CHAPTER

1

Introduction to Patient Assessment

David C. Shelledy and Jay I. Peters

CHAPTER OUTLINE

CHAPTER OBJECTIVES

1. Explain the rationale for patient assessment.
2. Describe each of the components of a complete patient assessment (history, physical, laboratory tests, imaging studies, and other diagnostic tests).
3. Explain specific factors that affect health.
4. Describe each of the main drivers of the healthcare system (quality, access, and cost).
5. Describe the impact of misallocated care.
6. Describe evidence-based practice.
7. Evaluate sources of evidence.
8. Describe an approach to critical diagnostic thinking.
9. Describe the presentation of common respiratory disorders.

KEY TERMS

activities of daily living (ADL)
acute lung injury (ALI)
acute respiratory distress syndrome (ARDS)
arterial blood gases
asthma
case control
chronic bronchitis
cohort studies
chronic obstructive pulmonary disease (COPD)
critical thinking
emphysema
evidence-based practice (EBP)
health
health-related quality of life (HRQOL)
history
meta-analysis
misallocation
obstructive lung disease
patient outcomes
physical examination
pneumonia
pulmonary function testing (PFT)
randomized controlled trial (RCT)
restrictive lung disease
signs
symptoms

Overview

This chapter reviews the rationale for respiratory care patient assessment, provides an overview of health issues in the United States, describes evidence-based practice, and introduces the skills needed for critical diagnostic thinking and respiratory care plan development. Techniques for hypothesis formulation and evaluation to include identifying and gathering needed information and evaluation of patient problems are introduced. Typical presentations of common respiratory problems are reviewed.

Introduction to Patient Assessment

Physicians, nurses, and respiratory therapists are intimately involved in the diagnosis, treatment, care, and follow-up evaluation of patients with heart and lung problems. Modern healthcare demands that patients receive the right care at the right time and that unnecessary or inappropriate care be reduced or eliminated. In addition, care should promote patients' health and well-being and prevent, when possible, the development of acute and chronic disease. All of these goals demand excellent patient assessment skills.

Respiratory care patient assessment can be divided into three key areas: history, physical examination, and diagnostic testing (laboratory tests and imaging studies). Following initial assessment, hypotheses are formulated and evaluated regarding the patient's

problem(s) and the respiratory care plan is developed and implemented.

We begin the assessment process with the patient interview, or **history**. This is where we determine the patient's perceptions of his or her health problem(s), as well as what the patient is experiencing (i.e., **symptoms**). Special emphasis should be placed on noting the difference between the patient's baseline symptoms and current symptoms. We review the patient's past medical history, as well as factors that may affect health, such as smoking, drug and/or alcohol use, nutrition, weight, fitness, occupation, environmental exposures, and family health problems. The patient interview is the first and most important step in identifying the problem. The physical assessment follows and includes observation of the patient (inspection) and his or her level of comfort or distress, auscultation (listening), palpation (touching), and percussion (thumping). Vital signs (i.e., pulse, respirations, blood pressure, and temperature) are measured, and pulse oximetry may be used to assess arterial blood oxygen saturation (Spo_2). During the physical assessment, we look for the presence (or absence) of **signs** associated with specific disease states or conditions. The **physical examination** helps us clarify the patient's problem and guides us in gathering additional information.

Next, we consider diagnostic testing, including laboratory and imaging studies, to gather additional information and further clarify the patient's problem. Laboratory studies may include **arterial blood gases**, pulmonary function tests, blood chemistry, hematology, lipids, blood sugar, microbiology, and cardiac enzymes. Imaging studies may range from the standard chest radiograph to computed tomography (CT), magnetic resonance imaging (MRI), and diagnostic medical sonography (ultrasound).

Last, we begin to formulate and test hypotheses and develop a patient care plan. What do the history and physical suggest? Do the laboratory and imaging studies confirm or refute this hypothesis? What additional information is needed? What are our conclusions at this point? And how should we now treat the problems that have been identified?

Rationale for Patient Assessment

Health is not concerned merely with the absence of disease, but rather the person's overall mental, physical, and social well-being.[1] Modern healthcare should aim not only to treat acute and chronic disease, but to maximize patients' **health-related quality of life (HRQOL)**. Effective assessment skills are essential to ensure that patient problems are properly identified, prioritized, evaluated, and treated. Health promotion, disease prevention, and management of patients with chronic conditions also require strong assessment skills. Patient assessment is essential for evidence-based practice and care plan development, and patient assessment is required to monitor and evaluate care delivery.

Factors That Affect Health

The factors that determine health include individual genetic makeup, access to medical care, environmental factors (housing, work, and school), and personal health-related behaviors (**Table 1-1**). Although genetics, the environment, and access to healthcare play important roles, much of the cost of healthcare in the

Table 1-1
Factors That Determine Individual Health

- **Genetic makeup**
- **Natural physical environment** (climate, housing, neighborhood, work, school)
  - Housing factors that may affect health
    - Lead exposures
    - Mold, mites, and other allergens
    - Temperature extremes
    - Indoor air pollution
    - Injuries
    - Residential crowding
  - Neighborhood conditions that may affect health
    - Physical conditions
    - Substandard housing
    - Poor air/water quality, exposure to hazardous substances
    - Crime and safety, safe places to exercise
    - Employment opportunities
    - Access to full-service grocery stores (presence of food deserts)
    - Schools, transportation and other municipal services
    - Social networks and social support
  - Work
    - Exposure to hazardous materials
    - Physical activity
    - Pay, promotions, social support, job satisfaction, stress
    - Access to medical care
  - School
    - Physical activity and nutrition
    - Environment
    - Access to medical care
  - Environmental stress (work, home, other) impacts other health factors, such as
    - Alcohol and drug abuse
    - Mental health
    - Eating habits and obesity
    - Blood pressure and immune response
- **Healthcare services**
  - Quality, access, and cost
  - Acute care
  - Preventative care
  - Rehabilitation
  - Chronic disease management
- **Health-related behaviors**
  - Nutrition
  - Smoking
  - Drugs and alcohol
  - Physical exercise

Adapted with permission from Center on Social Disparities in Health, University of California, San Francisco.

United States is associated with preventable illness due to smoking, obesity, lack of physical exercise, poor nutrition, and the use of drugs and alcohol. Projections place levels of obesity in the United States at 41% by 2015, with consequences for diabetes, heart disease, hypertension, cancer, **asthma**, and osteoarthritis.[2] Cigarette smoking is an important modifiable risk factor for adverse health outcomes, including cancer, **chronic obstructive pulmonary disease (COPD)**, heart disease, and stroke. Cigarette smoking prevalence among adults has decreased 42% since 1965, but declines in current smoking prevalence have slowed during the past 5 years.[3] Cigarette smoking among adults was slightly less than 20% in 2010 and has remained relatively constant. Cigarette use was highest among those with less than a high school education (28%), those with no health insurance (29%), those living below the federal poverty level (28%), and those aged 18 to 24 years (24%).[3] It is interesting to note that the top five leading causes of death in the United States (**Box 1-1**) are heart disease, cancer, chronic lower respiratory diseases (i.e., COPD), cerebrovascular disease (stroke), and accidents, all of which are impacted by personal health-related behaviors.[4]

Environmental factors that may directly affect health include housing, neighborhood of residence, work environment, and access to services near home (Table 1-1). Factors of special concern with respect to respiratory disease include exposure to air pollution, secondhand smoke, occupational dust and fumes, chemicals, pollen, mold, dust mite and cockroach allergens, animal dander, and other allergens and irritants. A complete patient assessment must include review of environmental factors and health-related behaviors that impact patients' health.

BOX 1-1

The 15 Leading Causes of Death in the United States

1. Diseases of the heart (myocardial infarcts or heart failure)
2. Malignant neoplasms (cancer)
3. Chronic lower respiratory diseases (COPD)
4. Cerebrovascular diseases (including stroke)
5. Accidents (unintentional injuries)
6. Alzheimer disease
7. Diabetes mellitus
8. Influenza and pneumonia
9. Nephritis, nephrotic syndrome, and nephrosis
10. Intentional self-harm (suicide)
11. Septicemia
12. Chronic liver disease and cirrhosis
13. Essential hypertension and hypertensive renal disease
14. Parkinson disease
15. Assault (homicide)

Reproduced from: Kochanek KD, Xu J, Murphy SL, Miniño AM, Kung HC. Deaths: preliminary data for 2009. *Natl Vital Stat Rep.* 2011;59(4).

Cost, Access, and Quality

The three main drivers of the healthcare system are cost, access, and quality.

Cost

In 2010, the United States spent $2.6 trillion, or about 17% of its gross domestic product (GDP), on healthcare, and this amount is expected to nearly double by 2020.[5] The United States spends twice the European average for healthcare.[6] However, in spite of these expenditures, the United States does poorly in comparison to other industrialized nations (**Table 1-2**), ranking 42nd in life expectancy and 56th in infant mortality.[1]

It is interesting to note that half of the U.S. population spends little or nothing on healthcare, while 5% of the population spends almost half of the total amount.[6] A small number of conditions accounted for most of the growth in total healthcare spending between 1987 and 2000, with heart disease, pulmonary disorders, cancer, mental disorders, and trauma accounting for 31% of the cost.[6]

The U.S. population is aging, and older patients are responsible for higher healthcare costs. The elderly (age ≥ 65) made up around 13% of the U.S. population in 2002, but they accounted for 36% of personal healthcare expenses.[9] By 2020, one in five Americans (20%) will be older than 65 years of age.[7] Over half of the patients over age 65 in the United States have three or more chronic conditions, and patients with multiple chronic conditions cost up to seven times as much as patients with only one chronic condition.[7,8]

Patients with chronic disease have been estimated to account for 75% of overall healthcare spending.[2] Chronic cardiopulmonary conditions include asthma, **emphysema**, **chronic bronchitis**, COPD, combined asthma/COPD, bronchiectasis, cystic fibrosis, interstitial lung disease, chronic hypertension, coronary artery disease (CAD), and congestive heart failure (CHF). Approximately 34 million people were diagnosed with asthma in the United States in 2007, and over 13 million adults were diagnosed with COPD in 2008.[9,10] COPD is currently the third leading cause of death in the United States, and the actual number of COPD patients is probably over 24 million due to underdiagnosis.[4,10]

Inpatient hospital costs represent the largest portion of healthcare expenditures in the United States and average over $2,000 per patient day.[11,12] In 2005,

Table 1-2
Health Outcomes by Country for Life Expectancy and Infant Mortality

Life Expectancy at Birth (years)	Infant Mortality (deaths/1000 live births)
1. Monaco (89.57)	1. Monaco (1.81)
2. Macau (84.48)	2. Japan (2.13)
3. Japan (84.46)	3. Bermuda (2.48)
4. Singapore (84.38)	4. Norway (2.48)
5. San Marino (83.18)	5. Singapore (2.53)
6. Hong Kong (82.78)	6. Sweden (2.60)
7. Andorra (82.65)	7. Czech Republic (2.63)
8. Switzerland (82.39)	8. Hong Kong (2.73)
9. Guernsey (82.39)	9. Macau (3.13)
10. Australia (82.07)	10. Iceland (3.15)
11. Italy (82.03)	11. France (3.31)
12. Sweden (81.89)	12. Italy (3.31)
13. Liechtenstein (81.68)	13. Spain (3.33)
14. Canada (81.67)	14. Finland (3.36)
15. France (81.66)	15. Anguilla (3.40)
16. Jersey (81.66)	16. Germany (3.46)
17. Norway (81.60)	17. Guernsey (3.47)
18. Spain (81.47)	18. Malta (3.59)
19. Israel (81.28)	19. Belarus (3.64)
20. Iceland (81.22)	20. Netherlands (3.66)
21. Anguilla (81.20)	21. Andorra (3.69)
22. Netherlands (81.12)	22. Switzerland (3.73)
23. Bermuda (81.04)	23. Ireland (3.74)
24. Cayman Islands (81.02)	24. Jersey (3.86)
25. Isle of Man (80.98)	25. Korea, South (3.93)
26. New Zealand (80.93)	26. Israel (3.98)
27. Ireland (80.56)	27. Slovenia (4.04)
28. Germany (80.44)	28. Denmark (4.10)
29. United Kingdom (80.42)	29. Austria (4.16)
30. Greece (80.30)	30. Isle of Man (4.17)
31. Saint Pierre & Miquelon (80.26)	31. Belgium (4.18)
32. Austria (80.17)	32. Luxembourg (4.28)
33. Malta (80.11)	33. Liechtenstein (4.33)

Table 1-2
Health Outcomes by Country for Life Expectancy and Infant Mortality (*continued*)

Life Expectancy at Birth (years)	Infant Mortality (deaths/1000 live births)
34. Faroe Islands (80.11)	34. European Union (4.43)
35. Luxembourg (80.01)	35. Australia (4.43)
36. Belgium (79.92)	36. United Kingdom (4.44)
37. European Union (79.86)	37. Portugal (4.48)
38. Taiwan (79.84)	38. Wallis and Futuna (4.49)
39. Korea, South (79.80)	39. Taiwan (4.49)
40. Virgin Islands (79.75)	40. San Marino (4.52)
41. Finland (79.69)	41. New Zealand (4.59)
42. **United States (79.56)**	42. Cuba (4.70)
43. Turks & Caicos Islands (79.55)	43. Canada (4.71)
44. Wallis & Futuna (79.42)	44. Greece (4.78)
45. Saint Helena, Ascension, & Tristan da Cunha (79.21)	45. French Polynesia (4.78)
46. Gibraltar (79.13)	46. Hungary (5.09)
47. Puerto Rico (79.09)	47. Slovakia (5.35)
48. Denmark (79.09)	48. New Caledonia (5.46)
49. Portugal (79.01)	49. Northern Mariana Islands (5.50)
50. Guam (78.82)	50. Guam (5.51)
51. Bahrain (78.58)	51. Faroe Islands (5.71)
52. Chile (78.44)	52. Bosnia and Herzegovina (5.84)
53. Qatar (78.38)	53. Croatia (5.87)
54. Cyprus (78.34)	54. Lithuania (6.00)
55. Czech Republic (78.31)	55. Serbia (6.16)
56. Panama (78.30)	56. **United States (6.17)**

Data from: Central Intelligence Agency. *The World Factbook*. May 2014 (2014 estimate). Available at: https://www.cia.gov/library/publications/the-world-factbook/rankorder/rankorderguide.html. Accessed May 7, 2014; United Nations Development Programme. *Human Development Reports*. Top 10 most highly developed countries based on the Human Development Index (HDI). Available at: http://hdr.undp.org/en/countries.

coronary artery bypass surgery to treat narrowed or obstructed arteries cost over $20,670 per patient in the United States, and a single hospital stay for **pneumonia** cost up to $15,829.[13,14]

A great deal of respiratory care is provided in the hospital setting, often in the intensive care unit (ICU). Mean ICU cost per patient in 2005 was about $32,000 for patients requiring mechanical ventilation and about $13,000 for those not requiring mechanical ventilation.[15] Interventions that reduce ICU length of stay and/or duration of mechanical ventilation could lead to substantial reductions in total inpatient costs.

Access

All of us want the best care possible for our patients. Unfortunately, not everyone has access to high-quality healthcare, and many people have little or no access to basic or preventative care. Healthcare disparities are of concern for patients with respiratory conditions. For example, African American men have the highest death rate and shortest survival of any racial or ethnic group in the United States for most cancers, including lung cancer.[16] Although health outcomes and life expectancy improve significantly with education and income, racial

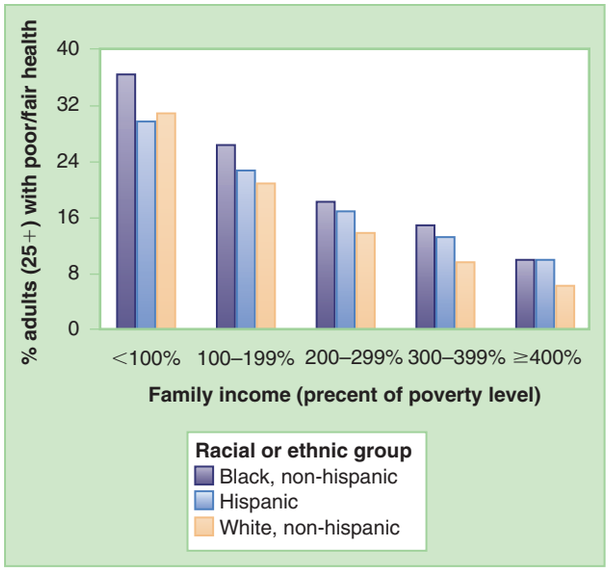

FIGURE 1-1 Racial and ethnic disparities at every income level.

Reproduced from: National Health Interview Survey (NHIS) 2001–2005. Age adjusted. Centers for Disease Control and Prevention.

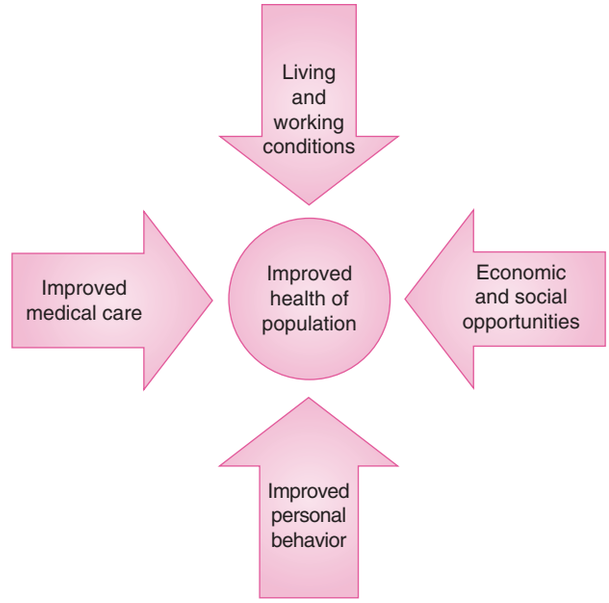

FIGURE 1-2 Conceptual framework for addressing healthcare disparities.

disparities persist at every income level (**Figure 1-1**).[17] The Agency for Healthcare Research and Quality (AHRQ) describes differences in health outcomes based on race/ethnicity, socioeconomic status (SES), insurance status, sex, sexual orientation, health literacy, and language.[18] Cardiopulmonary disease states or conditions that AHRQ has targeted as priorities for reduction in healthcare disparities include asthma, cystic fibrosis, CHF, CAD (ischemic heart disease, myocardial infarction), and hypertension.[18]

Figure 1-2 presents a conceptual framework for addressing healthcare disparities. It is thought that by improving economic and social opportunities, living and working conditions, medical care, and personal behaviors, healthcare disparities will be reduced, leading to improved population health.

Quality

It is clear that high healthcare expenditures may not result in better **patient outcomes**. Although the United States spends more on healthcare than any other industrialized country, measures of health and mortality are worse. In addition, studies point to major differences in healthcare expenses by geographic area within the United States, with no important differences in patient outcomes. One study found that patients in the higher spending areas received 60% more care, and that the increased care could not be attributed to levels of illness or socioeconomic status.[19] A major factor associated with increased cost was higher concentration of medical specialists in high-cost regions.[19]

In the presence of finite resources, should every patient receive all the care he or she prefers to receive, regardless of circumstances? This question gives rise to a number of ethical, moral, and practical dilemmas regarding the cost, quality, and accessibility of care. However, the need for strong assessment skills to help ensure that patients receive appropriate care in a cost-effective and efficient manner is evident.

Misallocation of Respiratory Care

It has been estimated that about 25% of all Medicare expenditures can be attributed to unnecessary variations in care.[2] Only 55% of adults receive recommended levels of general preventive care, and adults with a chronic illness receive only 56% of the care recommended by clinical practice guidelines.[20] **Misallocation** of care increases costs and may result in less than optimal health outcomes.

Respiratory care is not immune to misallocation. In a study of respiratory care in the acute care setting, we found that 25% of ordered basic respiratory care procedures were not indicated. In addition, as much as 32% of ordered aerosolized medications were not indicated, whereas about 12% of the patients assessed were not receiving respiratory care that was indicated. Others have estimated that the frequency of unnecessary respiratory care ranges from 20% to 60%.[21]

There are many reasons for the misallocation of care. Fear of lawsuits is sometimes suggested; however, it is likely that some care is provided simply because healthcare professionals believe it might help, probably

won't hurt, and, as such, is low-risk. Medical students and physicians-in-training generally learn very little about respiratory care, and much of what doctors learn about how to care for respiratory patients is not evidence based.

Optimizing Patient Outcomes

In order to ensure that patients receive appropriate, cost-effective care, the respiratory clinician must be able to correctly identify and treat the patient's problem. Patient education, follow-up care, and rehabilitation, if needed, should be provided. Patients should be provided information regarding health promotion and disease prevention, in addition to smoking cessation interventions for smokers.

All of this requires excellent patient assessment skills to ensure that patients receive the right care at the right time and that unnecessary care is reduced or eliminated. Careful assessment of the patient's history, physical, and laboratory and imaging studies is required. The assessment is then followed by the development, implementation, and monitoring of an evidence-based respiratory care plan. The development and implementation of respiratory care plans using evidence-based clinical practice guidelines can reduce unnecessary care, optimize care delivered, and may reduce costs and improve outcomes. Chapter 2 describes the development, implementation, and evaluation of the respiratory care plan.

Evidence-Based Practice

Evidence-based practice (EBP) integrates research findings with clinical expertise and patient values to provide a structured approach to clinical decision making. By integrating the best available scientific evidence into the decision-making process, EBP has the potential to improve patient outcomes and reduce costs.[2] EBP can help tell us if a diagnostic test is accurate, how well the test differentiates between patients with and without a specific disease, and whether the test is appropriate to specific situations. EBP can be useful in predicting a patient's prognosis and is the preferred method for selecting treatment.

Sources of Evidence

EBP requires valid, research-based information about the causes, diagnosis, treatment, prognosis, and prevention of specific conditions. Clinical decisions should not be based solely on preferences or practice patterns. Textbooks may be out-of-date, inaccurate, or based on opinion rather than scientific evidence. EBP requires familiarity with the best evidence and knowledge of how to find it. Sources for EBP include published research reports in peer-reviewed journals, evidence-based systematic reviews (e.g., Cochrane systematic reviews), expert panel recommendations, and clinical practice guidelines. In order to become proficient at EBP, one must become familiar with various Internet-based tools, such as PubMed, Medline, Google Scholar, and the Cumulative Index to Nursing and Allied Health Literature (CINAHL). Evidence-Based Medical Reviews (EBMR) and the Cochrane Library provide additional evidence-based services (**Box 1-2**).

Types of Evidence

The best single source of evidence is the multicenter **randomized controlled trial (RCT)** in which a clear clinical benefit is demonstrated that outweighs the potential risks of the therapy or procedure. Multiple independent RCTs are sometimes combined using a statistical method called **meta-analysis**, and the resulting meta-analyses can provide strong evidence of the value of a particular treatment or technique. In the absence of multicenter RCTs or multiple independent RCTs, evidence from a single-center RCT may be used with caution. Other types of evidence, from best to least preferable, include results from nonrandomized, concurrent **cohort studies**, historic cohort studies, **case-control studies**, case series, case reports, editorials, and animal studies. The best-evidence pyramid is shown in **Figure 1-3**.

Grades of Recommendations for Therapy

In order to perform EBP, the practitioner begins with a series of questions related to diagnosis, treatment, prevention, or prognosis, which are outlined in **Box 1-3**. These questions are designed to help clarify the patient problem and the intervention or treatment being considered. Next, the treatment or comparison options (if any) and the outcomes sought are identified. Once the EPB questions have been answered, an EBP literature search is conducted, using search terms related to the problem, treatment (or technique), comparison, and desired outcomes. The literature search is normally conducted using an electronic database such as Medline or PubMed. The publications located are then evaluated, and the best available evidence is used to guide clinical decisions.

As we have noted, the strongest evidence sources are well-designed RCTs (sometimes combined via meta-analysis) in which the benefits are clear and outweigh the risks. Factors in evaluating the evidence include the study design, size of the treatment effect, patient selection and type of sample, and important outcomes. RCTs that have unclear or inconsistent results or flaws in methodology can sometimes still provide evidence of moderate quality. Other types of studies (e.g., cohort and case control designs, case series), as well as expert panel recommendations and systematic reviews, can also help guide clinical decision making. **Table 1-3** provides one method for rating evidence for grades of recommendations for therapy.

BOX 1-2

Online Resources for Evidence-Based Practice

- **PubMed.** PubMed is a comprehensive online database of peer-reviewed biomedical research papers, reviews, and journal articles (http://www.ncbi.nlm.nih.gov/pubmed/).
- **Medline.** Similar to PubMed, Medline is a comprehensive online database of peer-reviewed biomedical research papers, reviews, and journal articles. It is available through college and university library services via OVIDSP.
- **CINAHL (Cumulative Index to Nursing and Allied Health Literature).** CINAHL is a comprehensive online database of nursing and allied health journal publications. It may include articles not listed in other databases. CINAHL is available through college and university library services via EBSCO Publishing (http://www.ebscohost.com/cinahl/).
- **Google Scholar.** Google Scholar provides an effective search engine which includes an "Advanced Scholar Search" option. When used properly, recall and precision of Google Scholar is similar to PubMed. (http://scholar.google.com)
- **Cochrane Database of Systematic Reviews.** The Cochrane Collaboration (http://www.cochrane.org) and the Cochrane Library (http://www.thecochranelibrary.com/view/0/index.html) provide systematic reviews of the literature for use in evidence-based practice.
- **MD Consult.** This comprehensive medical information service for evidence-based practice is available through college and university library subscription services (http://www.mdconsult.com).
- **UpToDate.** This comprehensive medical information service for evidence-based practice is available through college and university library subscription services (http://www.uptodate.com/index).
- **Centers for Disease Control and Prevention (CDC).** The CDC offers a wealth of tools and resources on its website (http://cdc.gov).
- **National Institutes of Health (NIH).** The NIH is a valuable source of information on evidence-based medicine (http://www.nih.gov).

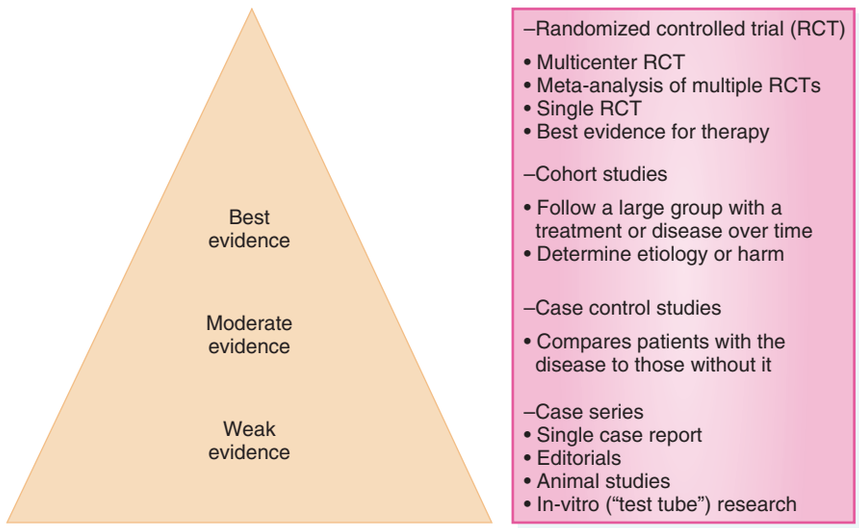

FIGURE 1-3 Evaluating the evidence (critical appraisal) → best evidence pyramid.

BOX 1-3

Use of Questions in Evidence-Based Practice

1. Patient problem or population
   - *What patient or problem is being considered?*
     - What is the patient's chief complaint or primary problem? Respiratory examples may include a patient's symptoms or primary disease state or condition:
       - Symptoms: Cough, sputum production, shortness of breath, wheezing, chest tightness, chest pain, other?
       - Disease states or conditions: Asthma "attack," COPD exacerbation, acute respiratory failure, chest trauma, other?
     - What is the larger patient population under consideration?
       - Asthma, COPD, pneumonia, acute lung injury, respiratory failure, ARDS, congestive heart failure (CHF), other?
2. Intervention
   - *What diagnostic method, treatment, medication, procedure or other intervention is being considered?*
     - The intervention is what you plan to do for the patient. Examples might include:
       - Diagnostic procedures (blood gases, pulmonary function testing, laboratory studies, imaging studies, other)
       - Drugs or medications (antimicrobial agents, bronchodilators, anti-inflammatory agents, cardiac drugs, other)
       - Respiratory care procedures (oxygen therapy, directed cough, lung-expansion therapy, bronchial hygiene techniques, other)
       - Mechanical ventilatory support (invasive or noninvasive)
3. Comparison
   - *What alternative treatments or interventions are being considered?*
     - Examples of comparisons for respiratory care might include:
       - Pulmonary rehabilitation versus home care in COPD
       - Peak flow versus symptom monitoring in moderate to severe asthma
       - Volume-control versus pressure-control modes of mechanical ventilation in ARDS
       - Rapid drug-susceptibility tests versus conventional culture-based methods for detection of multidrug-resistant tuberculosis
     - In some cases, there may not be an alternative treatment or therapy under consideration.
4. Outcome
   - *What outcomes are sought?*
     - Diagnosing a condition
     - Relieving or eliminating specific symptoms
     - Stopping or reversing a pathologic process
     - Improving or maintaining function
     - Prevention
5. Searching the literature
   - *The next step is to define the search terms and perform a literature review:*
     - Search terms should include the problem, intervention, and comparison (if there is to be a comparison).
     - Examples might include:
       - Noninvasive ventilation and COPD
       - Drug treatment and ARDS
       - Medications and acute asthma exacerbation
       - Antibiotics and ventilator-acquired pneumonia
       - Weaning method(s) and mechanical ventilation in ARDS patients

- The examples of preferred sources for the literature search are:
  - Medline
  - PubMed
  - Established clinical practice guidelines and expert panel reviews
  - Google Scholar

6. Evaluating the evidence (critical appraisal)
   - Following the literature search, the respiratory clinician must evaluate the evidence located. The best evidence sources are well-designed, multicenter RCTs or multiple independent RCTs (sometimes combined via meta-analysis) in which the benefits are clear and outweigh the risks. Factors in evaluating the evidence include the study design, size of the treatment effect, patient selection and type of sample, the importance of the outcomes, cost, and patient values and preferences. RCTs that have unclear or inconsistent results or flaws in methodology can sometimes still provide evidence of moderate quality. Other types of studies (cohort and case-control designs, case series), as well as expert-panel recommendations, can also help guide clinical decision making.
7. Applying the evidence to patient care
   - The clinician must make decisions regarding diagnosis, treatment, prevention, and/or prognosis based on the evidence. Clinical decision should balance potential benefit and harm, cost, as well as patient preferences and values.

Table 1-3
Rating the Evidence for Recommendations of Therapy

A number of rating systems have been developed to assess the strength of the evidence for evidence-based practice. The following system evaluates the strength of the recommendation and the quality of the evidence:

Strength of the Recommendation		
Level	*Strength*	*Description*
1	Stronger	Benefits clearly outweigh the risks and burdens (or vice versa) for nearly all patients.
2	Weaker	Risks and benefits are more closely balanced or are more uncertain.
Quality of the Evidence		
Grade	*Quality*	*Description*
A	High	Well-performed randomized controlled trials or overwhelming evidence of some other sort. Further research is very unlikely to change our confidence in the estimate of the effect.
B	Moderate	Randomized controlled trials that are less consistent, have flaws, or are indirect in some way to the issue being graded, or very strong evidence of some other sort. Further research is likely to have an important impact on our confidence in the estimate of effect and may change the estimate.
C	Low	Low observational evidence (from observational studies, case series, or clinical experience), or evidence from controlled trials with serious flaws. Further research is very likely to have an important impact on our confidence in the estimate of effect and is likely to change the estimate.
D	Very Low	Any estimate of effect is uncertain.

From: Restrepo, RD. AARC Clinical Practice Guideline: From "reference-based" to "evidence-based." *Respir Care.* 2010;55(6):787–789.

Following review of the evidence, the clinician must make decisions regarding diagnosis, treatment, prevention, and/or prognosis. Clinical decisions should balance potential benefit and harm and costs, as well as patient preferences and values.

Critical Diagnostic Thinking in Respiratory Care

Critical-thinking skills needed by respiratory clinicians include the ability to interpret, analyze, and evaluate data; make clinical inferences; and provide explanations.[22] Respiratory clinicians need to be able to prioritize, anticipate, troubleshoot, communicate, negotiate, make decisions, and reflect on experiences.[22] **Critical thinking** is used in establishing the patient's diagnosis and requires the integration of many different pieces of assessment information derived from the medical record, patient history, physical examination, laboratory tests, and imaging studies and from familiarity with the presentation of various disease states and conditions.

Approach to Hypothesis Formulation and Evaluation

Critical thinking to establish the patient's diagnosis should include the key elements of the scientific method.[23] These key elements or steps are:

1. Identify the problem.
2. Gather additional information to clarify the problem.
3. Formulate possible explanations (hypothesis formulation).
4. Test possible explanations (hypothesis testing).
5. Formulate and implement solutions.
6. Monitor and reevaluate.

Identify the Problem

The first step in making a diagnosis is to identify the patient's problem or chief complaint. The classic question, "Why are you here?" is often a good way to identify the problem from the patient's perspective. For respiratory patients, common complaints include acute or chronic cough, sputum production, shortness of breath (acute or chronic), wheezing, whistling, chest tightness, chest pain or discomfort, and hemoptysis (expectorating blood tinged or bloody sputum). Hoarseness, fever, and night sweats are also not uncommon. The time course of symptoms—acute (hours to days), subacute (days to a couple of weeks), or chronic (several weeks to months)—is often helpful in establishing a diagnosis. **Clinical Focus 1-1** lists common problems seen in respiratory care patients.

Gather Additional Information to Clarify the Problem

Following a review of the existing medical record, the respiratory clinician should complete a detailed patient history and perform a thorough physical examination to further identify and clarify the patient's problem(s). The existing medical record review should include patient demographics, previous physician's orders, results of previous history and physical examinations, laboratory and/or imaging reports, and progress notes and reports of procedures. The review of existing medical records is described in Chapter 3.

The patient interview should include the history of the present illness, past medical history, family history, current medications, smoking history, environmental data, and occupational history. The patient should be questioned in more detail regarding specific symptoms associated with pulmonary disease to include cough, sputum production, hemoptysis, dyspnea, and chest pain. The taking of a detailed patient history is discussed in Chapter 4.

The physical examination should include assessment of the patient's general appearance; mental state (anxiety, restlessness, distress) and level of consciousness (alert and awake, sleepy, somnolent); vital signs (pulse, respirations, blood pressure, temperature); skin color, mucosa characteristics, and nail beds (cyanosis); perfusion and capillary refill; and presence of pursed-lip breathing. The chest examination should include inspection, palpation, auscultation, and percussion. Inspection of the chest should include respiratory rate, depth, and pattern; retractions, accessory muscle use, or paradoxical motion of the chest and abdomen; AP (anteroposterior) diameter; and presence of deformity. Palpation should assess for tracheal deviation, chest expansion, vocal fremitus, chest wall tenderness, and subcutaneous emphysema. Percussion should note resonance, hyperresonance, or dullness. Auscultation should include assessment for normal and adventitious (abnormal) breath sounds, including crackles, gurgles, wheezes, rubs, stridor, and bronchial breath sounds over the periphery.

Knowledge of the patient's problem or chief complaint can help guide the physical examination in order to provide evidence to support, reject, or revise specific hypotheses as to the cause of the problem. The physical examination may also identify additional problems such as changes in vital signs, increased work of breathing, abnormal breath sounds, or alterations in mental status. The physical examination is described in Chapter 5.

CLINICAL FOCUS 1-1

Common Respiratory Care–Related History and Physical Findings

Symptoms

Acute or chronic cough
Acute or chronic sputum production
Anxiety, nervousness, excitement, or restlessness
Blurred vision
Chest pain (substernal, pleuritic, musculoskeletal) or discomfort
Dizziness, fainting
Fever, chills
Headache
Hemoptysis (expectorating blood tinged or bloody sputum)
Hoarseness, sore throat
Night sweats
Palpitations
Sinus pain, runny nose, sneezing, postnasal drip
Shortness of breath (acute or chronic dyspnea, orthopnea)
Sleep disturbances
Tremors
Tingling (extremities)
Weight loss, loss of appetite

Signs

Abnormal mental state (confusion, disorientation, hallucinations, loss of consciousness, lethargy, somnolence, coma)
Blood pressure (hypertension, hypotension)
Abnormal breaths sounds (diminished, crackles, gurgles, wheeze, rubs, bronchial breath sounds, stridor, egophony)
Heart rate abnormalities (tachycardia, bradycardia)
Skin (pale, cold, clammy, sweating, cyanosis, rash, redness)
Seizures, convulsions
Ventilatory disorders (tachypnea; hyperventilation; slowed, irregular respirations)

Formulate Possible Explanations (Hypothesis Formulation)

Following identification and clarification of the patient's problem, the next step is formulating possible explanations or hypotheses as to the cause of the problem. Each symptom and sign identified during the history and physical examination is listed, along with more common and less common possible explanations or causes for this sign or symptom. Based on the review of the existing medical records and history and physical examination, a leading, or differential, diagnosis is proposed. **Table 1-4** describes the more common and less common causes of typical respiratory care assessment findings.[23] The possible causes or explanations for each sign or symptom identified by the patient assessment provide the hypotheses that then need to be tested.

Test Possible Explanations (Hypothesis Testing)

Following a review of the patient's problems and the more common and less common causes for each, a primary or leading hypothesis as to the cause of the problem is developed. This hypothesis, also known as the leading or differential diagnosis, is then tested via additional laboratory and imaging studies. These studies may include oximetry, arterial blood gas analysis, **pulmonary function testing (PFT)**, sputum analysis, blood tests to include hematology and blood chemistry, other microbiologic studies, skin tests, and various stains, swabs, and molecular medicine techniques. An electrocardiogram (ECG) may be performed to assess cardiac function, and ECG monitoring is often done in the ICU setting. Imaging studies may include a chest radiograph, CT scan, MRI, and/or ultrasound imaging. Diagnostic bronchoscopy and other diagnostic procedures (e.g., thoracentesis, open lung biopsy) may be also be required. Sleep studies may be needed to evaluate sleep-disordered breathing, and exercise stress testing may be used to evaluate pulmonary and cardiac disease.

Chapters 6 and 7 will discuss assessment of oxygenation and ventilation. Chapter 8 will describe arterial blood gas analysis and acid–base balance. Chapter 9 will describe laboratory studies, including hematology, clinical chemistry, microbiology, sputum examination, urine analysis, skin testing, histology and cytology, and molecular diagnostics. Chapter 10 will discuss the ECG. Chapter 11 will review imaging studies. Chapter 12 will review pulmonary function testing. Chapter 13

Table 1-4
Common and Less-Common Causes of Respiratory Care Assessment Findings

Problem	Common Causes	Less-Common Causes
Acute cough	Viral upper respiratory infection (pharyngitis, rhinitis, tracheobronchitis, serous otitis) Bacterial infection (tracheobronchitis, acute bronchitis, mycoplasma, pneumonia, ear infection, sinusitis, abscess) Asthma Sinusitis Gastroesophageal reflux Congestive heart failure, pulmonary edema Inhalation of irritants (smog, smoke fumes, dusts, cold air) Bronchiolitis (RSV)	Tumor, neoplasm Pulmonary emboli Aspiration (foreign body, liquid) Laryngitis ACE inhibitor medication Pleural disease Diaphragm irritation Mediastinal disease Extrabronchial lesions Fungal lung disease Ornithosis
Chronic cough	Postnasal drip (sinusitis, allergic rhinitis) Smoking Asthma Chronic bronchitis Gastroesophageal reflux Congestive heart failure ACE inhibitor medication (20%) HIV Bronchiectasis Neoplasms, bronchogenic carcinoma Lung abscess Recurrent aspiration Aspiration (foreign body, liquid) Mycoplasma pneumonia Pulmonary tuberculosis Pulmonary fibrosis Cystic fibrosis	Chronic pulmonary edema Mitral stenosis Laryngeal inflammation or tumor Fungal pneumonia External or middle ear disease Bronchogenic cyst Mediastinal mass Zenker's diverticulum Aortic aneurysm Vagal irritation Pacemaker wires Pleural disease Pericardial, mediastinal, or diaphragm irritation Psychogenic cough
Acute dyspnea	Acute asthma (intermittent dyspnea) COPD exacerbation (chronic bronchitis, emphysema) Tracheobronchitis Pneumonia or other parenchymal inflammation Left-side CHF Pulmonary edema (acute) Acute pulmonary emboli Myocardial ischemia (coronary artery disease, acute or chronic) Pneumothorax Hyperventilation (anxiety, metabolic acidosis) Hypoxemia Large pleural effusion Upper airway obstruction (stridor, croup, epiglottis, laryngitis, laryngeal edema, foreign body aspiration) Noncardiogenic pulmonary edema Aspiration (gastric liquid, foreign body) Atelectasis Chest trauma (pulmonary contusions, rib fractures, flail chest) Acutely increased work of breathing (decreased compliance and/or increased resistance) Shock Neuromuscular disease	Pulmonary hypertension Fever Anemia Pericardial tamponade Lung cancer Diaphragmatic paralysis Inhalation of noxious fumes or gases Space-occupying lesions of the thorax Anaphylaxis Botulism Increased intracranial pressure
Chronic dyspnea (intermittent or persistent)	COPD (chronic bronchitis, emphysema, cystic fibrosis) CHF Asthma Interstitial fibrosis Hypoxemia Pulmonary hypertension Neuromuscular disease	Pulmonary alveolar proteinosis Alveolar microlithiasis Lipoid pneumonia Lung resection Recurrent pulmonary emboli Lung cancer Persistent large pleural effusion

(*continues*)

Table 1-4
Common and Less-Common Causes of Respiratory Care Assessment Findings (*continued*)

Problem	Common Causes	Less-Common Causes
	Poor physical conditioning with obesity Anemia Ascites Metabolic acidosis Aortic or mitral valve stenosis Arterial hypertension Chronically increased work of breathing (decreased compliance and/or increased resistance) Neuromuscular disease Bronchiectasis	Kyphoscoliosis Tracheal stenosis Mitral stenosis Abdominal mass Pregnancy Congenital heart disease Abnormal hemoglobin Thyroid disease Idiopathic pulmonary hemosiderosis Aortic or mitral valve stenosis or regurgitation
Acute sputum production	Viral infection (tracheobronchitis, bronchiolitis, pneumonia) Bacterial infection (tracheobronchitis, pneumonia) Mycoplasma pneumonia Lung abscess Asthma Inhalation of irritants (smoke, smog, dusts, fumes)	Tuberculosis Lung abscess Neoplasms, lung tumor Foreign body aspiration
Chronic sputum production	COPD (chronic bronchitis, cystic fibrosis) Cigarette smoking Asthma Chronic sinusitis with drainage	Bronchiectasis Tuberculosis Lung abscess Bronchopleural fistula with empyema Recurrent aspiration
Hemoptysis	Bronchitis (acute and chronic) Bronchiectasis Lung abscess Tuberculosis Pneumonia (includes necrotizing pneumonias) Neoplasms, bronchogenic carcinoma Pulmonary embolism, pulmonary infarction Cystic fibrosis Congestive heart failure	Trauma Fungal lung disease (includes allergic bronchopulmonary aspergillosis) Empyema Aspiration (foreign body) Inhalation of toxic gases Arteriovenous fistula Broncholithiasis Goodpasture syndrome Idiopathic pulmonary hemosiderosis Mycetoma Parasitic infection Wegener's granulomatosis Bronchogenic cyst Pulmonary endometriosis (catamenial hemoptysis) Anticoagulation
Pleuritic or chest wall pain	Pleuritis (viral/collagen vascular disease) Pneumonia Pulmonary embolism Empyema Tuberculosis Trauma Rib fracture Pneumothorax Hemothorax	Pulmonary infarction Irritation of intercostal nerves (herpes zoster, spinal nerve root disease) Costochondritis Irritation of the diaphragm
Visceral chest pain	Tumor, neoplasm of major bronchi, mediastinum Abnormalities of the heart, aorta, pericardium Esophageal pain (reflux, tumor) Acute bronchitis	Peptic ulcer Cocaine use Cholecystitis
Substernal pain	Myocardial ischemia, angina pectoris Myocardial infarction Esophagitis, esophageal pain Arrthymias Myocarditis Pericarditis	Dissecting aortic aneurysm Congenital cardiovascular anomalies Aortic stenosis Mitral regurgitation Mitral valve prolapse Psychogenic chest pain

This article was published in Stoller JK, Bakow ED, Longworth DL, eds. *Critical Diagnostic Thinking in Respiratory Care: A Case-Based Approach*. Philadelphia: W.B. Saunders; 2002: 3–38; Shelledy D, Stoller JK. An introduction to critical diagnostic thinking.

will review diagnostic bronchoscopy, thoracentesis, and open lung biopsy. Chapter 14 will describe acute and critical care monitoring and assessment. Chapter 15 will review sleep studies.

It is important to consider all available information from the patient history, physical examination, and laboratory and imaging studies before coming to a final conclusion about the patient's problem or diagnosis. Review of the available medical records can be enormously helpful, and additional laboratory and imaging studies should be limited to those needed to refine the diagnosis and optimize the patient's care. Confirmation or rejection of the primary hypothesis is then dependent on the results of additional diagnostic tests and laboratory studies.

Formulate and Implement Solutions

Based on the findings from the patient history, physical, laboratory and imaging studies, and medical records, the patient's diagnosis is confirmed and the respiratory care plan is designed and implemented. The respiratory care plan may include oxygen and/or humidity therapy, aerosol medication administration, lung expansion therapy, chest physiotherapy, and other techniques for secretion management, airway care, and/or mechanical ventilatory support. Medical treatment may include administration of anti-infective agents, anti-inflammatory agents, diuretics, cardiovascular medications, and other pharmacologic agents. Procedures may include physical therapy and rehabilitation techniques such as diet and exercise and, in some cases, surgical interventions. The development and implementation of the respiratory care plan is discussed in Chapter 2.

Monitor and Reevaluate

Following the establishment of the patient's diagnosis and development and implementation of the respiratory care plan, the patient is monitored and reevaluated. The respiratory clinician assesses the patient for improvement (or deterioration) in his or her condition and the possible development of new problems that may require further evaluation and treatment. Significant changes in vital signs are especially important and should always lead to reevaluation.

Response to therapy is an important aspect of patient assessment. For example, reversible bronchospasm, as demonstrated by a reduction in wheezing and improvement in PFT expiratory flow rates (PEFR, FEV_1) following bronchodilator therapy, provides additional evidence for a diagnosis of reversible airways disease (asthma and some patients with COPD). Improvement in oxygenation in hypoxemic patients following administration of low to moderate concentrations of oxygen therapy (24% to 40%) is associated with pulmonary disorders with low lung ventilation to perfusion ratios (low $\dot{V}/\dot{Q}$). Examples of conditions in which hypoxemia may be caused by low $\dot{V}/\dot{Q}$ include asthma, chronic bronchitis, emphysema, bronchiectasis, cystic fibrosis, and CHF. Conditions that may require high concentrations of oxygen in order to reverse hypoxemia are associated with intrapulmonary shunting and include atelectasis, severe pneumonia, **acute lung injury (ALI)**, and **acute respiratory distress syndrome (ARDS)**. Thus, response to oxygen therapy can help support (or refute) a specific patient diagnosis.

Common mistakes in clinical problem solving include failure to consider possible causes that should be considered, consideration of only exotic or uncommon diseases, failure to consider that two or more problems may coexist, and inadequate information gathering and processing. Sometimes a diagnosis has been assigned to a patient without adequately considering alternative explanations. For example, a known COPD patient may suffer from a myocardial infarction (MI) and come to the emergency department. By mislabeling the patient as suffering from acute exacerbation of COPD, a potentially catastrophic outcome could result. Any diagnosis should be considered as provisional until confirmed by all of the evidence, including appropriate response to therapy. **Clinical Focus 1-2** provides an example of clinical problem solving.

Typical Presentations of Common Respiratory Disorders

Common respiratory disorders include **restrictive lung disease**, **obstructive lung disease**, and problems of oxygenation and ventilation. Obstructive disorders are associated with a decrease in PFT expiratory flow rates (FEV_1, $FEV_{25-75\%}$, PEF) and include asthma, chronic bronchitis, emphysema, combined/COPD, bronchiectasis, and cystic fibrosis. Because patients have trouble getting air out of the lungs, the FEV_1/FVC ratio is reduced. Restrictive disorders are associated with a decreased ability to take a deep breath in, as indicated by a reduced inspiratory capacity (IC), vital capacity (VC), and total lung capacity (TLC) as assessed by PFT. Acute restrictive problems include pneumonia, atelectasis, ALI, ARDS, pleural effusion, pneumothorax, and pulmonary edema associated with CHF. Chronic restrictive disorders include pulmonary fibrosis, lung cancer, thoracic deformity, neuromuscular weakness, and obesity. Both restrictive and obstructive disorders can lead to problems with oxygenation and ventilation. Other common respiratory care–related problems often seen in the acute care setting that may affect oxygenation and or ventilation are listed in **Clinical Focus 1-3**. Typical presentations of common respiratory disease states and conditions are described in **Table 1-5**.

CLINICAL FOCUS 1-2

Clinical Problem Solving

Identify the Problem

Mr. Smith, a 56-year-old male patient, presents to the emergency department (ED) with complaints of increasing shortness of breath *(dyspnea)*, difficulty breathing in the supine (flat) position *(orthopnea)*, and a history of *chronic cough* with *increasing sputum production*.

Gather Additional Information to Clarify the Problem

Upon *interview,* Mr. Smith indicates he has had a recent change in the color, consistency, and volume of sputum production and worsening ability to perform **activities of daily living (ADL)** due to increasing shortness of breath. Mr. Smith has an extensive smoking history (two packs a day for 20 years, or 40 pack-years) as well as chronic cough with over a tablespoon per day of generally clear sputum produced. The cough with sputum production has been present most days for over 2 consecutive years. Sputum production has increased over the last several days and is now purulent (containing pus). Current medications include use of an albuterol (a bronchodilator) inhaler at home.

On *physical examination*, Mr. Smith has an increased AP diameter of the chest, accessory muscle use on inspiration, and diminished breath sounds with a prolonged expiratory phase, along with crackles and bronchial breath sounds. Vital signs include an increased heart rate (pulse = 115, tachycardia), increased respiratory rate (f = 26, tachypnea), and elevated temperature. Pulse oximetry indicates a reduced arterial oxygen saturation (Spo_2 = 82%) while breathing room air. Together, the symptoms and signs identified on history and physical exam make up the patient's problem list.

Formulate Possible Explanations (Hypothesis Formulation)

Mr. Smith's findings so far can be summarized as follows:

- History findings are associated with a chronic respiratory problem:
  - Chronic cough with sputum production
  - Decreased ability to perform ADLs
  - Smoking history of 40 pack years
  - Home use of inhaled medications (albuterol inhaler)
- Physical examination findings are associated with acute distress:
  - Tachypnea, accessory muscle, and tachycardia.
  - Increasing dyspnea, orthopnea.
  - Diminished breath sounds indicate decreased air movement and a prolonged expiratory phase is associated with air trapping.
  - Crackles upon auscultation are associated with alveolar fluid or, in some cases, fibrosis.
  - Bronchial breath sounds heard over the periphery of the chest are associated with consolidation.
  - Increased chest diameter is associated with overinflation of the lungs.
  - Reduced Spo_2 on room air indicates hypoxemia.

Common causes for these findings include *chronic bronchitis, bronchiectasis,* and *acute exacerbation of COPD*. Acute exacerbation of COPD can be precipitated by increased air pollution, upper respiratory tract infection, flu virus, bacterial infection, or pneumonia.

Test Possible Explanations (Hypothesis Testing)

Mr. Smith presents with increasing dyspnea, tachypnea, tachycardia, reduced Spo_2, accessory muscle use, and chronic cough with recently increased purulent sputum production. These findings, along with a significant smoking history, increased AP chest diameter, abnormal breath sounds, and prolonged expiratory phase suggest that Mr. Smith is likely suffering from an *acute exacerbation of COPD*; however, other acute and chronic pulmonary problems will need to be ruled out.

Common causes of acute exacerbation of COPD include viruses, bacteria, and possibly air pollution. Rhinovirus (common cold virus), respiratory syncytial virus (RSV), influenza, parainfluenza, adenovirus, and bacterial infection have all been associated with COPD exacerbation. Consequently, an upper respiratory tract infection, the common cold or flu, and possible development of pneumonia will need to be considered. Laboratory and imaging studies that should be considered include *arterial blood gas analysis*, *complete blood count (CBC)*, *blood chemistry*,

and *chest radiograph* to test our hypothesis that the patient is suffering from an acute exacerbation of COPD. *Pulmonary function testing* should also be performed when the patient has recovered in order to document the presence and severity of COPD.

Formulate and Implement Solutions

Mr. Smith's history, physical examination, and vital signs are consistent with acute exacerbation of COPD. Arterial blood gases show chronic ventilatory failure with moderate to severe hypoxemia (pH = 7.35; Pa_{O_2} = 47 torr; Pa_{CO_2} = 55 torr; Sa_{O_2} = 82%). CBC indicates slightly elevated hemoglobin and an increased white blood cell count. Blood chemistry indicates electrolytes in the normal range, except for potassium, which is slightly reduced. The chest radiograph indicates hyperinflation and what appear to be new infiltrates. *These findings are consistent with acute exacerbation of COPD associated with a superimposed pneumonia.*

Treatment of acute exacerbation of COPD should include *oxygen therapy* and *aerosolized bronchodilators* (β_2-agonists and/or anticholinergic agents). A short course of *steroids* may be considered and *antibiotics* to treat pneumonia as well as the exacerbation of COPD. *Noninvasive positive pressure ventilation* (NIPPV) should be considered in the presence of elevated Pa_{CO_2} with acidosis and continuing ventilatory distress. If NIPPV fails, invasive mechanical ventilation may be required in the presence of worsening hypoventilation with acidosis. Potassium replacement may be needed in the presence of low potassium, and diuretics may be given to treat peripheral edema and fluid overload.

Monitor and Reevaluate

The respiratory care plan for Mr. Smith includes oxygen therapy at 2 L/min via nasal cannula to maintain his Sp_{O_2} in the range of 88% to 90% and avoid further (oxygen-induced) hypercapnea (due to his preexisting chronic CO_2 retention). Bronchodilator therapy, steroids, and antibiotics are ordered. Mr. Smith should now be monitored for adequate oxygenation, ventilation, and acid-base balance. Once the acute COPD exacerbation/pneumonia has been reversed, a smoking cessation program should begin and pulmonary function testing completed. Inhaled bronchodilators, in combination with inhaled steroids, may be useful to reduce future hospitalizations. Triple therapy, which may combine tiotropium (an anticholengeric bronchodilator), salmeterol (a long-acting β_2 bronchodilator [LABA]), and an inhaled steroid may be useful to reduce future hospitalizations. A formal pulmonary rehabilitation program should also be considered.

CLINICAL FOCUS 1-3

Common Disease States and Conditions Seen in Respiratory Care

Acute Restrictive Disease

Acute bronchitis
Acute lung injury (ALI)*
Acute respiratory failure
Acute respiratory distress syndrome (ARDS)
Atelectasis
Lung cancer
Pleural effusion/pleural disease
Pneumonia
Pneumothorax
Pulmonary edema

*Recently, the Berlin Definition of ARDS has incorporated variables and related criteria for mild ARDS that were previously described as ALI.

Chronic Restrictive Disease

Interstitial lung disease (pulmonary fibrosis/other)
Lung cancer
Thoracic deformity
Sarcoidosis (restrictive/obstructive)
Obesity
Pneumoconiosis

Obstructive Disease

Asthma
Bronchiectasis
Chronic bronchitis
COPD
Cystic fibrosis
Emphysema
Sarcoidosis (restrictive/obstructive)
Upper airway obstruction

Cardiac and Circulatory Problems

Abdominal aortic aneurysm
Abnormal cardiac stress test
Cardiac arrhythmias
Chronic hypertension
Acute myocardial ischemia
Aortic valve disease
Heart murmur
Congestive heart failure (CHF)
Coronary artery disease (CAD)
Hyperlipidemia
Mitral valve prolapse
Myocardial infarction (MI)
Chronic, stable angina
Congenital heart disease
Peripheral artery disease (claudication)
Peripheral edema
Pulmonary vascular disease (pulmonary embolus, pulmonary hypertension)
Syncope

Other Problems Affecting the Cardiopulmonary System

Alcohol and drug abuse
Anemia
Burns and smoke inhalation
Chest trauma
Diabetes
Drug overdose
Fluid and electrolyte disturbances
Fungal lung disease
Hypersensitivity pneumonitis
Malnutrition
Neurologic problems affecting ventilatory drive
Neuromuscular disease affecting respiration
Obesity
Postoperative care
Preoperative care
Renal failure
Sepsis
Shock (cardiogenic, hypovolemic, septic, anaphylactic)
Sleep-disordered breathing
Tobacco addiction/dependence
Trauma
Upper respiratory tract infection

Table 1-5
Typical Presentation of Common Respiratory Disease States and Conditions

Disease State or Condition	History	Physical Examination	Laboratory Tests
Viral upper respiratory infection	Nasal congestion, runny nose, scratchy sore throat, laryngitis, cough, sputum production	Mucopurulent nasal discharge; fever; pharynx pale, boggy, swollen Breath sounds may show gurgles or coarse rhonchi	Chest radiograph may be clear, throat culture to rule out streptococcal infection
Sinusitis	Postnasal drip, cough, sneezing, nasal congestion, facial pain, pressure or fullness	Headache pain worsened by touch	Sinus CT scan
Mycoplasma bronchitis or pneumonia	Dry hacking cough progressing to cough with purulent sputum	Fever, crackles, signs of pneumonia	Chest radiograph shows signs of pneumonia, Gram stain negative except for neutrophils, bedside cold agglutinins positive, ESR elevated

Table 1-5
Typical Presentation of Common Respiratory Disease States and Conditions (*continued*)

Disease State or Condition	History	Physical Examination	Laboratory Tests
Pneumonia	Cough, purulent or rusty sputum, fever, chills, dyspnea, pleuritic chest pain **(in elderly patients: sometimes only confusion, fatigue, with minimal or no pulmonary complaints)**	Sudden onset, spiking fever with rigors, mental status changes associated with hypoxemia, tachycardia, tachypnea, cyanosis, crackles, bronchial breath sounds, egophony, vocal fremitus, diminished breath sounds, dull percussion note	New or progressive infiltrate on chest radiograph, sputum analysis (color, amount, consistency, odor, Gram stain, direct fluorescent antibody stain, fungal stains, acid-fast stains, culture and sensitivity), WBC with differential
Atelectasis	History of recent abdominal or thoracic surgery, immobilization, chest wall pain, muscular weakness, thoracic or abdominal limitation to diaphragmatic excursion (ascites, obesity, peritonitis, thoracic deformity, etc.), weakness, neuromuscular disease, pneumonia or other acute restrictive disease, other chronic restrictive pulmonary disease, sedatives or narcotics	Decreased chest wall movement over affected side, absent or diminished breath sounds, dull percussion node, crackles	Findings associated with atelectasis on chest radiograph, decreased inspiratory capacity, vital capacity
COPD exacerbation (chronic bronchitis, emphysema)	Chronic cough with sputum production (chronic bronchitis), increased dyspnea, orthopnea, decreased mobility	Diffuse wheezing, cyanosis (chronic bronchitis), dependent edema, clinical manifestations of hypoxemia, increased AP diameter, accessory muscle use, pursed lip breathing, diminished breath sounds, prolonged expiration, wheezing, crackles, rhonchi	Decreased FEV_1/FVC; hyperinflation on chest radiograph, possible new infiltrates
Pleural effusion	Dyspnea, pleuritic chest pain, cough	Chest wall movement reduced over affected side, dull percussion note, absent or diminished breath sounds over effusion, egophony and/or bronchial breath sounds above effusion, pleural rub may be present	Chest x-ray consistent with pleural effusion, thoracentesis, pleural fluid analysis (appearance, WBC and differential, Gram stain, culture, glucose, amylase)
Pneumothorax	Chest pain, dyspnea	Tachycardia, tachypnea, respiratory distress, tracheal deviation to opposite side with tension, decreased chest wall movement on affected side, resonant or hyperresonant percussion note, absent or decreased breath sounds	Chest x-ray consistent with pneumothorax, arterial blood gases, oximetry may show hypoxemia with or without hypercapnea

ESR, erythrocyte sedimentation rate; WBC, white blood cell count.
This article was published in Stoller JK, Bakow ED, Longworth DL, eds. *Critical Diagnostic Thinking in Respiratory Care: A Case-Based Approach*. Philadelphia: W.B. Saunders; 2002: 3–38; Shelledy D, Stoller JK. An introduction to critical diagnostic thinking.

Key Points

- Respiratory care patient assessment includes the history, physical examination, and diagnostic testing (laboratory tests and imaging studies).
- Patient assessment is needed to ensure that patients' problems are properly identified, prioritized, evaluated, and treated.
- Health may be defined as a person's overall mental, physical, and social well-being.
- The primary factors that determine health are individual genetic makeup; access to medical care; environmental factors (housing, work, school); and personal health-related behaviors, such as smoking, physical exercise, nutrition, and the use of drugs and alcohol.
- The top five leading causes of death in the United States are heart disease, cancer, COPD, stroke, and accidents.
- The major drivers of the modern healthcare system are quality, access, and cost.
- Patients with chronic disease, such as asthma, COPD, heart disease, and diabetes, account for about 75% of overall healthcare spending.
- In spite of spending more on healthcare, the United States ranks below many other nations in measures of overall health.
- Careful patient assessment may reduce misallocation of care, decrease costs, and save valuable resources.
- A major goal of patient assessment is to ensure that patients receive the right care at the right time and that unnecessary care is reduced or eliminated.
- Evidence-based practice uses research findings to aid in clinical decision making.
- The best sources of evidence for clinical decision making include the results of well-designed randomized controlled trails (RCTs), systematic reviews, expert panel recommendations, and national/international clinical practice guidelines and standards.
- Critical thinking to establish a patient's diagnosis includes identifying the problem, gathering additional information, formulating hypotheses, hypothesis testing, formulating and implementing solutions, and monitoring and reevaluating the patient.
- Common respiratory problems include cough, dyspnea, sputum production, hemoptysis, and chest pain.
- Common respiratory disease states or conditions requiring patient assessment include upper respiratory tract infection, pneumonia, atelectasis, asthma, emphysema, COPD, acute or chronic bronchitis, acute respiratory failure, ALI, ARDS, pulmonary edema, chest trauma, interstitial lung disease, and lung cancer.

References

1. World Health Organization. Frequently asked questions: what is the WHO definition of health? http://ww.who.int/suggestions/faq/en/index.html. Accessed January 10, 2012.
2. Yong PL, Saunders RS, Olsen L. *The Healthcare Imperative: Lowering Costs and Improving Outcomes—Workshop Series Summary*. Washington, DC: National Academies Press; 2010.
3. Centers for Disease Control and Prevention. Clusters of acute respiratory illness associated with human enterovirus 68—Asia, Europe, and United States, 2008–2010. *MMWR.* 2011;60(38):1301–1336.
4. Kochanek KD, Xu J, Murphy SL, Miniño AM, Kung HC. Deaths: preliminary data for 2009. *Natl Vital Stat Rep.* 2011;59(4).
5. Kocher R, Sahni NR. Rethinking health care labor. *N Engl J Med.* 2011;365(15):1370–1372.
6. Stanton MW, Rutherford MK. The high concentration of U.S. health care expenditures. *Research in Action Series,* Issue 19. Rockville, MD: Agency for Healthcare Research and Quality; 2006: 1–11.
7. Keehan SP, Lazenby HC, Zezza MA, Catlin AC. Age estimates in the national health accounts. *Health Care Financ Rev* (Web Exclusive). 2004;1(1):1–16.
8. Wolff JL, Starfield B, Anderson G. Prevalence, expenditures, and complications of multiple chronic conditions in the elderly. *Arch Intern Med*. 2002;162:2269–2276.
9. Centers for Disease Control and Prevention, National Asthma Control Program. Asthma fast facts. http://www.cdc.gov/asthma/pdfs/asthma_fast_facts_statistics.pdf. Accessed January 3, 2012.
10. American Lung Association. Chronic obstructive pulmonary disease (COPD) fact sheet 2011. http://www.lungusa.org/lung-disease/copd/resources/facts-figures/COPD-Fact-Sheet.html. Accessed January 3, 2010.
11. Stranges E, Kowlessar N, Elixhauser A. Components of growth in inpatient hospital costs, 1997–2009. *HCUP Statistical Brief*. No. 123. Rockville, MD: Agency for Healthcare Research and Quality; 2011. http://www.hcup-us.ahrq.gov/reports/statbriefs/sb123.pdf. Accessed January 3, 2012.
12. Chen LM, Jha AK, Guterman S, Ridgway AB, Orav EJ, Epstein AM. Hospital cost of care, quality of care, and readmission rates: penny-wise and pound-foolish? *Arch Int Med.* 2010;170(4):340–346.
13. Costs of coronary artery bypass graft surgery in U.S. more than Canada. *Medical News Today*. July 19, 2005. http://www.medicalnewstoday.com/printerfriendlynews.php?newsid=27589. Accessed January 3, 2011.
14. Thorpe KE, Florence CS, Joski P. Which medical conditions account for the rise in health care spending? *Health Affairs* (Web Exclusive) 2004: W4-437-45. http://content.healthaffairs.org/content/early/2004/08/25/hlthaff.w4.437.short. Accessed April 24, 2014.
15. Dasta JF, McLaughlin TP, Mody SH, Piech CT. Daily cost of an intensive care unit day: the contribution of mechanical ventilation. *Crit Care Med.* 2005;33(6):1266–1271.

16. American Cancer Society. Cancer facts and figures for African Americans 2011–2012. http://www.cancer.org/acs/groups/content/@epidemiologysurveilance/ documents/document/acspc-027765.pdf. Accessed January 3, 2012.
17. Center on Social Disparities in Health, University of California–San Francisco. http://www.familymedicine.medschool.ucsf.edu/csdh. Accessed December 29, 2011.
18. Quality improvement interventions to address health disparities: evidence-based practice center systematic review protocol. *Closing the Quality Gap: Revisiting the State of the Science Series.* Rockville, MD: Agency for Healthcare Research and Quality; 2011. http://www.ahrq.gov/clinic/tp/gapdisptp.htm. Accessed December 28, 2011.
19. Fisher ES, Wennberg DE, Stukel TA, Gottlieb DJ, Lucas FL, Pinder EL. The implications of regional variations in Medicare spending. Part 1: The content, quality, and accessibility of care. *Ann Int Med.* 2003;138(4):273–287.
20. Elhauge E. Why we should care about health care fragmentation and how to fix it. In: E. Elhauge, ed. *The Fragmentation of U.S. Health Care Causes and Solutions*. New York: Oxford University Press; 2010: 1–16.
21. Shelledy DC, LeGrand TS, Peters JI. An assessment of the appropriateness of respiratory care delivered at a 450-bed acute care Veterans affairs hospital. *Respir Care.* 2004;49(8):907–916.
22. Mishoe SC. Critical thinking in respiratory care. In: Mishoe SC, Welch MA, eds. *Critical Thinking in Respiratory Care: A Problem-Based Approach*. New York: McGraw-Hill; 2002: 33–64.
23. Shelledy DC, Stoller, JK. *An Introduction to Critical Diagnostic Thinking.* In: Stoller, JK, Bakow, ED, Longworth, DL, eds. *Critical Diagnostic Thinking in Respiratory Care: A Case-Based Approach*. Philadelphia: W.B. Saunders; 2002: 3–38.