An Assessment of the Appropriateness of Respiratory Care Delivered at a 450-Bed Acute Care Veterans Affairs Hospital

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INTRODUCTION: Respiratory care is expensive and time-intensive, inappropriate care wastes resources, and failure to provide necessary and appropriate respiratory care may adversely affect patient outcomes. OBJECTIVE: To determine the appropriateness of basic respiratory care delivered at a 450-bed Veterans Affairs hospital during a 3-month interval. METHODS: We determined (1) the percentage of delivered respiratory care that was not indicated (based on standardized clinical practice guidelines), (2) the percentage of respiratory care that was indicated but not ordered (based on standardized clinical practice guidelines), and (3) the labor cost and potential savings of protocol-based respiratory care at our hospital. We selected 5 assessment days, occurring at 2-week intervals. All patients who received basic respiratory care underwent a complete respiratory care assessment, including medical records review, patient interview, physical assessment, and measurement of blood oxygen saturation (via pulse oximetry) and inspiratory capacity. Intensive care patients were excluded from the study. The assessment instrument provided a standardized format based on American Association for Respiratory Care clinical practice guidelines. RESULTS: We assessed 75 patients. A mean of 24.8% of the delivered respiratory therapies reviewed were not indicated. The percentages of ordered but not indicated therapies were: oxygen 17.7%; all categories of aerosolized medications (bronchodilators, mucolytics, anti-inflammatory agents) 32.4%; chest physiotherapy 37.5%; lung expansion therapy 7.7%. A mean of 11.8% of the patients assessed were not receiving respiratory care that was indicated. The percentages of indicated but not ordered therapies were: oxygen 5.3%; bronchodilator 5.3%; lung expansion therapy 36%. CONCLUSION: A mean of 24.8% of the basic respiratory care procedures delivered were not indicated and 11.8% of patients were not receiving care that was indicated. Inappropriate utilization of respiratory care services may increase costs and adversely affect morbidity, mortality, and duration of stay. We believe that implementation of respiratory care assessment protocols based on nationally accepted clinical practice guidelines can reduce unnecessary care, optimize care delivered, and may reduce costs and improve outcomes. ***Key words:*** *respiratory therapy, clinical protocols, clinical practice guidelines, needs assessment, outcome assessment.* [Respir Care 2004;49(8):907–916.

Introduction

The economics of health care delivery in the acute care setting have produced substantial pressures on providers to reduce the cost of care and shift the provision of care to

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David C Shelledy PhD RRT presented a version of this report at the OPEN FORUM of the 44th International Respiratory Congress, held November 7–10, 1998, in Atlanta, Georgia.

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less expensive providers and venues.[1–3] In an attempt to improve patient outcomes and reduce duration of stay some providers have developed care paths and protocols to ensure that patients receive appropriate care and that inappropriate or unnecessary care is minimized.[4,5] Others have resorted to downsizing and layoffs to lower personnel costs, which is the largest element of cost.[4] That strategy, however, has encountered problems related to maintaining the quality of care, patient safety, and employee morale.[6–11]

Respiratory care is expensive and time-intensive and the provision of inappropriate or unnecessary care wastes resources.[1,4] Estimates of the frequency of unnecessary respiratory care orders range from 20 to 60%.[5,12–16] Failure to provide necessary and appropriate respiratory care may adversely affect patient outcomes.

The Department of Veterans Affairs (VA) health system is a major provider of acute care services in the United States, and VA medical centers treat approximately 600,000 patients per year.[17] To our knowledge no assessment of appropriateness of care delivered at a large VA Medical Center has been described previously. The present study determined the appropriateness of basic respiratory care delivered at a 450-bed VA teaching hospital during a 3-month interval. Our aims were:

1. To determine the percentage of respiratory care that was ordered but not indicated (based on standardized clinical practice guidelines)
2. To determine the percentage of respiratory care that was indicated (based on standardized clinical practice guidelines) but not ordered
3. To estimate the labor costs and savings of implementing and providing protocol-based respiratory care at a VA hospital

Methods

We selected 5 assessment days, beginning in January of 1998, at 2-week intervals over a 10-week period, based on availability of the assessors and department faculty. The assessments occurred on Wednesdays, and the number of days chosen (5) was based on the average daily patient treatment load, with a goal of reviewing care received by approximately 75 patients. Basic respiratory care was defined as oxygen therapy, bronchodilator therapy (small-volume nebulizer and metered-dose inhaler), inhaled steroids, inhaled asthma medications (eg, cromolyn), mucolytics, lung expansion therapy (incentive spirometry, intermittent positive-pressure breathing [IPPB]), chest physiotherapy (postural drainage and chest percussion), high-volume bland aerosol, directed cough, and airway suctioning. All patients admitted to the hospital and receiving basic respiratory care received a complete respiratory care assessment by a respiratory therapist (RT), including medical records review, patient interview, physical assessment, and measurement of blood oxygen saturation (measured via pulse oximetry [S_{pO_2}]) and inspiratory capacity at the bedside. Patients in the intensive care units were excluded from the study.

We developed a 4-part patient-assessment instrument that included the components noted above. Section 1 of the instrument is a thorough chart review. The reviewed data included name, age, gender, height, weight, current respiratory care orders (oxygen, aerosol therapy, chest physiotherapy, IPPB and/or incentive spirometry, and other), respiratory care progress notes, arterial blood gas analyses, chest radiograph reports, pulmonary function test results, and sputum analysis results. Appendix 1 shows the assessment instrument's chart review sections for current aerosol medication and incentive spirometry.

Section 2 of the assessment instrument was an in-depth patient interview. Appendix 2 shows example questions from the patient interview. The interview questions assessed cough, sputum production, hemoptysis, wheezing, whistling, chest tightness, dyspnea, chest illness, smoking history, occupational history, hobby and leisure history, home respiratory care, family history, current illness, and response to respiratory care. Interview questions were standardized and used a "check yes or no" format for the assessor to indicate the patient's response to each question.

Section 3 of the instrument included a directed physical assessment, chest inspection, chest auscultation, measurement of pulse, respiration, blood pressure, S_{pO_2}, inspiratory capacity, and work of breathing. Assessment for general appearance included a check box for each of: relaxed, resting quietly, anxious/agitated, and other, plus a space for comments. Check boxes were provided for level of consciousness to indicate: whether the patient was awake and alert; oriented to time, place, and person; confused; sleepy but arouses easily; lethargic, obtunded, or stuporous/difficult to awaken; and comatose/does not respond. Oxygen and perfusion were assessed with check boxes provided for skin color (pink, pale/ashy, cyanotic), nail beds, and skin characteristics (warm, dry, diaphoretic, cool, moist) and capillary refill. Chest inspection items included configuration, right-left symmetry on inspiration/expiration, diaphragm-to-chest-wall synchrony, accessory muscle use, chest excursion, and respiratory pattern. Pulse, respirations, blood pressure, S_{pO_2}, and inspiratory capacity were also measured. Work of breathing was assessed as either normal or increased. Auscultation was performed and a diagram of the chest (anterior and posterior) was marked to indicate the location of breath sounds (good, diminished, or absent aeration) and the presence or absence of adventitious sounds (wheezes, crackles, gurgles).

Section 4 of the instrument provided a standardized format for assessing respiratory care, based on the American Association for Respiratory Care Clinical Practice Guidelines.[18–24] A summary of each assessment was transferred to a summary sheet, reviewed by one of the study authors, and a final determination was made as to whether therapy was indicated. For oxygen therapy, indications were any one of: hypoxemia based on current or previous arterial blood gas measurement or S_{pO_2}, corrected hypoxemia (defined as a $P_{aO_2} < 90–100$ while receiving oxygen therapy), suspected hypoxemia based on chart review and/or physical assessment, severe trauma, or acute myocardial infarction. Hypoxemia was suspected if, based on physical assessment or chart review, there were signs or symptoms of hypoxemia (general appearance, level of consciousness, skin color, respiratory rate, heart rate, work of breathing).

For aerosol bronchodilator therapy, indications included any one of: physician diagnosis of asthma or chronic obstructive pulmonary disease; wheezing noted on chart review, history, or physical assessment; or a documented response to a bronchodilator (forced expiratory volume in the first second increase $\geq$ 15%, forced vital capacity increase $\geq$ 12% or peak expiratory flow increase). Appendix 3 shows the criteria for assessing appropriateness for each form of basic respiratory care assessed.

All assessments were performed by RTs trained to use the assessment instrument and who had extensive clinical experience and academic course work on patient assessment techniques. Assessments were supervised and reviewed by faculty of our department of respiratory care, all of whom are registered RTs with extensive clinical and teaching experience. Comparisons of ordered versus indicated therapy were based on the most recent order received. The assessments did not occur concurrently with the receipt of the order for therapy; rather, a chart review and patient history were taken to determine if the ordered therapy was appropriate.

The data were collected as part of a quality assurance program approved by our institution's chief of staff. Following completion of the quality assurance program, our institutional review board reviewed and approved the study as a review of existing records for research and publication purposes. We calculated the numbers of patients receiving each type of respiratory care, the number for whom care was indicated and ordered, the number who received care that was not indicated, the percentages of care indicated and not indicated, and the frequency and percentage of patients for whom care was indicated but not ordered.

Results

We assessed 75 patients, of whom 51 were receiving oxygen therapy, 61 were receiving aerosol bronchodilator therapy, 7 were receiving mucolytic therapy, 13 were receiving lung expansion therapy, 8 were receiving chest physiotherapy, and 6 were receiving anti-inflammatory inhaled aerosols. There also was 1 patient receiving a high-volume aerosol for sputum induction, and 1 receiving suctioning. Table 1 summarizes the results. For oxygen therapy 17.7% of the ordered therapy was not indicated. For all categories of aerosolized medications (bronchodilators, mucolytics, anti-inflammatories) 32.4% of the ordered therapy was not indicated. For bronchodilator therapy 39% of the therapy delivered via small-volume nebulizer was not indicated and 10% of the therapy delivered via MDI was not indicated. For mucolytic therapy 42.9% of the therapy was not indicated. For chest physiotherapy 37.5% of the ordered therapy was not indicated. For lung expansion therapy 7.7% of the ordered therapy was not indicated.

Table 2 shows the frequency and percentage of patients for whom respiratory care was indicated but not ordered. The percentages for therapy indicated but not ordered were: lung expansion 36% (28% for incentive spirometry, 8% for IPPB), directed cough 8%, oxygen therapy 5.3%, bronchodilator therapy 5.3%, mucolytic therapy 1.3%, and anti-inflammatory therapy 2.7%. A mean of 11.8% of the patients assessed were not receiving respiratory care that was indicated, based on clinical practice guidelines.

For the patients assessed for appropriateness of aerosol medication therapy (bronchodilators, mucolytics, anti-inflammatory agents) there were 20 orders for therapy every 4 h, 29 orders for therapy every 6 h, 4 orders for therapy every 8 h, and 1 order for treatment every 12 h.

Discussion

The percentage of inappropriate respiratory care orders we identified at our VA hospital is comparable to values reported elsewhere.[5,12–16] We found that 24.8% of the ordered therapy was unnecessary and 11.8% of the patients were not receiving care that was indicated. The largest and most time-intensive category of unnecessary care provided was aerosolized medication delivery (bronchodilators, mucolytics, anti-inflammatory agents). The number of ordered procedures in that category was approximately 250 individual treatments, for an average of 50 procedures per day. The majority (81%) had orders for some form of bronchodilator therapy.

Currently, our VA facility is performing approximately 27,375 aerosol therapy procedures per year. Based

Table 1. Numbers and Percentages of Indicated and Not-Indicated Basic Respiratory Care During the Study Period

Type of Respiratory Care	Patients (n = 75)				
	Received Therapy	Care Indicated and Ordered*	Care Given But Not Indicated	Care Indicated (%)	Care Not Indicated (%)
Oxygen therapy (total)	51	42	9	82.4	17.7
Nasal cannula	48	39	9	81.3	18.8
Air-entrainment nebulizer	1	1	0	100.0	0
Venturi mask	2	2	0	100.0	0
All types of aerosol therapy: combined totals	74	50	24	67.6	32.4
Aerosol bronchodilator therapy	61	40	21	65.6	34.4
Small-volume nebulizer	51	31	20	61.0	39.0
Metered-dose inhaler	10	9	1	90.0	10.0
Aerosol mucolytic	7	4	3	57.1	42.9
Anti-inflammatory aerosol	6	6	0	100.0	0
Lung expansion therapy	13	12	1	92.3	7.7
Incentive spirometry	13	12	1	92.3	7.7
IPPB	0	0	0	0	0
Chest physiotherapy	8	5	3	62.5	37.5
Directed cough	1	1	0	100.0	0
Large-volume aerosol	1	1	0	100.0	0
Suctioning	1	1	0	100.0	0
Totals	75*	112*	37	75.2	24.8

IPPB = intermittent positive-pressure breathing.
*Some patients received more than 1 type of respiratory care.

Table 2. Frequency and Percentage of Patients for Whom Respiratory Care Was Indicated But Was Not Ordered

Procedure	Patients (n = 75)	%
Lung expansion therapy	27	36.0
Incentive spirometry	21	28.0
IPPB	6	8.0
Directed cough	6	8.0
Oxygen therapy	4	5.3
Aerosol bronchodilator therapy	4	5.3
Aerosol mucolytic therapy	1	1.3
Aerosol anti-inflammatory therapy	2	2.7
Average	NA	11.8

IPPB = intermittent positive-pressure breathing.
NA = not applicable.

on our results 32.4% (8,870) of those procedures may be unnecessary. A typical aerosol procedure requires 12–15 min (0.20–0.24 man-hours) to perform.[25] One full-time-employee RT could optimally perform 24 aerosol procedures in an 8-h shift.[25] The American Association for Respiratory Care estimated that the mean annual salary of 1 full-time-employee (1.0 FTE) RT was $40,809 in the year 2000.[26] Assuming a 40-h work week and an additional benefit factor of 0.30 (ie, 30%), the labor cost of providing the number of unnecessary aerosol therapies we observed is approximately $8.50 per procedure times 8,870 procedures per year, for a total of $75,395. That figure does not include the cost of equipment, supplies, medications, administrative costs, or physical plant. These potential cost savings do not take into account the cost of providing the additional care that was indicated but not ordered in our study. For aerosol therapy 9.3% of the patients who met the criteria for aerosol therapy were not receiving it.

Other overutilized forms of respiratory care found in our study included chest physiotherapy and oxygen therapy, and our results are consistent with other studies, which found substantial overuse of oxygen therapy and chest physiotherapy with certain patient populations.[5,12]

We found that 11.8% of the patients reviewed were not receiving care that was indicated, based on national clinical practice guidelines. That figure included patients who met the criteria for oxygen therapy, incentive spirometry, IPPB, directed cough, and/or aerosol therapy.

Assessment protocols allow RTs to evaluate patients and intervene to minimize unnecessary care and optimize care ordered by the physician.[27] Protocol-based respiratory care performed by RTs is safe and effective for weaning patients from mechanical ventilation,[28,29] in adult basic respiratory care,[30,31] after anesthesia,[32] and in pediatric respiratory care.[33]

Studies suggest that protocol-based respiratory therapy delivered by RTs can lessen misallocation of care and the associated costs without adverse consequences.[27,31,34,35] The system described by Shrake et al[27] saved $61,350 per year after factoring in the cost of providing in-depth assessments. Such a system requires one or more trained assessors from the respiratory care department to evaluate all new respiratory care orders. Following the patient assessment, therapy is given as ordered if indicated. If the assessor finds that the ordered care is inappropriate or unnecessary under the protocol, an order change is requested from the ordering physician. More sophisticated assess-and-treat protocols include algorithms for the selection of care and the provision for the physician to simply order respiratory care per protocol.[27,30] Assessment-based protocols may improve RTs' job satisfaction while providing cost savings and improving patient care.[1,4,11] The objection that protocol-based respiratory care may detract from physician medical trainees' education may be unfounded.[36]

Limitations of the present study include the fact that assessments were not performed at the time the therapy orders were written, and consequently the patient's clinical status may have changed. However, a history and chart review were included as a part of each assessment. If specific indications were documented in the chart, identified by patient history, or observed at the time of assessment, that therapy was classified as indicated. For example, for bronchodilator therapy, if asthma, chronic obstructive pulmonary disease, wheezing, or a documented response to a bronchodilator was noted during the assessment history-and-physical or documented in the chart at any time during the patient's current admission, the therapy was classified as indicated.

Another limitation of the study is that inter-rater reliability was not assessed. However, the RTs had been trained to use the assessment instrument, and the assessments were supervised by our respiratory care department faculty. In addition, for consistency, the final classification of whether a therapy was indicated was performed by one individual.

Conclusions

At our VA hospital 24.8% of basic respiratory care procedures reviewed were not indicated and 11.8% of patients were not receiving respiratory care that was indicated. Inappropriate utilization of respiratory care services may increase costs and adversely affect morbidity, mortality, and duration of stay. We believe that implementation of respiratory care assessment protocols based on nationally accepted clinical practice guidelines can reduce unnecessary care, optimize care received, and may reduce costs and improve outcomes.

REFERENCES

1. Burton GG. A short history of therapist-driven respiratory care protocols. Respir Care Clin N Am 1996;2(1):15–26.
2. Benko LB. Outlook '03. Even with unrelenting cost increases, some sectors enjoy a healthier prognosis, but the year promises formidable challenges for all. Mod Healthc 2003;33(1):26–30.
3. Tietsort JA. Therapist-driven protocols and newer models for patient care delivery. Respir Care Clin N Am 1996;2(1):147–155.
4. Stoller JK. The rationale for therapist-driven protocols. Respir Care Clin N Am 1996;2(1):1–14.
5. Alexander E, Weingarten S, Mohsenifar Z. Clinical strategies to reduce the utilization of chest physiotherapy without compromising patient care. Chest 1996;110(2):430–432.
6. Probst TM. Layoffs and tradeoffs: production, quality, and safety demands under the threat of job loss. J Occup Health Psychol 2002;7(3):211–20.
7. Morrissey J. Quality vs quantity. IOM report: hospitals must cut back workload and hours of nurses to maintain patient safety. Mod Healthc 2003;33(45):8,11.
8. Aiken LH, Clarke SP, Silber JH, Sloane D. Hospital nurse staffing, education, and patient mortality. LDI Issue Brief 2003;9(2): 1–4.
9. Oransky I. Limits imposed on residents' work hours. Reduced workload said to increase patient—and resident—safety. Lancet 2003;362(9381):378–379.
10. Castledine G. Inadequate staffing leads to poor nursing care. Br J Nurs 2001;10(11):751.
11. Shelledy DC, Mikles SP, May DF, Youtsey JW. Analysis of job satisfaction, burnout, and intent of respiratory care practitioners to leave the field or the job. Respir Care 1992;37(1):46–60.
12. Pancioli AM, Bullard MJ, Grulee ME, Jauch EC, Perkis DF. Supplemental oxygen use in ischemic stroke patients: does utilization correspond to need for oxygen therapy? Arch Intern Med 2002;162(1):49–52.
13. Brougher LI, Blackwelder AK, Grossman GD, Staton GW Jr. Effectiveness of medical necessity guidelines in reducing the cost of oxygen therapy. Chest 1986;90(5):646–648.

14. Kester L, Stoller JK. Ordering respiratory care services for hospitalized patients: practices of overuse and underuse. Cleve Clin J Med 1992;59(6):581–585.
15. Shapiro BA, Cane RD, Peterson J, Weber D. Authoritative medical direction can assure cost-beneficial bronchial hygiene therapy. Chest 1988;93(5):1038–1042.
16. Zibrak JD, Rossetti P, Wood E. Effect of reductions in respiratory therapy on patient outcome. N Engl J Med 1986;315(5):292–295.
17. Facts about the Department of Veterans Affairs. May 2004. Available at http://www1.va.gov/opa/fact/vafacts.html. Accessed May 24, 2004.
18. American Association for Respiratory Care. AARC Clinical Practice Guideline: Oxygen therapy for adults in the acute care facility—2002 revision & update. Respir Care 2002;47(6):717–720.
19. American Association for Respiratory Care. AARC Clinical Practice Guideline: Assessing response to bronchodilator therapy at point of care. Respir Care 1995;40(12):1300–1307.
20. American Association for Respiratory Care. AARC Clinical Practice Guideline: Directed cough. Respir Care 1993;38(5):495–499.
21. American Association for Respiratory Care. AARC Clinical Practice Guideline: Bland aerosol administration. Respir Care 1993; 38(11):1196–1200.
22. American Association for Respiratory Care. AARC Clinical Practice Guideline: Incentive spirometry. Respir Care 1991;36(12): 1402–1405.
23. American Association for Respiratory Care. AARC Clinical Practice Guideline: Intermittent positive pressure breathing—2003 revision & update. Respir Care 2003;48(5):540–546.
24. American Association for Respiratory Care. AARC Clinical Practice Guideline: Postural drainage therapy. Respir Care 1991; 36(12):1418–1426.
25. American Association for Respiratory Care. Respiratory care uniform reporting manual, 3rd ed. Dallas: AARC; 1993.
26. Dubbs WH. AARC respiratory therapist human resources study 2000. AARC Times 2000;24(12):34–42.
27. Shrake KL, Scaggs JE, England KR, Henkle JQ, Eagleton LE. A respiratory care assessment-treatment program: results of a retrospective study. Respir Care 1996;41(8):703–713.
28. Kollef MH, Shapiro SD, Silver P, St John RE, Prentice D, Sauer S, et al. A randomized, controlled trial of protocol-directed versus physician-directed weaning from mechanical ventilation. Crit Care Med 1997;25(4):567–574.
29. Ely EW, Bennett PA, Bowton DL, Murphy SM, Florance AM, Haponik EF. Large scale implementation of a respiratory therapist-driven protocol for ventilator weaning. Am J Respir Crit Care Med 1999;159(2):439–446.
30. Stoller JK, Mascha EJ, Kester L, Haney D. Randomized controlled trial of physician-directed versus respiratory care consult service-directed respiratory care to adult non-ICU inpatients. Am J Respir Crit Care Med 1998;158(4):1068–1075.
31. Stoller JK, Orens D, Ahmad M. Changing patterns of respiratory care service use in the era of respiratory care protocols: an observational study. Respir Care 1998;43(8):637–642.
32. Stoller JK, Kester L. Respiratory care protocols in postanesthesia care. J Perianesth Nurs 1998;13(6):349–358.
33. Volpe J 3rd. Therapist-driven protocols for pediatric patients. Respir Care Clin N Am 1996;2(1):117–131.
34. Haney DJ. Therapist-driven protocols for adult non-intensive care unit patients: availability and efficacy. Respir Care Clin N Am 1996;2(1):93–103.
35. Ford RM, Phillips-Clar JE, Burns DM. Implementing therapist-driven protocols. Respir Care Clin N Am 1996;2(1):51–76.
36. Stoller JK, Thaggard I, Piquette CA, O'Brien RG. The impact of a respiratory therapy consult service on house officers' knowledge of respiratory care ordering. Respir Care 2000;45(8):945–952.

Appendix 1

Chart Review

Current Aerosol Medication Use

Yes	No	
□	□	Small-volume nebulizer. If yes, write in frequency, medication, and dosage. Frequency (eg, QID, BID).: _____ Medication (eg, albuterol): _____ Dose (eg, 0.3 mL in 3 mL NS): _____
□	□	MDI. If yes, please write in frequency, medication and dosage. Frequency (eg, QID, q 4 h): _____ Medication (eg, Atrovent, albuterol): _____ Dose (eg, 2 puffs): _____
□	□	Do the respiratory care notes indicate wheezing?
□	□	Do the respiratory care notes indicate improvement in wheezing following therapy?
□	□	Do the respiratory care notes indicate that the patient coughs following treatments?
□	□	Is cough productive? If yes, please write in the most recent sputum appearance and amount: _____

Current Incentive Spirometry Use

Yes	No	
□	□	Is the patient currently doing incentive spirometry? If yes, is the volume obtained recorded? If so, please write in volume achieved (eg, 1200 mL): _____
□	□	If incentive spirometry is ordered, is the patient using it? If yes, please write in how often: q _____ hours × _____ breaths per use
□	□	Has anyone measured and recorded the patient's spontaneous inspiratory capacity, tidal volume, or vital capacity? If yes, please write in: IC: _____ V_T: _____ VC: _____

Appendix 2

Section 2: Patient Interview

Use actual wording of each question. Put an "X" in the appropriate space after each question. When in doubt, record "No".

1. COUGH
   - A. Do you USUALLY cough first thing in the morning? Yes __ No __
   - B. Do you USUALLY cough at other times during the day or night? Yes __ No __

   If both A and B are "No" proceed to question 2.
   - C. Do you cough on most days as much as 3 months of the year? Yes __ No __
   - D. How many years have you had this cough? Yes __ No __
   - E. Do you cough more on any particular day of the week? Yes __ No __

     If "Yes", which day? _____

2. PHLEGM, SPUTUM, OR MUCUS
   - A. Do you USUALLY bring up phlegm (sputum, mucus) from your chest first thing in the morning? Yes __ No __
   - B. Do you USUALLY bring up phlegm (sputum, mucus) from your chest at other times during the day or night? Yes __ No __
   - C. Do you bring up phlegm (sputum, mucus) from your chest on most days for as much as three months of the year? Yes __ No __
   - D. For how many years have you raised phlegm (sputum, mucus) from your chest? _____
   - E. What is the USUAL color of the phlegm (sputum, mucus) you bring up from your chest? Don't know ___

     Clear ___ White ___ Yellow ___ Green ___ Other (give details): _____

3. HEMOPTYSIS
   - A. Have you coughed up blood from your chest in the past 2 years? Yes __ No __
   - B. If yes, when, how many times, give details. _____
   - C. Did you have a chest x-ray? Yes __ No __

4. WHEEZING, WHISTLING, CHEST TIGHTNESS
   - A. Have you ever noticed any wheezing, whistling, or tightness in your chest? Yes __ No __

     If "No" proceed to question 5.
   - B. Which symptoms have you experienced?

     Only Wheezing and Whistling ___ Only Chest Tightness ___ Both ___
   - C. At what age did your wheezing, whistling, or chest tightness first occur? _____
   - D. When did the wheezing, whistling, or tightness last occur? _____
   - E. How frequently have you experienced this wheezing, whistling, or chest tightness? Daily ___ Nightly ___

     Few times a week ___ Few times a month ___ Few times a year ___ Only rarely ___
   - F. Is your wheezing, whistling or chest tightness brought on or made worse by exposure to:

     House dust ___ Other dust or fumes at home ___ Contact with animals ___

     Contact with plants or pollen ___ Dust, gases, or fumes at work ___ Tobacco smoke ___

     Cold weather ___ Perfumes, colognes ___ Other: _____
   - G. Is your wheezing, whistling, or chest tightness worse on any particular day of the week? If "Yes" what day or days? _____ Yes __ No __

     Do you always have it on Mondays? Yes __ No __
   - H. Is your wheezing, whistling, or chest tightness worse:
     1. Before work Yes __ No __
     2. After beginning work Yes __ No __
     3. With exercise Yes __ No __
     4. At night or when away from work Yes __ No __

     If symptoms are worse after beginning work, how many hours after beginning the shift? ____

     How long do the symptoms last? ____
   - I. Are you allergic to anything? Yes __ No __

     If "Yes" what? _____
   - J. After a week or more away from work, do you notice any change of breathing after return to work? No change ___ Better ___ Worse ___

Appendix 3

ASSESSMENT FOR THERAPY

Evaluate whether each specific therapy listed would be indicated and/or appropriate for this patient based on your chart review, patient interview, and physical assessment data. NOTE: Check all indications present REGARDLESS of whether the patient is currently receiving a particular therapy.

Assessment for Oxygen Therapy (check all indications present for oxygen therapy)

Yes	No	
☐	☐	Documented hypoxemia (S_{pO_2} or ABG) - Adults and children: $P_{aO_2} < 60$ mm Hg and/or $S_{pO_2} < 90$ - Neonates (less than 28 days): $P_{aO_2} < 50$ mm Hg and/or $S_{pO_2} < 88\%$
☐	☐	Corrected hypoxemia: P_{aO_2} of < 90–100 mm Hg while receiving oxygen therapy is consistent with corrected hypoxemia
☐	☐	Suspected hypoxemia based on chart review and/or physical assessment (follow with S_{pO_2} or ABG)
☐	☐	Severe trauma
☐	☐	Acute myocardial infarction
☐	☐	Immediate post-operative recovery (recovery room or ICU)

Assessment for Bronchodilator Therapy (check all indications present for bronchodilator therapy)

Yes	No	
☐	☐	Asthma
☐	☐	COPD (emphysema, chronic bronchitis, cystic fibrosis, bronchiectasis)
☐	☐	Wheezing
☐	☐	Documented response to bronchodilator: - FEV_1 increase of ≥ 15% or FVC increase of ≥ 12% or - PEF increase: PEF increase to > 70–90% of baseline = good response PEF increase to 50–70% of baseline = incomplete response

Assessment for Anti-inflammatory Aerosol Agents (inhaled steroids) (check the indications present for the patient)

Yes	No	
☐	☐	Asthma
☐	☐	COPD (emphysema, chronic bronchitis, cystic fibrosis, bronchiectasis)
☐	☐	Upper-airway edema (post-extubation, croup)

Assessment for Anti-asthmatic Aerosol Agents (eg, cromolyn) (check the indications present for this patient)

Yes	No	
☐	☐	Asthma

Assessment for Mucolytic Therapy (check the indications present for this patient)

Yes	No	
☐	☐	Evidence of viscous/retained secretions not easily removed via other therapy
☐	☐	Chronic bronchitis, cystic fibrosis, bronchiectasis

(continued)

Appendix 3
(continued)

Assessment for Lung Expansion Therapy

Incentive Spirometry (check all of the indications present for this patient)

Yes	No	
☐	☐	Patient is able to perform the maneuver every 1–2 hours while awake and is able to achieve an inspired volume of at least 1/3 of predicted inspiratory capacity (or VC ≥ 10 mL/kg) AND (check as many as apply):
☐	☐	Patient predisposed to atelectasis
☐	☐	Upper abdominal surgery
☐	☐	Thoracic surgery
☐	☐	Surgery with COPD patient
☐	☐	Patient debilitated/bedridden
☐	☐	Presence of atelectasis
☐	☐	Quadriplegic and/or dysfunctional diaphragm

IPPB (check the indications present for this patient)

Yes	No	
☐	☐	Presence of clinically important atelectasis AND other therapy has been unsuccessful
☐	☐	Unable to spontaneously deep-breathe (inspired volumes < 1/3 of predicted IC or VC < 10 mL/kg) in patients with inadequate cough and/or secretion clearance AND other therapy has been unsuccessful
☐	☐	To provide short-term ventilatory support in an attempt to avoid intubation and continuous mechanical ventilation
☐	☐	To deliver aerosol medication to a patient who is unable to adequately deep-breathe and/or coordinate the use of other aerosol devices.

Assessment for Directed Cough (check the indications present for this patient)

Yes	No	
☐	☐	Retained secretions
☐	☐	Atelectasis
☐	☐	At risk for post-operative pulmonary complications
☐	☐	Cystic fibrosis, bronchiectasis, chronic bronchitis, necrotizing pulmonary infection, or spinal cord injury
☐	☐	During/following other bronchial hygiene therapies
☐	☐	To obtain sputum specimens
☐	☐	Presence of endotracheal or tracheostomy tube

Assessment for Chest Physiotherapy (check the indications present for this patient)

Yes	No	Postural Drainage and Percussion
☐	☐	Suggestion/evidence of problems with secretion clearance
☐	☐	Difficulty clearing secretions with volume > 25–30 mL/day (adult)
☐	☐	Retained secretions in presence of an artificial airway
☐	☐	Atelectasis caused by or suspected to be due to mucus plugging
☐	☐	Cystic fibrosis, bronchiectasis, cavitating lung disease
☐	☐	Presence of a foreign body in airway

Assessment for High-Volume Bland Aerosol (check the indications present for this patient)

Yes	No	Cool Large-Volume Nebulizer
☐	☐	Post-extubation
☐	☐	Upper-airway edema
☐	☐	Delivery of precise F_{IO_2} via aerosol mask, tracheal mask, or T-piece and high humidity
		Heated Large-Volume Nebulizer or Ultrasonic Nebulizer
☐	☐	Evidence/potential for secretion clearance problem
☐	☐	Precise F_{IO_2} via aerosol mask, tracheal mask, or T-piece and high humidity