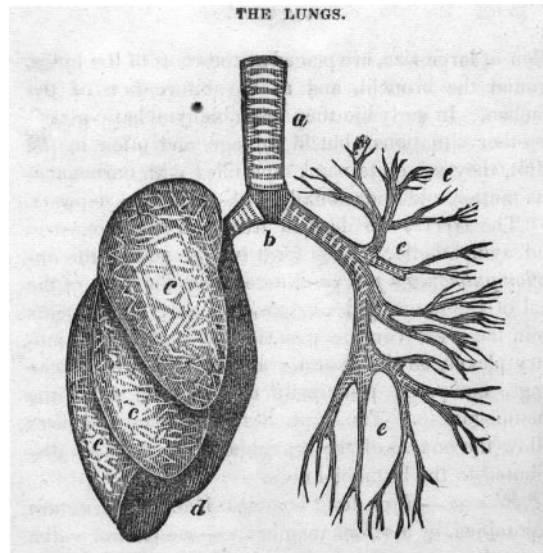
In conclusion, this analysis of changing patterns of inpatient respiratory care services over a decade shows that trends of growing demands for respiratory care have been accompanied by generally improving clinical outcomes and favorable retention of RTs in our section. Though concurrent trends do not establish a cause-effect relationship, we believe that our focus on the process of care, including enhanced professionalism, communication, and participation, has permitted a generally favorable response in providing respiratory care services to these rising demands. We offer these insights in the hope that they will be of value to colleagues who are also experiencing challenges in providing respiratory care.

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