FLEXIBLE BRONCHOSCOPY EDUCATION PROJECT

Training manual for students

Subject: Introduction to Flexible Bronchoscopy Competency Program

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Bronchoscopy International™
Non-profit organization dedicated to education and the global dissemination of knowledge*
www.Bronchoscopy.org

*The Foundation for the Advancement of Medicine is a 501-3C non-profit organization
Welcome to the Bronchoscopy Education Project. The purpose of this project is to provide bronchoscopy educators and training program directors in the United States and abroad with competency-oriented tools and materials with which to train student bronchoscopists and assess progress along the learning curve from novice to competent practitioner. Material can be incorporated in whole or in part, as needed by each program.

The foundation of this project is a standardized curriculum (schedule, content, checklists, assessment tools, training models, and train-the-trainers instruction) pertaining to an Introductory Course in Flexible Bronchoscopy. This course addresses bronchoscopic inspection, lavage, brushing and endobronchial biopsy, transbronchial lung biopsy and conventional transbronchial needle aspiration.

Modeled on this curriculum, work is in progress for programs pertaining to (a) endobronchial ultrasound, (b) interventional flexible bronchoscopy, and (c) rigid bronchoscopy.

This project is ongoing and will be updated at www.bronchoscopy.org as components become available. We invite your comments as you use these materials.

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<sup>§</sup> Checklists, Assessment Tools, and Bronchoscopy Step-by-Step Narrative created by Mohsen Davoudi MD and Henri Colt MD
The Introduction to Flexible Bronchoscopy Curriculum contains:

1. Introduction to Flexible Bronchoscopy Competency Program Completion
2. Regional Introductory courses comprised of didactic lectures, interactive sessions and simulation-based hands-on workshops using a pre-test/post-test model to document cognitive knowledge and technical skill acquisition.
3. Mandatory reading assignments:
   - *The Essential Bronchoscopist*, a six module, 186 questions/answer Web-based study guide with downloadable PDF files and post-tests.
   - *Moderate Sedation* Module with didactic lecture, synopsis and checklist.
   - *Fluoroscopy* Module with didactic lecture, synopsis and checklist.
4. The Bronchoscopy Step-by-Step procedural skill accumulation curriculum
5. A series of simulation workshops that include:
   - An informed consent-patient safety-procedural pause simulation also including instruction in the use of universal, droplet, and airborne pathogens precautions.
   - A flexible bronchoscopy inspection with BAL, biopsy and brushing scenario, using inanimate models and/or high-fidelity computer-based simulation.
   - A flexible bronchoscopy inspection with transbronchial lung biopsy and/or transbronchial needle aspiration scenario, using inanimate models and/or high-fidelity computer-based simulation.
6. A series of interactive (instructor-student) Practical Approach to Procedural Decision-making workshops
7. A collection of Assessment tools used to monitor progress:
   - Bronchoscopy Skills and Tasks Assessment Tool (BSTAT)
   - BSTAT-TBLB and TBNA Assessment Tool
8. A collection of Checklist tools used to monitor progress:
   - Informed consent checklist
   - Procedural pause checklist
   - Fluoroscopy checklist
   - Moderate sedation checklist
   - Proctored flexible bronchoscopy checklist

Most of the materials for this project can be accessed via Bronchoscopy International at [http://www.Bronchoscopy.org](http://www.Bronchoscopy.org)
Section 1

Introduction to Bronchoscopy
Competency Program Completion
Recommendations for Using the Introduction to Bronchoscopy Competency Program Completion

This checklist contains all of the elements comprised in the basic flexible bronchoscopy curriculum. The purpose of this curriculum is to help trainees climb the learning curve from novice and advanced beginner to intermediate and then competent bronchoscopist, able to perform flexible bronchoscopy independently.

Not all students will progress at the same speed. It is also assumed that students may become competent at certain procedures before they become competent in others. The frequency with which the checklists and assessments tools pertaining to the individual components of the curriculum need to be administered has not yet been ascertained.

This curriculum assures that all students have completed certain materials to the satisfaction of their instructors. It is understood that some students may need to repeat certain elements of the curriculum until they obtain a passing grade. Some institutions may wish for their trainees to repeat parts of the curriculum during the course of their training (yearly for example, or during the months prior to completing their training).

To maximize objective scoring, each element in the program checklist has been defined explicitly in this user manual. Participation in specially-designed Train-the-Trainers courses (being currently organized) is encouraged to assist with standardization and helping instructors use this program to its fullest potential.

A PASS grade signifies that each student has achieved a satisfactory (passing) score in each of the ten elements contained in the curriculum. The overall number of procedures performed by the student should also be recorded; it is recommended that students keep a diary-log of their procedures, and that program directors conduct feedback sessions with students to monitor patient-care related outcomes.
# Introduction to Flexible Bronchoscopy
## Competency Program Completion Checklist

<table>
<thead>
<tr>
<th>Educational Item</th>
<th>Completed Yes/No</th>
<th>Assessment Item</th>
<th>Pass/Fail/Incomplete</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Participation in regional introductory course if available*</td>
<td>Yes / No</td>
<td>Post-test scores Target 12/20 (60% correct) Score ______%</td>
<td>Pass / Fail / Incomplete</td>
</tr>
<tr>
<td>2. Mandatory reading: Web-based <em>Essential Bronchoscopist</em></td>
<td>Yes / No</td>
<td>Post-test scores Target 7/10 (70% correct) Score ______%</td>
<td>Pass / Fail / Incomplete</td>
</tr>
<tr>
<td>• Module 1</td>
<td>Yes / No</td>
<td>Score ______</td>
<td>Pass / Fail / Incomplete</td>
</tr>
<tr>
<td>• Module 2</td>
<td>Yes / No</td>
<td>Score ______</td>
<td>Pass / Fail / Incomplete</td>
</tr>
<tr>
<td>• Module 3</td>
<td>Yes / No</td>
<td>Score ______</td>
<td>Pass / Fail / Incomplete</td>
</tr>
<tr>
<td>• Module 4</td>
<td>Yes / No</td>
<td>Score ______</td>
<td>Pass / Fail / Incomplete</td>
</tr>
<tr>
<td>• Module 5</td>
<td>Yes / No</td>
<td>Score ______</td>
<td>Pass / Fail / Incomplete</td>
</tr>
<tr>
<td>• Module 6</td>
<td>Yes / No</td>
<td>Score ______</td>
<td>Pass / Fail / Incomplete</td>
</tr>
<tr>
<td>Sedation Module</td>
<td>Yes / No</td>
<td>Score ______</td>
<td>Pass / Fail / Incomplete</td>
</tr>
<tr>
<td>Fluoroscopy Module</td>
<td>Yes / No</td>
<td>Score ______</td>
<td>Pass / Fail / Incomplete</td>
</tr>
<tr>
<td>3. Informed consent, patient safety, and procedural pause simulation workshop</td>
<td>Yes / No</td>
<td>IC 10-pt Checklist Target 100% Score ______%</td>
<td>Pass / Fail / Incomplete</td>
</tr>
<tr>
<td>4. Informed consent, patient safety, and procedural pause patient-based scenario</td>
<td>Yes / No</td>
<td>IC 10-pt Checklist Target 100% Score ______%</td>
<td>Pass / Fail / Incomplete</td>
</tr>
<tr>
<td>5. Practical Approach interactive workshop</td>
<td>Yes / No</td>
<td>Subjective scores Target Pass</td>
<td>Pass / Fail / Incomplete</td>
</tr>
<tr>
<td>6. Flexible bronchoscopy simulation workshop</td>
<td>Yes / No</td>
<td>Target scores 100% BSTAT ______% TBLB/TBNA ______%</td>
<td>Pass / Fail / Incomplete</td>
</tr>
<tr>
<td>7. Flexible bronchoscopy patient-based scenario</td>
<td>Yes / No</td>
<td>Target scores 100% BSTAT ______% TBLB/TBNA ______%</td>
<td>Pass / Fail / Incomplete</td>
</tr>
<tr>
<td>8. Proctored case bronchoscopy checklist</td>
<td>Yes / No</td>
<td>FB 10-pt Checklist Target 100% Score ______%</td>
<td>Pass / Fail / Incomplete</td>
</tr>
</tbody>
</table>

* Currently available to 5-8 institutions in each of the following regions: Southern California, Upper Midwest, Southeast, Texas, and Northeast. Additional regional sites are being developed for face-to-face interaction as well as a web-based program.
Section 2

Regional Courses

Regional Introductory courses comprised of didactic lectures, interactive sessions and simulation-based hands-on workshops using a pre-test/post-test model to document cognitive knowledge and technical skill acquisition.
User Instructions

Regional Courses (1 day)
Introduction to Flexible Bronchoscopy

Learning bronchoscopy in the clinical setting promotes learner anxiety, subjects patients to the burden of procedure-related education [1], and results in a highly variable learning experience [2]. Clinical responsibilities often interfere with reading of bronchoscopy-related material, and, in the absence of periodic assessments of bronchoscopy-related knowledge, trainees are unlikely to be compliant with educational endeavors they perceive as optional or reliant on individual motivation, especially if there are no pass/fail grading consequences [3]. The current subspecialty bronchoscopy learning environment is further rendered less-than-ideal for beginners because of concerns regarding patient safety, fiscal constraints, and an increasing impetus to document procedural competency [4-6].

Whilst not supplanting on-the-job training that occurs with subspecialty rotations, short postgraduate courses comprised of lectures and simulation-based hands-on instruction, have thus become a popular means towards enhancing procedure-related learning [7-9]. In accordance with continued medical education (CME) guidelines, these programs identify learner objectives and provide opportunities for feedback from students regarding the perceived quality of the course.

The purpose of regional courses is to provide standardized learning material to bronchoscopy trainees. By regionalizing the process, program directors can enlist participants from numerous regional programs, thereby reducing course-related expenditures pertaining to travel and lodging. Already, several courses have become highly popular in the Carolinas, Southern California, and Midwest. Other regional courses are planned in the Northeast, Texas, and Southeast. During course participation, students are exposed to standardized course material delivered using didactic lectures, interactive sessions, hands-on training using patient models, low-fidelity and high-fidelity simulation, debriefing exercises, and problem-based learning modules. Pre-test/post-test assessments help document knowledge and technical skill acquisition, thereby setting a new baseline for students in subspecialty training.

It has long been recognized that assessment drives learning, and that rigorous assessment inspires learning, reinforces confidence, and reassures the public. Proving that course participation is responsible for learning gains is difficult. For example, demonstrating the short-term benefit of an educational intervention is controversial because of debates regarding the value of pre-test and post-test assessments, and because of the obvious difficulty constituting a control group to which studies of an educational intervention can be compared [10-13]. Studies of long-term retention are problematic because causality is subject to the effects of normal maturation and ongoing training history [14].
The true value of pre-test/post-test assessments has also been controversial because of the effects of many extraneous variables, which include the Hawthorne effect (knowing that one is being tested may affect the results), the halo effect (the human tendency to respond positively or negatively to an instructor), and the practice effect (of a pre-test on a subsequent post-test). In the context of procedure-based training, the calculation of various measures of learning gain, including class-average and single-student normalized gain provides an objective and informative means to document learner performance and demonstrate robustness of the educational intervention.

Patients should not bear the burden of procedure-related training. Participation in regional courses, using simulation-based deliberate practice to acquire technical skill, and documenting a rapid climb up the initially steep slope of the novice’s learning curve should result in decreased patient suffering and improved procedure-related decision making. Diverse opinions regarding educational methodologies, curricular structure, and measures of effectiveness persist in regards to short one- or two-day programs [15-16]. Additional studies are therefore needed, not only to document the effectiveness of regional courses, but also to determine how such courses might favorably impact patient outcomes.

Selected References

**Example of Course Schedule (Southern California, with participation of 7 different training institutions)**

One day Introductory Bronchoscopy Course for First Year Pulmonary and Critical care Medicine Trainees

<table>
<thead>
<tr>
<th>Time</th>
<th>Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>7:30-8:15 am</td>
<td>Registration, pre-course technical skill assessments</td>
</tr>
<tr>
<td>8:15-8:30</td>
<td>Welcome, introduction, and learning objectives</td>
</tr>
<tr>
<td>8:30-9:00</td>
<td>Pretest and survey of practice experience</td>
</tr>
<tr>
<td>9:00-9:20</td>
<td>Patient safety: Pre-bronchoscopy evaluation</td>
</tr>
<tr>
<td>9:20-9:40</td>
<td>Patient safety: Bronchoscopy in special populations</td>
</tr>
<tr>
<td>9:40-10:15</td>
<td>Preventing and managing airway complications</td>
</tr>
<tr>
<td>10:15-10:30</td>
<td>BREAK</td>
</tr>
<tr>
<td>10:30-10:45</td>
<td>Anatomic relationships</td>
</tr>
<tr>
<td>10:45-11:15</td>
<td>Bronchoscopic airway inspection</td>
</tr>
<tr>
<td>11:15-11:45</td>
<td>Evaluation of central airway obstruction</td>
</tr>
<tr>
<td>11:45-12:00</td>
<td>Basic diagnostic procedures (lavage, brushings, and biopsy)</td>
</tr>
<tr>
<td>12:00-12:30</td>
<td>Transbronchial lung biopsy</td>
</tr>
<tr>
<td>12:30-1:00</td>
<td>Practical approach to transbronchial needle aspiration</td>
</tr>
<tr>
<td>1:00-2:00</td>
<td>LUNCH</td>
</tr>
</tbody>
</table>

Afternoon hands-on training

<table>
<thead>
<tr>
<th>Time</th>
<th>Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>2:00-4:30 pm</td>
<td>Hands-on training: 5 stations - 30 minutes per station</td>
</tr>
<tr>
<td></td>
<td>(1) Airway anatomy and bronchoscopy step by step</td>
</tr>
<tr>
<td></td>
<td>(2) Endobronchial brushings, and endobronchial biopsy</td>
</tr>
<tr>
<td></td>
<td>(3) Transbronchial needle aspiration</td>
</tr>
<tr>
<td></td>
<td>(4) Emergency bronchoscopic intubation</td>
</tr>
<tr>
<td></td>
<td>(5) Diagnostic strategies: interactive small group session</td>
</tr>
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</table>

<table>
<thead>
<tr>
<th>Time</th>
<th>Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>4:30-4:45</td>
<td>Post course technical skills learning assessment</td>
</tr>
<tr>
<td>4:45-5:15</td>
<td>Post course cognitive learning assessment</td>
</tr>
<tr>
<td>5:15-5:30</td>
<td>Interactive session: True-False exercises</td>
</tr>
<tr>
<td>5:30-6:00 pm</td>
<td>Wrap up; certificate of course completion</td>
</tr>
</tbody>
</table>
Introductory Flexible Bronchoscopy: Hands-On Workstations

Workstation 1: Airway Anatomy & Bronchoscopy Step by Step

Learning Objectives:

1. To be able to enter the airway from the larynx atraumatically and navigate down the trachea maintaining the bronchoscope in the midline.
2. To learn to practice the basic “right-left” maneuver.
3. To become familiar with right-sided exercises.
4. To become familiar with left-sided exercises.
5. To be able to identify bronchial segmental anatomy, and understand the standard order of segmental airway examination.

Description:

The instructor will first demonstrate step by step principles and techniques of airway examination. Students will then use simulation to learn bronchial anatomy, and focus on principles that include keeping the scope in the midline, avoiding wall trauma (red out), identifying and entering bronchial segments appropriately, and performing certain left and right sided exercises. This educational principle resides on the concept of muscle memory, repetition, and focused practice.

Workstation 2: Endobronchial Brushing & Endobronchial Biopsy

Learning Objectives:

1. To be able to brush a simulation of a mucosal lesion using proper communication skills and technique while maintaining the bronchoscope in the midline and without causing airway trauma.
2. To be able to biopsy a simulation of a mucosal lesion using proper communication skills and technique while maintaining the bronchoscope in the midline and without causing airway trauma.

Description:

The instructor will guide the student as the student brushes and biopsies an airway abnormality. Another student will serve as the bronchoscopy assistant, so that the “bronchoscopist” may practice and learn proper communication skills such as “brush out, brush in, open forceps, close forceps” while maintaining proper bronchoscopic technique.

Workstation 3: Transbronchial Needle Aspiration

Learning Objectives:

1. To be able to demonstrate three different techniques of needle insertion: hub against wall, piggyback, and jab technique.
2. To be able to demonstrate three ways to protect the bronchoscope during needle aspiration: Straightening the scope during needle insertion and removal, complete...
visualization of the needle during retraction from the airway wall, pulling the needle completely into the sheath before removal through the bronchoscope.

**Description:**

The instructor will first demonstrate videobronchoscopy and each of the three techniques of TBNA with the help of a bronchoscopy assistant. TBNA will be performed through the carina into subcarinal adenopathy of the specially lo-fidelity airway model. The instructor will also describe different ways with which to assure patient and operator safely, and ways in which the flexible bronchoscope is protected. Each team member will then demonstrate needle insertion techniques, while another team member serves as the bronchoscopy assistant, making sure that patient, operator, and equipment safety are assured.

**Workstation 4: Difficult Airway: Emergency Bronchoscopic Intubation**

**Learning Objectives:**

1. The learner should be able to manage a normal, emergency airway, using mask ventilation, laryngoscopic intubation, and fiberoptic intubation.
2. The learner should be able to intubate a patient with a difficult airway (limited jaw range of motion, swollen tongue) using the flexible bronchoscope

**Description:**

Intubation in the patient with a difficult airway is a life-saving procedure. It is a time when family members, nursing team, physicians, and respiratory therapists are at the bedside assisting and watching. It is a time for the bronchoscopist to take control of the situation, use the airway team wisely in order to maintain an environment of calm, trust, and efficacy.

**Workstation 5: Diagnostic Strategies: Interactive Small Group Session**

**Learning Objectives:**

1. The learner should be able to proceed through the 4-Box Practical Approach model, knowing the significance of each box.
2. The learner should be able to analyze a bronchoscopic case by walking a colleague through the process of initial patient evaluation, assessment of procedural strategies, discussion of procedural techniques and results, and devising long-term management plans.

**Description:**

In this interactive session, the instructor opens up the floor to the learners, and together they walk through a complicated case using the 4-Box Practical Approach model, working their way through initial patient evaluation, assessment of procedural strategies (including indications and contraindications, expected results, and risk-benefit analysis), discussion procedural techniques and results (including choosing among technical options and instruments, knowing the anatomic risks, results, and possible complications and how to deal with each), and devising long-term management plans (including assessment of the results, plan for follow-up diagnostic and therapeutic options, along with quality improvement for the procedural team).
Section 3

Mandatory Reading

Mandatory readings:
- *The Essential Bronchoscopist*: Six modules, 186 questions/answer web-based study guide with downloadable PDF files
  - Moderate Sedation module
  - Fluoroscopy module

* Checklists and post-tests used at the discretion of program director.
User Instructions

Mandatory reading of the 6 module, 186 question/answer Essential Bronchoscopist© with post-tests

The web-based Essential Bronchoscopist© (referred to as the EB©) is a laddered curriculum of theoretic bronchoscopic knowledge that can be accessed free of charge in English, French, Spanish, Portuguese, Vietnamese, Japanese, and Korean (with Italian and Chinese translations in progress). This online and downloadable text has been officially endorsed as a complementary educational tool by several national and international bronchology and pulmonary organizations (including those from Argentina, Singapore, Belgium, Malaysia, Spain, France, Brazil, Korea, and Japan, as well as by the American Association for Bronchology, The South American Association for Bronchoesophagology, and the World Association for Bronchology). The EB© website is HON code certified (Health on the Net).

The EB© is just one component of an online curriculum being established by an increasing international forum of expert bronchoscopists and educators (see Bronchoscopy International, at www.bronchoscopy.org). This is a free, web-based six-part basic curriculum that deconstructs procedures into three elements: strategy and planning, technical skills, and outcomes assessment (quality control and ability to respond to complications). In order to identify the elements crucial to medical reasoning when entertaining a bronchoscopy consultation, these elements are further deconstructed into four categories using a four box practical approach to procedural decision making: patient evaluation, procedural strategies, techniques, and outcomes described on one of the six elements of the curriculum, called the practical approach to procedural decision making.

This curriculum is being increasingly used as a foundation for standardized curricula delivered by experienced bronchoscopy educators who have participated in specially designed “train the trainers” courses established by Bronchoscopy International, in order to provide one day seminars in countries such as Argentina, the United States, Vietnam, Singapore, the Philippines, and India.

The EB© itself is comprised of six modules, each with a module-specific competency-based learning objective, totaling 186 multiple-choice question-answer sets, viewable online (available at http://bronchoscopy.org/ under the link 'Essential Bronchoscopist©) and also downloadable as PDF files. Each question-answer set contains information pertaining to the major topics represented in traditional textbooks of bronchoscopy (anatomy and airway abnormalities, patient preparation, indications, contraindications and complications, techniques and solutions to technical problems, lung cancer and infections, bronchoalveolar lavage, lung biopsy techniques, therapeutic and interventional bronchoscopy, anesthesia and medications, equipment and its maintenance, as well as history and education).
The aim of the EB© is not to replace but to complement the conventional apprenticeship model of training in bronchoscopy by emphasizing important facets of knowledge and skill required for competency, and by encouraging trainees to discuss these with their preceptors and colleagues. Elements addressed in the Essential Bronchoscopist© are intentionally written so that contrary opinions might occasionally be provided by instructors. In this fashion, dialogue is promoted, but access to a certain amount of “essential” material is guaranteed. In one study, conducted in Argentina and the US, select material from the question-answer sets of the EB©, were used to create a validated test of bronchoscopic knowledge. Questions from the EB© have also been used in other studies pertaining to bronchoscopy education.

In order to document that a student has been exposed to material contained in the EB©, a passing score on each of the post-tests is warranted. Each test can be taken three times if a passing score is not achieved on the first try. All students should document a passing score as proof that they have completed the module. A score of 70 and above (7 correct responses) allows the student to move on to the next module using the online version. After three attempts, however, the next module can be accessed regardless of one’s score. The print-out of one’s passing scores can be placed in the student’s file and the program director can check off the module as completed on the Bronchoscopy Education Competency Checklist.

**Selected References**

5. Goldberg R, Colt HG, Davoudi M, Cherisson L. Realistic and affordable lo-fidelity
The Essential Bronchoscopist®

A self-learning curriculum containing 6 modules, 10 MCQs with explained answers, and a series of post-tests.

Module Learning Objectives

1. List three factors considered by the patient before undergoing bronchoscopy.
2. Describe how airways from the lung to the bronchoscope can be visualized.
3. Describe the presence of extrinsic and intrinsic airway obstruction.
4. Provide a thorough explanation of airway cartilage, mucosa, and bronchial wall function.
5. Understand the role of respiratory muscles in maintaining normal airway patency.
6. Identify potential complications associated with bronchoscopy.
7. Discuss the need for preoperative antibiotic prophylaxis.
8. Understand the contraindications to bronchoscopy.
9. List the indications for bronchoscopy.
10. Examine the common sites of airway obstruction.

How Learners can use The Essential Bronchoscopist®

- The Learner
  - Should complete each module before proceeding to the next.
  - Should devote no more than 2-3 hours to each module.
  - Should self-assess using the self-assessment tests.

How Instructors can use The Essential Bronchoscopist®

- The Instructor
  - Should review the material in each module.
  - Should use the self-assessment tests to evaluate understanding.
  - Should provide feedback on the test results.

Begin post test
User Instructions

Mandatory reading of the Moderate Sedation and Fluoroscopy modules

The purpose of these mandatory readings is to provide students with exposure to basic principles pertaining to the use of moderate sedation during bronchoscopy, and to the use of fluoroscopy during bronchoscopy. While it is presumed that institutions have their own regulations and protocols, many do not have a formal program of education in these two areas.

The inappropriate use of sedation and fluoroscopy can severely affect patient safety. It is for this reason that we believe knowledge in these two areas is necessary, and it is also why we have prepared special checklists so that instructors can document the acquisition of knowledge during the course of training.

We recommend at least ONE formal session during which a didactic lecture on each of these two subjects is provided (after students have reviewed the synopsis and other reading material on these two subjects). Checklists can be reviewed at a separate and individual session, or during the course of day-to-day procedural training.
MODERATE SEDATION

SYNOPSIS

The purpose of this synopsis is to provide the reader with a brief overview of moderate sedation as it might apply to flexible bronchoscopy. It is assumed that institutions and practitioners have different biases and regulations. Herein a short summary is provided so that beginner bronchoscopists might acquire at least some of the elements necessary for a safe procedure. Readers are encouraged to follow guidelines and protocols established in their own institutions.

Definitions

• Moderate sedation may be produced by the use of intravenous, oral, transmucosal or intramuscular narcotics, sedatives or anxiolytic medications
• Moderate sedation is a medically controlled state of depressed consciousness that allows protective reflexes to be maintained, while retaining the patient’s ability to maintain a patent airway independently and continuously. This implies that the patient is mildly drowsy but arouses to voice easily. This is to be distinguished from
• Deep sedation, where the patient is arousable only by vigorous stimulation and may lose the ability to maintain airway patency and protection.

ASA Classification

• ASA 1: normal and healthy patient
• ASA 2: Mild controlled systemic disease and no functional limitation
• ASA 3: Moderate to severe systemic disease that limits activity.
• ASA 4: severe systemic disease that is a constant threat to life or is functionally incapacitating.
• ASA 5: Moribund and not expected to survive without surgery

Equipment

• Informed consent for sedation should be obtained in addition to consent for the procedure.
• Oximetry
• Ability to monitor the patient for vital signs, airway patency, degree of wakefulness.
• Electrocardiogram
• Intravenous access
• Rescue equipment for any patient moving into deep sedation, including crash cart and defibrillator
• Appropriate size endotracheal tubes and ability to ventilate patient (including self-inflating Ambu-bag and mask system) should be available.
• Reversal agents for narcotics and benzodiazepines
• Charting should include baseline ventilatory, hemodynamic, neurologic status, time of administration of medication, dose administered, type of medication used, physical
examining, informed consent, allergies, nothing to eat 8 hours prior to the procedure (except for clear liquids and medications, up to four hours prior to procedure).

- Ability to monitor patient status at least every 15 minutes during the procedure and for a minimum of thirty (30) minutes after the procedure and/or until patient returns to baseline status, including pulse oximetry equal or greater than 92% on room air, or assured with supplemental oxygen if patient on oxygen.
- Following administration of reversal agents such as naloxone, patient should not be discharged for a minimum of one (1) hour, and flumazenil two (2) hours.

Potential contraindications

- Uncooperative patients
- Mentally ill patients
- Severe cardiac, pulmonary, hepatic, renal or central nervous disease
- Pregnancy
- Morbid obesity
- Alcohol or drug abuse
- History of sleep apnea

High risk patients

- Previous problems with anesthesia or sedation
- Previous surgery or radiation or injury to neck or face
- Stridor, snoring, or sleep apnea
- Dysmorphic facial features
- Advanced rheumatoid arthritis
- Significant obesity, protruding teeth
- Small mouth opening (<3cm in adults), macroglossia, non-visible uvula, tonsillar hypertrophy, short neck, limited neck extension, decreased hyoid-mental distance (<3cm in adult).

Response to complications

- Ability to rotate patient onto lateral decubitus position in case of vomiting.
- Ability to insert a nasal trumpet
- Ability to perform chin lift/neck extension in case of obstructed airway
- Oral suction should always be available
- Ability to establish a safe and patent airway, and provide hemodynamic and circulatory support in case of compromise.

Specific medications

- **Midazolam** (Versed) is currently the most widely used agent for moderate sedation and anxiolysis. It is a water-soluble benzodiazepine with rapid onset of action. It is four times more potent on a mg per mg basis than

  - When administered intravenously, sedation and anxiolysis usually occurs within 2 minutes. Complete recovery of motor performance and consciousness occurs within one hour in most individuals.
  - Combining Midazolam and opioids increases the incidence of apnea. Large doses can produce prolonged drowsiness and cardio-respiratory arrest.
Central nervous system dysfunction, including confusion and seizures can be seen in patients with brain metastases and paraneoplastic syndromes.

- Ventilation is depressed by 0.15 mg/kg, especially in patients with COPD. The peak effect of respiratory depression occurs at three minutes following injection and remains for approximately 15 minutes. It can be most pronounced in geriatric and COPD patients.

*Fentanyl* is a synthetic opiate analog that is structurally different from morphine or meperidine. It is 100 times more potent than morphine. The usual adult dose is 50-100 micrograms. Given intravenously, its onset of action and maximum respiratory depression effect occurs about 5-10 minutes after administration, and lasts 30-60 minutes.

- Given intramuscularly, the onset of action is within 7-15 minutes with duration of action lasting up to two hours.

- Fentanyl should never be used in patients receiving MAO inhibitors because of increased risk of respiratory depression and coma.

*Combination drugs.* Sedative responses are increased in patients who have received opioids or other benzodiazepines. Level of sedation and risk for respiratory depression are increased in the elderly and in patients with pre-existing respiratory dysfunction.

*Reversal agents:*

- Naloxone is a pure opiate antagonist that reverses all effects and side effects of opiates. The initial dose is 0.1-0.2 mg IV, SQ, IM or via endotracheal tube and can be repeated every 2 minutes. The onset of action is about 30 seconds. Actually, no more than 0.4 mg should be administered because this might lead to increased activity of the sympathetic nervous system from acute termination of analgesia. Consequently, patients may develop hypertension, dysrhythmias, and pulmonary edema.

- Flumazenil is a benzodiazepine antagonist that should be administered (0.2 mg IV over 15 seconds, then repeated every minute up to a maximum of 1 mg). Low doses of Flumazenil will reliably reverse sedation within 2 minutes, but higher doses are needed to reverse benzodiazepine-related anxiolysis. Duration of action is about 60 minutes. Side effects include nausea, vomiting, tremors, seizures, tears and dizziness. Contrary to naloxone, it does not cause hemodynamic instability.

**Dosing guidelines**

- *Midazolam* single dose 1 mg IV, onset of action 1-2.5 minutes, total dose 5 mg
- *Lorazepam* single dose 2 mg IV, onset of action 20-30 minutes, total dose 4 mg
- *Morphine* single dose 2-4 mg IV, onset of action 1-5 minutes, total dose 10 mg
- *Fentanyl* single dose 50 mcg IV, onset of action 1-5 min, total dose 100 mcg
FLUOROSCOPY

SYNOPSIS

The purpose of this synopsis is to provide the reader with a brief overview of fluoroscopy as it might apply to flexible bronchoscopy. It is assumed that institutions and practitioners have different biases and regulations. Herein a short summary is provided so that beginner bronchoscopists might acquire at least some of the elements necessary for a safe procedure. Readers are encouraged to follow guidelines and protocols established in their own institutions. Students are urged to read the Syllabus on Fluoroscopy and Radiation Protection created by the California Department of Health Services, which is downloadable from http://www.cdph.ca.gov/pubsforms/Guidelines/Documents/RHB-FluoroSyllabus.pdf

Definitions and consequences

• Refraction is the bending of light rays as they pass from a medium of one density to a medium of a different density. Brightness improves visual acuity
  ○ If the fluoroscopic image is not bright enough to be of good quality, it cannot be improved by prolonged observation.
• Visual acuity is the ability of the eye to recognized differences between two sources of light stimulus, and thus to perceive fine detail.
  ○ Night vision is best when the eye scans a scene (moving the fluoroscopic image).
• The eye retains any image it receives for a fraction of a second after the image is removed.
  ○ Frame rates of 24 frames per second (still frames as for television), will thus appear continuous, as in a movie).
• Fluoroscopy images are electromagnetic radiation waves traveling at the speed of light (186,000 miles/second). Photons have energy that is directly proportional to the frequency or inversely proportional to the wavelength of the radiation.
  ○ Increasing voltage increases energy and shortens the wavelength, making a more energetic and penetrating beam. The intensity of the radiation beam is influenced by current (milliAmperes mA).
• Radiation, like all energy, can be primary, scattered, or remnant. Interactions with tissues continue until all energies are spent.
  ○ Primary is the radiation emitted directly towards the patient, scattered is what happens when the energy collides with matter (the patient), remnant is the energy that pass through the patient and strikes the image detector.
• Scatter increases if tissue density or thickness increases, or when voltage and milliAmperage increase.
  ○ Compton scatter results from colliding electrons that lose their energy, as photons are scattered in all directions at low energies. Usually this is associated with increased voltage, and will diminish the quality of the fluoroscopic image. This causes quantum mottle (a grainy appearance in the image)
• Resolution, Distortion, and Lag time
  ○ Definitions provided below. Move fluoroscope slowly while scanning. Keep image centered, and use highest lines/mm monitor (screen) possible.

Reducing patient exposure
• Collimate (focus) the radiation beam to the target of interest
• Use last image hold technique of fluoroscopy rather than continuous applications
• Keep patient to image intensifier (image to detector) distance as short as possible. Moving image intensifier away from the patient increases patient radiation dose.
• Use highest voltage and lowest milliAmperage as possible
• Use largest image intensifier mode (with non magnification) if possible
• Target to tabletop distance never less than 12 inches (30 cm), and should be at least 18 inches (45 cm) because patient dose decreases with increasing distance
• Use low absorption tabletops (made of aluminum, Bakelite, or carbon fiber) that do not attenuate the radiation beam.
• Use “dead-man” exposure switch (pedal) that terminates the radiation exposure when the foot is removed from the pedal. Do not provide continuous exposure.
• Doubling exposure time doubles radiation dose to both operator and patient.
• Do not use magnification mode unless absolutely necessary.

Improving visibility
• Adjust brightness and contrast settings on the screen
• Darken the procedure room lighting
• Avoid changing settings such as milliAmperage or voltage. It is better to adjust room lighting and screen properties.
• Changing the brightness setting on the screen will not improve quality of original image.
• Changing the contrast mode on the screen should be set so that bright objects of interest do not completely saturate (white out). It may be necessary to modify brightness after changing contrast modes.

Patient and operator shielding and monitoring
• Gonad shields, Thyroid shields
• Lead curtains, Body aprons
• Personal radiation film badges should be worn at collar height above the protective apron or on top of the protective apron itself.
• Badges should be checked periodically to record exposure and measure accumulated exposure over a specified period of time

Special precautions for pregnant patient and health care providers
• There is always a potential for adverse biological effects after exposure to radiation.
• Examinations should not be postponed if deemed clinically necessary, but appropriate shielding precautions should be followed.
• There is no “safe” period” for the real or potential embryo/fetus or future fertilized ovum
• Therapeutic abortion is never justified because of radiation dose to embryo/fetus during a diagnostic fluoroscopic examination
• Effects are proportional to absorbed radiation dose
Bronchoscopy Education Project

- The first three months of pregnancy are when the embryo-fetus is most sensitive to radiation.
- Pregnant or potentially pregnant health care providers should not assist in fluoroscopic procedures.

Resolution, Distortion, Scattered radiation, and Lag
- Limited by screen capabilities (525 to 1000 lines/mm)
- Defined as the ability of the imaging system to differentiate small objects as separate images when they are close together.
- Distortion effects size and shape, and can be greatest at the periphery of the image.
- Lag time, and thus blurring of the image as the fluoroscope is moved, occurs because it takes a certain amount of time for the image to build on the screen.
- Scattered radiation is increased in case of high voltage, large field size and thick body parts (obesity).
- The fluoroscopist and assistants should stand as far away from the patient as possible.
- The dose of radiation received from scattered radiation by the fluoroscopist and assistants is directly proportional to the patient radiation dose.
- Preferably a 0.5 mm protective apron should be worn (transmitted exposure reduction is thus 99.9 percent, as compared to 97% reduction for a 0.25 mm apron). Aprons cover only 80% of active bone marrow of the body.

Basic operational procedures
- Use short looks rather than continuous observation. Because the recognition time of the human eye is 0.2 seconds, a short look will accomplish the same as continuous observation.
- Use a resettable timer that will alarm when a maximum of 5 minutes exposure time is reached.
- Use best contrast (lowest milliAmperage) and highest peak voltage possible.
- Keep target area small and focused, but without magnification mode.
- Maintain radiation dose as low as possible (should be less than 5 rads per minute)
- Use last frame hold strategy to keep an image on screen without additional radiation exposure.
- Place image intensifier as close to the patient as possible.
- Prevent patient motion by giving clear instructions.
- Reduce extraneous light in procedure room.
- Use gonad shields and protective aprons of at least 0.25 mm lead equivalent.
- Use audible indicator (beeper alert) when fluoroscopy is on.
- Use personal radiation dose monitoring devices (radiation badge) according to institutional guidelines.
Section 4

Bronchoscopy Step-by-Step

The Bronchoscopy Step-by-Step exercises were inspired by Arthur Murray’s dance education principles. The most complex dance sequences, when broken down into numbered steps, can be learned step-by-step. Gradually, the steps are combined, and the moves finessed, until an elegant dance can be performed. Bach’s Goldberg variations, all 30, are some of the most difficult to master pieces written for harpsichord and piano. No pianist learned them all together; but with patience, they can be mastered note by note by note. To become a good tennis player, one cannot master the forehand, backhand, serve, volley, smash and all other strokes at the same time; separately and repeatedly, the different strokes are practiced and then combined to play a beautiful game.

What these examples have in common is:

- **Systematic Approach**: Deconstructing complex tasks into constituent elements

- **Development of Muscle Memory**: Motor learning through the subconscious process of improving motor skills, smoothness and accuracy of movements, thus creating maximum efficiency and economy of movement. The major prerequisite for development of muscle memory is repeated, deliberate practice.

- **Development of Spatial Awareness**: To learn to flow in space, always occupying the desired position. In bronchoscopy, this additionally requires the accurate identification of airway anatomy.
Bronchoscopy Step-by-Step

All exercises are done while observing basic principles. Optimum hand position and posture should be maintained at all times. The bronchoscope should be kept midline, minimizing white-out and red-out. The airway wall should be respected and trauma avoided. Steps should be practiced while standing both at the “patient’s” head and side. It is best that practice be done initially on inanimate models and/or a virtual reality (VR) simulator.

Remember: Decision; Intent; Control; Confidence; Economy of Movement.

Step 1: Practice advancing from the nares or oral cavity (through a bite block) to the larynx. Identify structures as you proceed: nasal turbinates, hard and soft palate, uvula, posterior tongue, valecula, epiglottis and frenulum, ariepylglottic folds and arythenoid cartilages, false and true vocal cords separated by the vestibule. Assess the movement and symmetry of the vocal cords upon tidal and deep respiration and phonation.

Step 2: Practice delivery of topical anesthetic (lidocaine) in small 1-2 ml. aliquots until anesthesia has been achieved. Observing the timing of breathing, during maximum abduction of the vocal cords, proceed beyond the vocal cords into the subglottic space (the widest point is usually near the posterior commisure). Examine the subglottic space while passing through the subgottic funnel, beyond the thyroid and cricoids cartilages, and the first tracheal ring. Stopping in the subglottis is uncomfortable, and induces cough and should be avoided.

Step 3: Navigate from the subglottis, following the tracheal curve, to the carina. Repeat up and down many times.

Step 4: Turn from the neutral position at the carina to the left, then back to the neutral position. Repeat many times. Then, turn from the neutral position at the carina to the right, then back to the neutral position. Repeat many times. Then practice doing each exercise both possible ways (“forward” and backward”). Then do the two exercises intermittently, one to the left, then to the right, then to the left, and so on. Then shuffle the exercises randomly, left and right and forward and backward.
Step 5: Turn from the neutral position at the carina to the left, down to the end of the LMB, and back up to neutral position at the carina. Do this exercise both possible ways (“forward” and backward”). Repeat many times. Then, turn from the neutral position at the carina to the right, down to the end of the RMB, then down the BI, and back up to neutral position at the carina. Do this exercise both possible ways (“forward” and backward”). Repeat many times. Then do the two exercises intermittently, one to the left, then to the right, then to the left, and so on. Then shuffle the exercises randomly, left and right and forward and backward.

Step 6: From the carina, follow the LMB, entering the two lobar bronchi (LLL and LUL) and return back to the LMB and carina. Repeat several times. Then, from the carina, follow the RMB and BI, entering the three lobar bronchi (RML, RLL, and RUL) and return back to the RMB and carina. Repeat several times.

Steps 7 & 8: On the left, from the LMB, enter the LLL, first the Sup segment, then the basilar pyramid (Ant, Lat, Post). Then, from the LMB, enter the LUL, then each of the two divisions (Upper Div and Lingula), then each segment (Ant, Apic-Post, Sup-Ling, Inf-Ling). Then, perform the B-4-5-6 exercise, entering the Sup and Inf segments of the Lingula, followed by the Sup segment of the LLL. On the right, from the RMB, follow the BI to the RML, and enter both segments of the RML (Med, Lat). Then, enter the RLL, first the Sup segment, then the basilar pyramid (Med, Ant, Lat, Post). Then, perform the B-4-5-6 exercise, entering the Med and Lat segments of the RML, followed by the Sup segment of the RLL. Follow the BI up and enter the RUL, entering all three segments (Ant, Post, Apic). Shuffle left and right exercises.

You are now ready to perform a complete flexible bronchoscopy. Remember, there is usually no need to enter a segment more than once.
Section 5

Simulation Workshops

A series of simulation workshops that include:

- An informed consent-patient safety-procedural pause simulation with use of universal, droplet, and airborne pathogens precautions [Sample provided]
- A flexible bronchoscopy inspection with BAL, biopsy and brushing simulation, using inanimate models and/or high-fidelity computer-based virtual reality simulator
- A flexible bronchoscopy with TBLB and/or TBNA simulation, using inanimate models and/or high-fidelity computer-based virtual reality simulator

* Checklists and assessment tools used at the discretion of program director.
User Instructions
Simulation workshops

The purpose of these workshops is for students to practice skills pertaining to flexible bronchoscopy without endangering or causing undue emotional or physical discomfort to patients. Using a combination of patient models, affordable low-fidelity case-based simulation, computer-based high-fidelity simulation, and interactive discussions and debriefing sessions, trainees and instructors work together to build a mutually productive educational environment consistent with the needs outlined in the ACGME Outcome Project.

Various assessment tools and ten-point checklists are used to document knowledge and skill acquisition in accordance with the elements required by ACGME (patient care, medical knowledge, practice-based learning and improvement, interpersonal communication skills, professionalism, and systems-based practice).

Case-based scenarios can be created by each training program, or scenarios already developed and tested can be used (some are downloadable from the Bronchoscopy.org website). Airway models, many of which are already being used internationally, can be purchased from organizations such as the American Association for Bronchology and Interventional Pulmonology and the Foundation for the Advancement of Medicine a (501-C3 nonprofit organization), as well as from private companies. Some can be loaned to institutions for specific courses.

Examples of Simulation Models

Lo and high fidelity simulation
Needle aspiration, Airway inspection, and computer simulation models
Reduce dependence on animal and cadavers
Decrease ”patient-based” practice
Training Program

Informed Consent, Patient Safety, Procedural Time-Out

**Learning materials** (Items 1-6 should be reviewed prior to workshop participation)

1. Informed consent/research and procedures: read the essay from The Picture of Health: Medical ethics and the movies (Oxford University Press). View film clip from *Extreme Measures*.

2. Informed consent/competence and capacity: read the essay from The Picture of Health: Medical ethics and the movies (Oxford University Press). View film clip from *A Beautiful Mind*.

3. Simulation session: read case descriptions, debriefing and concepts.

4. Read the manuscript *Psychological Aspects of Flexible Bronchoscopy* (by Colt, Goldman, Edell, and Knippa).

5. Read *Medical Informed Consent: general considerations for physicians* (by Patrick et al).


7. Read the text abstracted from Center for Disease Control *CDC Universal Precautions* downloaded from cdc.gov January 2010.

8. Participation in group session simulation workshop (duration 90 minutes) during which materials are reviewed and case-based simulations pertaining to informed consent, patient safety, and procedural pause are performed.

9. Interactive session with critical review of scene from the film *Death of Mr. Lazarescu*.

10. Interactive session (one-on-one assessment) with instructor for scoring and feedback purposes.
INFORMED CONSENT, PATIENT SAFETY, and PROCEDURAL PAUSE (Time-Out)*

Case Information

Part 1: Demographics

Case Title: Informed Consent, Patient Safety, Procedural Pause (Time Out)

Subject Name: (1) Janette Lee (2) Beatrice Woods (3) John Jackson

Scenario Name: Informed consent-patient safety-procedural pause

Simulation Developer(s): H. Colt

Date(s) of Development: January 2010

Appropriate for following learning groups
- Post graduate education
- Residents
- Specialties: Pulmonary, Anesthesiology, Surgery, Critical Care
- Medical Students

Simulated patients 3 scenarios

Scenario # 1 (10 minutes, with 10 minutes debriefing): Obtain informed consent for flexible bronchoscopy from patient's wife. The patient has suspected left main bronchial obstruction. He is intubated and mechanically ventilated.

Scenario # 2: (10 minutes, with 10 minutes debriefing): Identify important elements of history and physical in a patient with tracheal stenosis and stridor being evaluated for flexible bronchoscopy and possible subsequent referral for bronchoscopic intervention (dilation, laser, stent insertion) or open surgery.

Scenario # 3: (10 minutes with 10 minutes debriefing): Review all of the elements of a Procedural Pause (Time Out) for a patient with AIDS, hemoptysis, left upper lobe infiltrate and suspected infectious lung disease about to undergo flexible bronchoscopy with bronchoalveolar lavage, brushing and transbronchial biopsy of the left upper lobe.

Scenario description: The instructor will read the scenario to the team. A specially trained patient educator will be the subject of the simulation. A team member will be designated to lead the simulation, and together with other team members, the team will proceed to perform each of the scenarios with guidance and specific instruction from the instructor. It is assumed that approximately ten minutes will be devoted to each scenario, with 10 minutes for an instructor-led debriefing. The instructor may choose to perform a ten minutes debriefing after moving the team through each of the three scenarios.

* Template for Simulation Patient. Design Modified from original template by Jeffrey M. Taekman, M.D, Duke University Simulation and Patient Safety Center
Part 2: Curricular Information

Educational Rationale:
There has been little or no emphasis on methods for obtaining informed consent for interventional pulmonary procedures, including flexible bronchoscopy. We believe that developing and applying guidelines for informed consent is necessary in view of the increasing number and complexity of interventional procedures to ensure that specific information about each procedure, as well as benefits, potential complications, and alternatives are shared with the patient. In addition, in an environment that respects cultural diversity, this information should be shared in respect with patient-defined goals, values and priorities, including participation of family members, when desired or warranted, in the information sharing and decision-making process.

Morbidity and mortality from medical errors is a growing concern for the public, and for healthcare professionals. Patient safety has become of outmost importance, especially in regards to interventional pulmonary diagnostic and therapeutic procedures, where, at least in the United States, where the legal system does not consider interventional pulmonologists to be practicing potentially dangerous or life-threatening procedures. Patient safety also includes knowledge and performance of the procedural pause, now mandatory in the United States in both the bronchoscopy suite and the operating room theater. We believe that it is possible to implement greater patient safety measures if bronchoscopists were regularly informed and instructed about these patient safety practices.

Learning Objectives:

- The learner should be able to characterize the informed consent process according to accepted criteria
- The learner should be able to characterize the informed consent process in the setting of an emergency airway procedure where interaction is only possible with a family member.
- The learner should be able to identify specific questions while obtaining the patient’s history that help to ensure patient safety.
- The learner should be able to enumerate the elements of a procedural pause and lead the bronchoscopy healthcare team in a “time-out.”

Guided Study Questions:
- What are the key elements of informed consent?
- In respect for cultural diversity, what elements should be taken into consideration?
- What key elements of the patient history are important for enhancing patient safety during an interventional diagnostic or therapeutic pulmonary procedure?
- What are the key elements of the procedural pause? Why is such a “time out” necessary?

References (in addition to those provided for this session)
- Braddock CH et al., How doctors and patients discuss routine clinical decisions. J. Gen Intern Med 1997;12:339-345

Didactics:
• Not applicable

Assessment Instruments:
• Informed consent checklist
• Procedural pause checklist
• Patient safety and procedure-related precautions checklist

Part 3: Preparation

Monitors Required:

Not applicable

Other equipment required:

Not applicable

Time Duration

For each scenario

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**Part 4: Supporting Files (case scenario handouts)**

**Scenario # 1 (Informed consent):** A 60 year Korean old male with severe emphysema and a history of increasing shortness of breath, cough and weight loss has been hospitalized emergently with hypoxemia and respiratory failure. He is intubated and mechanically ventilated. Chest radiograph reveals opacification of the left hemithorax with ipsilateral shift of the mediastinum.

![Chest Radiograph](image)

You must obtain informed consent from the patient’s wife for flexible bronchoscopy in order to determine the cause for this radiographic finding.

**Scenario # 2 (Patient safety):** A 42 year old African-American woman with increasing shortness of breath and a history of healed tracheotomy and severe rheumatoid arthritis is now admitted with stridor and cough. Three months earlier, bronchoscopy had revealed airway narrowing but the patient chose to do nothing.

![Airway Narrowing](image)

In addition to obtaining informed consent, you must identify elements from the history that will help assure patient safety during and after the procedure.

**Scenario # 3 (Procedural pause):** A 30 year old male patient with AIDS, hemoptysis, left upper lobe infiltrate and suspected infectious lung disease is about to undergo flexible bronchoscopy with bronchoalveolar lavage, brushing and transbronchial biopsy of the left upper lobe.

![Chest Radiograph](image)

In addition to the procedural pause, you must identify procedure-related elements such as universal precautions, droplet precautions, and airborne pathogen precautions instituted, before, during and after the procedure.
Part 5: Debriefing

Scenario # 1: Informed Consent

Elements of informed decision making include: (1) discussion of the clinical issue, (2) description of the procedure, (3) discussion of the risks and potential benefits of the procedure, (4) discussion of the therapeutic alternatives, and potential consequences from choosing those alternatives, (5) discussion of the implications of declining treatment, (6) assessment of the patient’s and/or family member’s understanding, (7) discussion of the uncertainties associated with the decision, and (8) asking the patient and family to express a preference.

Scenario # 2: Patient Safety and Procedure-Related Precautions

Elements crucial to safe bronchoscopic intervention and follow-up include (1) review of medical history such as COPD, pulmonary embolus, deep venous thrombosis, rheumatoid arthritis, ankylosing spondylitis, infectious lung disease, other illnesses potentially affecting the airway, cardiac disease, pacemaker, coronary artery disease, obstructive sleep apnea, CO2 retention, laryngospasm or bronchospasm, asthma; (2) review of surgical history such as neck surgery, lung surgery, spine surgery; (3) dentures or loose teeth that might interfere with appropriate response to procedure-related complications; (4) bleeding disorder; (5) allergies to medications including local anesthetics, antibiotics, or reactions to general anesthetic drugs; (6) medication usage including anticoagulation, antiplatelet agents or clopidogrel (Plavix); (7) living situation and family or friend support system; (8) proximity to medical center and physician services; (9) pregnancy; (10) inquiry regarding advanced directives and health care decision making. (12) Universal precautions should always be used to protect the patient and the health care team from spread of blood borne infections such as Hepatitis and HIV. (13) Droplet precautions are warranted in case of risk for infectious lung disease which are droplet-transmitted (14) Airborne pathogens precautions are warranted in selected cases, especially in case of suspicion for tuberculosis or influenza. (15) Resuscitation cart must always be readily available, a regularly checked and restocked.

Scenario # 3: Procedural Pause (Time-Out)

The procedural pause is performed immediately prior to the start of a procedure and must include specific elements to assure patient safety and avoid wrong procedure-wrong site-wrong patient events. A visual memory (triggers) is helpful to assure that all elements are addressed. These include (1) verification of patient, (2) verification of procedure, (3) verification of site and side, (4) verification of consistency with signed informed consent, (5) verification of availability of medical records and equipment, (6) declaration of need for medication or fluids, (7) description of allergies, drug reactions, (8) declaration and communication regarding other safety concerns. Initiated by the team leader, a verbal acknowledgement is required by all members of the health care team. During the time-out, each person in the room should stop what they are doing and actively participate in the process. No individual is exempt, and active participation requires that each individual state clearly that they agree with the elements of the time-out. Any discrepancies and disagreements must be addressed before the procedure is begun. If any distractions occur during the time-out, such as if another individual enters the room or a telephone rings, the time-out must be restarted.
Concepts: Informed consent

The concept of Informed Consent

- Protects the patient by providing them with complete information on which to make an informed decision.
- Protects the health care provider from liability provided the procedure is properly executed according to the prevailing standards of care in the community and without negligence.
- Gives the health care providers an opportunity to consider and re-consider the diagnostic and therapeutic strategies being proposed.
- Allows for a discussion of possible risks and benefits and to prepare for procedure-related events.

The requirements of Informed Consent

From a legal standpoint, consent for a medical procedure must be both informed and effective.

To be informed, a patient must be given information about the procedure relevant to their individual situation.

To be effective, the person undergoing the procedure should be able to demonstrate, in his or her own words, their understanding of the procedure or treatment.

American Medical Association: Informed consent is a process which should disclose and discuss:

- The patient’s diagnosis and concerning clinical issues.
- The nature and purpose of the proposed procedure.
- The risks and benefits of the proposed procedure.
- Alternative regardless of cost or coverage by health insurance.
- Potential risks and benefits from choosing the alternatives.
- The risks and benefits of not receiving or undergoing treatment or procedures.
**Concepts: Patient Safety and procedure-related precautions**

### History, Risk factors, and Universal precautions

1. Medical history such as COPD, pulmonary embolus, deep venous thrombosis, rheumatoid arthritis, ankylosing spondylitis, infectious lung disease or other illnesses potentially affecting the airway, cardiac disease, pacemaker, coronary artery disease, obstructive sleep apnea, CO2 retention, laryngospasm or bronchospasm, asthma.
2. Surgical history such as neck surgery, lung surgery, spine surgery;
3. Dentures or loose teeth that might interfere with appropriate response to procedure-related complications;
4. Bleeding disorder;
5. Allergies to medications including local anesthetics, antibiotics, or reactions to general anesthetic drugs;
6. Medication usage including anticoagulation, antiplatelet agents or Clopidogrel;
7. Living situation and family or friend support system;
8. Proximity to medical center and physician services;
9. Pregnancy;
10. Inquiry regarding advanced directives and health care decision making.
11. Universal precautions should always be used to protect the patient and the health care team from spread of blood borne infections such as Hepatitis and HIV.

### Droplet precautions

- Droplet precautions are warranted in patients known or suspected to be infected with microorganisms transmitted by droplets (larger than 5 microns in size) that can be generated by coughing, sneezing, talking, or during the procedure.
  - Surgical masks, facial shield, or goggles
  - Patient transport precautions
  - Droplet precaution sign on procedure room door
  - Cough/respiratory hygiene etiquette

### Airborne pathogens precautions

- Hand hygiene
- Cough/respiratory hygiene etiquette
- Cleaning and disinfection of contaminated surfaces
- Negative airflow with external exhaust
- N-95 respiratory or other National Institute for Occupational Safety and Health recommended device.
- Power air purifying respiratory (PAPR) might be considered in selected high risk cases.
- Airborne precautions sign
Concepts: Procedural pause (Time-Out)

The concept of a “Procedural Pause”, also known as a “Time Out”

► This safety protocol eliminates events involving the wrong patient, wrong site or wrong procedure.
► The protocol has been endorsed by more than fifty professional organizations, and is applicable to all high-risk procedures.
► The protocol is included in the USA Joint Commission for the Accreditation of Healthcare Organization National Patient Safety Goals project and was originally approved in 2004.
► The protocol also includes other components important in fostering a culture of patient safety, such as purposeful team communication and ensuring patient understanding.

Requirements of an active “Time Out”

► Performed immediately prior to the start of the procedure.
► Ensures that the correct patient, site, positioning, and procedure to be performed are correctly identified.
► Ensures that pertinent imaging studies, medical records and equipment are available.
► Initiated by the provider and includes active verbal acknowledgement by all members of the health care team and any other persons present.
► All environmental distractions should be eliminated as much as possible.

Time Out: visual memory guide

1. Verification of patient
   This is patient (read name badge), confirm with patient or family.
2. Verification of procedure
   I am Dr... We are going to perform... Patient agrees...
3. Verification of side and site
4. Nurse verifies consistency with signed informed consent.
5. Team members verify and declare availability of pertinent medical records, imaging studies and equipment.
6. Declare need for antibiotics, fluids or moderate sedation.
7. Describe allergies or drug reactions
8. Declare of safety issues based on medical history
Section 6

Practical Approach Sessions

A series of interactive (instructor-student) 
Practical Approach to Procedural Decision-making workshops
User Instructions
Practical Approach workshops

The purpose of these practical approach sessions is to help learners think through the decision making process. Often, instructors will use a practical approach to help students gain insights into the strategy and planning, technical performance, and response to complications elements of a minimally invasive procedure.

These exercises are done orally, and the assessment is subjective, based on the instructor’s perception of how the learner responds to questions and outlines a procedural strategy. Learners should be taught to use scientific evidence as well as expert opinion to formulate plans and achieve desired results. A dialogue is thus engendered between instructor and student in order to address alternatives and differences in technique, as well as expected outcomes.

It is expected that sessions should last no more than 30 minutes. The student may be given a scenario, and using a model of the four box approach the student might be asked to address each of the four boxes, with specific emphasis on one or two items based on instructor preference. Numerous exercises are available on the Bronchoscopy.org website to serve as examples, but any scenario the instructor chooses or devises can be used for teaching purposes.
The Practical Approach© is an interactive learning program:

- The purpose of The Practical Approach is to help learners gain the cognitive, technical, experiential, and affective skills necessary to perform bronchoscopy. Competency is sought in the three major elements of a procedure; strategy and planning, execution, and response to procedure-related adverse events or complications.

- Using a four box approach inspired from Albert Jonsen’s\(^1\) classic work in medical ethics, learners rationalize various components of the decision making process.
  - By working through case scenarios, learners are prompted to think about the how and why of their actions, based on background information, pertinent literature, and experience.
  - Consistent with the ACGME professionalism competency guides \(^2, 3\), case scenarios prompt learners to address various components of the informed consent process, and discuss outcomes based on possible as well as real results.

- The Practical Approach helps learners become competent bronchoscopists according to current recommendations set forth by the American College of Graduate Medical Education \(^4\) whereby trainees learn to:
  - Gather essential and accurate information about their patients.
  - Make informed decisions about diagnostic and therapeutic interventions based on patient information and preferences, up-to-date scientific evidence and clinical judgment.
  - Use information technology to support patient care decisions and patient education.
  - Develop patient management plans.
  - Counsel and educate patients and their families.
  - Communicate effectively and demonstrate caring and respectful behaviors when interacting with patients and their families.
  - Provide healthcare services aimed at preventing health problems or maintaining health.
  - Work with healthcare professionals, including those from other disciplines to provide patient-focused care.

References

4. ACGME Competencies at http://www.acgme.org
PRACTICAL APPROACH MODULE

Example of a Practical Approach to Interventional Bronchoscopy Procedural Decision Making:
Scenario # 13: Flexible bronchoscopy with BAL in suspected pulmonary lymphangitic carcinomatosis, and informed consent in a deaf person
[Abstracted from: Bronchoscopy.org]

Based on the information presented below, please describe your procedural decision making using The Practical Approach to Procedural Decision making. Do your best to complete each item of the Four Boxes. If the case scenario contains no information pertaining to an item, please address it as NOT AVAILABLE. Note that each case scenario may have greater emphasis on one or more items listed in the “Practical Approach”.

MM is a 72 year old man with stage IV adenocarcinoma of the lung admitted for progressive dyspnea. He has undergone multiple chemotherapy regimens. Four months before admission he was started on tyrosine kinase inhibitors. He has increasing shortness of breath, fatigue, dry cough, and weight loss for several weeks. He also has COPD with FEV1 35% predicted and is deaf. He lives with his 33 year old son. The patient’s Karnofsky status is 50.

Chest radiograph shows diffuse bilateral interstitial infiltrates and an ill-defined opacity at the right lung base. Computed tomography scan reveals intralobular septal thickening and consolidation in the right middle lobe which was the site of the primary tumor.

Physical examination reveals a temperature of 37.6 blood pressure 112/74 pulse 92 respiratory rate 22 and SaO2 91% on Room Air. He is in no acute distress but is ill-appearing and cachectic. His examination is normal except for diffuse bilateral crackles with decreased breath sounds at the right base and evidence of digital clubbing.

Laboratory findings reveal: Sodium 136; BUN 33; Creatinine 1.7; Glucose 124; CBC showing WBC 12.3, Neutrophil 78% with no bands, Hemoglobin 13.3, and Platelets 163,000. Blood cultures are negative; urinalysis is negative; sputum gram stain is negative (cultures are pending).

The oncology team has formulated a differential diagnosis that includes lymphangitic carcinomatosis, pulmonary infection, and drug-related pneumonitis.
Pulmonary consultation is requested for bronchoscopy.

After addressing items of the four boxes, please consider the following:

- Identify radiographic characteristics of pulmonary lymphangitic carcinomatosis.
- Define the role of bronchoalveolar lavage and transbronchial lung biopsy in the diagnosis of lymphangitic spread.
- Identify possible ways of obtaining informed consent from a deaf person.

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<td>1. Indications, contraindications, and expected results</td>
</tr>
<tr>
<td>2. Patient’s significant co-morbidities</td>
<td>2. Operator and team experience and expertise</td>
</tr>
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<td>3. Patient’s support system (also includes family)</td>
<td>3. Risk-benefits analysis and therapeutic alternatives</td>
</tr>
<tr>
<td>4. Patient preferences and expectations (also includes family)</td>
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</tr>
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<td>4. Referrals to medical, surgical, or palliative/end of life subspecialty care</td>
</tr>
<tr>
<td>4. Results and procedure-related complications</td>
<td>5. Quality improvement and team evaluation of clinical encounter</td>
</tr>
</tbody>
</table>
Slide 1

Bronchoscopy for suspected pulmonary lymphangitic carcinomatosis

Learning Objectives
- To identify radiographic characteristics of pulmonary lymphangitic carcinomatosis.
- To define the role of bronchoalveolar lavage and transbronchial lung biopsy for diagnosis of lymphangitic spread.
- To identify ways of obtaining informed consent from a deaf person.

Slide 2

Case description
- G.G. is a 72 year old man with stage IV adenocarcinoma of the lung admitted for progressive dyspnea. He has undergone multiple chemotherapy regimens. Four months before admission he was started on tyrosine kinase inhibitors. He has increasing shortness of breath, fatigue, dry cough, and weight loss for several weeks. The patient has COPD with FEV1 35% predicted and is deaf. He lives with his 33 year old son. Karnofsky status is 50.

Chest radiograph shows diffuse bilateral interstitial infiltrates and an ill-defined opacity at the right lung base. Computed tomography scan reveals intralobular septal thickening and consolidation in the right middle lobe which was the site of the primary tumor. The oncology team has formulated a differential diagnosis that includes lymphangitic carcinomatosis, pulmonary infection, and drug-related pneumonitis. Pulmonary consultation is requested for bronchoscopy.

Slide 3

The Practical Approach

Initial Evaluation
- Examination, functional status
- Significant comorbidities
- Support system
- Mental, emotional, and spiritual

Procedural Strategies
- Indications, contraindications, and results
- Technique, equipment
- Risk-benefit analysis and therapeutic alternatives
- Informed Consent

Techniques and Results
- Anesthesia and peroperative
- Equipment
- Technique
- Inotropic agents and other drugs
- Assisted and permissive-ventilation

Long term Management
- Outcome assessment
- Referral to care and procedures
- Follow-up
- Quality improvement

Bronchoscopy Education Project
Slide 4

**Initial Evaluation**

► Physical Exam
  - T 37.6°BP 122/74 P 92 R 22 SaO₂ 91% RA
  - General: NAD but ill-appearing, G6PD, cachectic
  - HEENT: PERRLA, jaundiced, no neck LAD
  - Chest: diffuse bilateral crackles with decreased BS at right lung base, no wheezing
  - Heart: RRNR S₁ S₂ no murmur
  - Abd: soft, NT, ND, normoactive BS
  - Ext: +digital clubbing, no edema or cyanosis

► Labs
  - Chem panel: Na+ 136 BUN 33 Cr 1.7 Glu 124
  - CBC: WBC 12.3 Neutrophil 78% no bands Hgb 13.3 Plt 163
  - Blood cx NGTD, U/A neg, sputum cx pending (Gram stain neg)

Slide 5

**Initial Evaluation**

► Left chest radiograph shows diffuse bilateral interstitial infiltrates and an ill-defined opacity at the right lung base, right, compared toopy with wire-like abnormal septal thickening and consolidation seen in the right middle lobe, which is the site of the primary tumor.

► Functional status assessment
  - Karnofsky status score 50

► Significant co-morbidities
  - Advanced COPD, HTN, chronic renal insufficiency, poor functional capacity

► Support system
  - Lives with wife, has 3 children who are supportive

► Preferences and expectations
  - Realistic and understands severity of disease
Karnofsky Performance Status Scale
Definitions Rating (%) Criteria
► Able to carry on normal activity and to work; no special care needed
   100: normal; no complaints; no evidence of disease
   90: able to carry on normal activity; minor signs or symptoms of disease
   80: normal activity with effort; some signs or symptoms of disease
► Unable to work; able to live at home and care for most personal needs;
  ▶ 70: cares for self; unable to carry on normal activity or to do active work
  ▶ 60: requires occasional assistance, but is able to care for most of his personal needs
  ▶ 50: requires considerable assistance and frequent medical care
► Unable to care for self; requires equivalent of institutional or hospital care;
  ▶ 40: disabled; requires special care and assistance
  ▶ 30: severely disabled; hospital admission is indicated although death not imminent
  ▶ 20: very sick; hospital admission necessary; active supportive treatment necessary
  ▶ 10: moribund; fatal processes progressing rapidly
  ▶ 0: dead

Procedural Strategies
► Indications for bronchoscopy
   Diagnosis of lymphangitic carcinomatosis
   Evaluation of presence of infection
   Evaluation of fungal in sputum
► Contraindications for bronchoscopy
   No history of recent MI or arrhythmia
   History of advanced COPD
   5% of COPD patients with bronchoscopy-related complication
   Compared to lung patients with normal lung function
   Especially at risk:
     FEV1/FVC <50% or
     FEV1 <1L and FEV1/FVC <69%
   Consider preprocedure spirometry in severe COPD (increased concern if FEV1 <40%)
   Use sedation and O2 carefully in patients with elevated CO2 (concern for retention)
   Premedicate with bronchodilator to reduce decrease in FEV1 in asthmatic patients
   Laryngospasm
   Hypoxemia
   Bleeding
   UCI policy is to check preoperative CBC and coagulation panel
   BTS recommends routine group AAB before bronchoscopy
  ▶ Operator and team experience
  ▶ Risks of bronchoscopy
     Mortality rate: 0.01-0.04%
     Complication rate: 0.12-0.30%
     Overedation
      ◀ May cause desaturations or CO2 retention
     Bronchospasm
      ◀ Premedicate with bronchodilator to reduce decrease in FEV1
      ◀ Data in asthmatic patients
      ◀ Laryngospasm
      ◀ Hypoxemia
      ◀ Maintain SaO2 >90% in perioperative setting
      ◀ Bleeding
      ◀ BTS recommends routine group AAB before bronchoscopy
Slide 10

**Procedural Strategies**

- Informed consent for the hearing-impaired
- When deaf patients sign consent forms, they often do so without understanding them
  - Many believe they are malpractice waivers
  - Involvement of an interpreter is indispensable
  - Allows physician to
    - Obtain thorough history and proper examination
    - Ensure the patient understands risks and benefits of procedure
    - Establish effective communication and environment of caring and trust
  - Communicate through writing when possible as opposed to lip-reading

Slide 11

**Procedural Techniques and Results**

- Anesthesia: moderate sedation
  - Midazolam
  - Well tolerated
  - Less than 10% exhibit prolonged effect from impaired metabolism
  - Initial dose of 2 mg followed after 2 minutes by increments of 1 mg/min if needed
  - Propofol: monitor for hypotension
  - Flumazenil: benzodiazepine antagonist
    - Short elimination time allows re-sedation
  - Usual initial dosage: 250–500 micrograms
- Perioperative care
  - Continuous oxygen with monitoring
  - Preoperative bronchodilator

**Procedure-related complications**

*reference

Slide 12

**Long-term Management Plan**

- BAL was performed and revealed malignant cells consistent with adenocarcinoma
- Diagnosis of lymphangitic carcinomatosis was discussed with patient and given poor prognosis a palliative care consult was considered
- Patient was discharged home with hospice
  - Patient and family expressed satisfaction with care and management by all subspecialty and ancillary teams
Q 1: What are the specific CT characteristics of pulmonary lymphangitic carcinomatosis and how do they differ from those of tyrosine kinase inhibitor-induced interstitial pneumonitis?

**HRCT findings in lymphangitic carcinomatosis**
- Irregular, nodular, and/or smooth interlobular septal thickening
- Thickening of fissures as result of involvement of lymphatics concentrated in subpleural interstitium
- Preservation of normal parenchymal architecture at level of second pulmonary lobule
- Peribronchovascular thickening
- Centrilobular peribronchovascular thickening predominating over interlobular septal thickening in a minority of patients
- Polygonal arcades of polygons with prominence of centrilobular bronchovascular bundle in association with interlobular septal thickening (50%)
- Mediastinal and/or hilar lymphadenopathy (30-50%)
- Pleural effusions (30-50%)
- Findings can be unilateral or bilateral and focal or diffuse

**HRCT findings in tyrosine kinase-induced interstitial pneumonitis**
- Diffuse interstitial markings and increased radiodensities
- Ground glass opacities
- Multiple centrilobular nodules
- Focal air trapping
- Pleural effusion
- Extensive fibrosis and honeycombing with traction bronchiectasis in chronic and advanced disease

Lymphangitic carcinomatosis
Smooth and nodular interlobular septal thickening (black arrow)
Lymphangitic carcinomatosis

Prominent axial interstitium with thickened bronchovascular bundles (solid arrow). Also thickening of fissure secondary to involvement of subpleural lymphatics (open arrow).

Tyrosine kinase-induced interstitial pneumonitis

Q2: What is the expected yield of bronchoalveolar lavage for diagnosing lymphangitic carcinomatosis, and how does this yield compare with that of transbronchial lung biopsy?

► Transbronchial lung biopsy
  - Goal is to replace more invasive open lung or transthoracic needle biopsy
  - 29 patients with diffuse interstitial disease underwent flexible bronchoscopy with transbronchial biopsy
  - Lymphangitic carcinomatosis was established in 6 (21%) of patients
  - One patient developed 30% pneumothorax which was treated with chest tube evacuation
  - The diffuse bronchial and peribronchial lymphatic involvement demonstrated suggests that TBLB should be the procedure of choice in diagnosis of lymphangitic carcinomatosis
Q 2: What is the expected yield of bronchoalveolar lavage for diagnosing lymphangitic carcinomatosis, and how does this yield compare with that of transbronchial lung biopsy?

- Bronchoalveolar lavage
  - Retrospective analysis, 12 patients with known neoplastic disease and diffuse pulmonary infiltrates consistent with lymphangitic carcinomatosis
  - BAL correctly identified 5/5 (100%)
  - No complications
  - Detection rate 93.7% (93.7%)
  - Bronchial brushing 2/5 (40%)
  - Transbronchial lung biopsy 4/9 (44%)
  - Conclusion: BAL should be performed to confirm diagnosis before proceeding to biopsy, especially when risks of pneumothorax and hemorrhage are excessive

ref. Chest 1998; 113: 1028-30

Q 3: Should you perform transbronchial lung biopsy in this case? If so, why? If not, why not?

- History of advanced COPD with increased concern for pneumothorax
- History of chronic renal insufficiency with concern for platelet dysfunction and increased risk of bleeding
- Evidence showing BAL as the initial test of choice in diagnosis of lymphangitic carcinomatosis
- Consider TBLB if BAL is non-diagnostic and patient wishes to pursue further diagnosis and treatment
Section 7

Assessment Tools

A collection of assessment tools:

- BSTAT
- BSTAT-TBLB/TBNA
- BSAT
Scoring Recommendations for
BSTAT Assessment Tools
(BSTAT, BSTAT-TBLB/TBNA)

The goal of these assessment tools is to be able to monitor a student’s progress along the learning curve from novice (Score < 60) to advanced beginner (Score 60-79), intermediate (score 80-99), and competent (score 100). The instructor should be able to ascertain, by observing the student’s performance (For BSTAT tools, this could be done on a once or twice a year basis) that each of the ten elements in each tool are covered satisfactorily. Repeated testing will demonstrate increases in knowledge and technical skill acquisition as the student climbs the learning curve from novice to advanced beginner, intermediate and competent bronchoscopist for the procedure being assessed.

To maximize objective scoring, each task has been defined explicitly in this user manual for each checklist and assessment tool. Participation in specially-designed Train-the-Trainers courses being currently organized is encouraged to assist with standardization and to help instructors use this program to its fullest potential.

Scores can be plotted on a graph, and each institution/program can obviously choose its own cut-offs for a PASS grade, although we recommend that a final PASS grade be achieved with a score of 100, in order for the student to be judged competent to perform bronchoscopy independently. In the absence of a large pilot study demonstrating standard normograms as is done for high-stakes testing, consensus of world renowned experts was obtained to delineate cut-off scores for the following four categories.

<table>
<thead>
<tr>
<th>Category</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Novice</td>
<td>&lt; 60</td>
</tr>
<tr>
<td>Advanced Beginner</td>
<td>60-79</td>
</tr>
<tr>
<td>Intermediate</td>
<td>80-99</td>
</tr>
<tr>
<td>Competent</td>
<td>100</td>
</tr>
</tbody>
</table>

Specific instructions marked by an asterisk (*) are provided in each of the following assessment tools.

**Instructions:** To administer the BSTAT, the trainee is asked to perform a complete diagnostic flexible bronchoscopy, while at all times stating what she is doing and where she is navigating in the airway. Thus, items 1, 2, 5, 6, and 7 are scored. She is then asked to go from the neutral position at the main carina to segments RB-4,5,6 and LB-8,9,10, and items 3 and 4 are scored. Items 8 and 9 are scored using the associated slide-show images. Finally, item 10 is scored while the trainee performs a BAL, brushing and mucosal biopsy. The BSTAT-TBLB/TBNA is also administered with a full diagnostic bronchoscopy, followed by a conventional TBNA and TBLB procedure (not necessarily all in the same patient, if assessment is being done in a patient).
# Bronchoscopy Skills and Tasks Assessment Tool (BSTAT)

**Student:** ________________________________   **Training Year** _____________  
**Faculty** _________________________________  **Date** ______________

<table>
<thead>
<tr>
<th>Educational Item*</th>
<th>Items 1-10 each scored separately</th>
<th>Satisfactory</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1. Identification of Right sided anatomy (2 points each, target 20 points)</strong></td>
<td>☐ RB1 apical ☐ RB2 posterior ☐ RB3 anterior ☐ RB4 medial ☐ RB5 lateral ☐ RB6 superior ☐ RB7 mediobasal ☐ RB8 anterobasal ☐ RB9 laterobasal ☐ RB10 posterobasal</td>
<td>Yes / No</td>
<td>Score ____/20</td>
</tr>
<tr>
<td><strong>2. Identification of Left sided anatomy (2 points each, target 16 points)</strong></td>
<td>☐ LB1+2 apical/posterior ☐ LB3 anterior ☐ LB4 superior ☐ LB5 inferior ☐ LB6 superior ☐ LB8 anterobasal ☐ LB9 laterobasal ☐ LB10 posterobasal</td>
<td>Yes / No</td>
<td>Score ____/16</td>
</tr>
<tr>
<td><strong>3. Identify and enter RB 4+5+6 on demand (All three segments must be entered to earn 5 points, no partial points given, target 5 points)</strong></td>
<td>☐ RB 4+5+6</td>
<td>Yes / No</td>
<td>Score ____/5</td>
</tr>
<tr>
<td><strong>4. Identify and enter LB 8+9+10 on demand (All three segments must be entered to earn 5 points, no partial points given, target 5 points)</strong></td>
<td>☐ LB 8+9+10</td>
<td>Yes / No</td>
<td>Score ____/5</td>
</tr>
<tr>
<td><strong>5. Posture/Hand positions/Equipment safety (3 points each, target 9 points)</strong></td>
<td>☐ Body posture ☐ Hand positions ☐ Equipment handling</td>
<td>Yes / No</td>
<td>Score ____/9</td>
</tr>
<tr>
<td><strong>6. Scope centered and kept in midline (5 points, no partial points given)</strong></td>
<td>☐ Scope centered in airway lumen</td>
<td>Yes / No</td>
<td>Score ____/5</td>
</tr>
<tr>
<td><strong>7. Airway wall trauma avoided (5 points, no partial points given)</strong></td>
<td>☐ Airway wall trauma avoided</td>
<td>Yes / No</td>
<td>Score ____/5</td>
</tr>
<tr>
<td><strong>8. Nomenclature: secretions descriptions (1 point each, target 10 points)</strong></td>
<td>☐ Image 1 ☐ Image 2 ☐ Image 3 ☐ Image 4 ☐ Image 5 ☐ Image 6 ☐ Image 7 ☐ Image 8 ☐ Image 9 ☐ Image 10</td>
<td>Yes / No</td>
<td>Score ____/10</td>
</tr>
<tr>
<td><strong>9. Nomenclature: Mucosal descriptions (1 point each, target 10 points)</strong></td>
<td>☐ Image 1 ☐ Image 2 ☐ Image 3 ☐ Image 4 ☐ Image 5 ☐ Image 6 ☐ Image 7 ☐ Image 8 ☐ Image 9 ☐ Image 10</td>
<td>Yes / No</td>
<td>Score ____/10</td>
</tr>
<tr>
<td><strong>10. Tasks: (5 points each, target 15 points)</strong></td>
<td>☐ BAL ☐ Mucosal biopsy ☐ Brush</td>
<td>Yes / No</td>
<td>Score ____/15</td>
</tr>
</tbody>
</table>

* The combined use of the 10 items pertains to technical skills needed to climb learning curve from novice to advanced beginner to intermediate to competent bronchoscopist able to perform flexible bronchoscopy with lavage, brushing and endobronchial biopsy independently.

**FINAL GRADE**  
PASS   FAIL   **SCORE** ___________/100
Bronchoscopy Skills and Tasks Assessment Tool, for Transbronchial Lung Biopsy and Transbronchial Needle Aspiration (BSTAT-TBLB/TBNA)

Student: _________________________________ Training Year _____________
Faculty _________________________________ Date ______________

<table>
<thead>
<tr>
<th>Educational Item*</th>
<th>Satisfactory</th>
<th>Yes/No</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1. TBLB: Airway inspection without trauma (no partial points)</strong></td>
<td>Complete inspection done properly</td>
<td>Yes / No</td>
<td>Score ____/5</td>
</tr>
<tr>
<td><strong>2. TBLB technique (no partial points)</strong></td>
<td>Wedge scope into target segment, Visualize target with fluoroscopy, Advance forceps under fluoroscopy guidance to target, Open forceps at target, Advance and close forceps at target, Remove forceps from scope</td>
<td>Yes / No</td>
<td>Score ____/10</td>
</tr>
<tr>
<td><strong>3. TBLB Complications: Pneumothorax (no partial points)</strong></td>
<td>Perform panoramic view of hemithorax using fluoroscopy, Recognize signs and symptoms, Demonstrate easy access to small or large bore chest tube</td>
<td>Yes / No</td>
<td>Score ____/10</td>
</tr>
<tr>
<td><strong>4. TBLB: Complications: Bleeding (no partial points)</strong></td>
<td>Scope wedged into target segment, Move patient into lateral decubitus safety position, Access upper airway with oral suction, Demonstrate access and use of bite block and endotracheal tube</td>
<td>Yes / No</td>
<td>Score ____/10</td>
</tr>
<tr>
<td><strong>5. TBLB: Decision making (5 points each, target score 15 points)</strong></td>
<td>Image 1, Image 2, Image 3</td>
<td>Yes / No</td>
<td>Score ____/15</td>
</tr>
<tr>
<td><strong>6. TBNA: Airway inspection and imaging interpretation (5 points each)</strong></td>
<td>Complete inspection done properly, Imaging studies correctly interpreted</td>
<td>Yes / No</td>
<td>Score ____/10</td>
</tr>
<tr>
<td><strong>7. TBNA Technique - Jab (no partial points)</strong></td>
<td>Advance catheter towards target area, Advance needle to target area without airway trauma, Jab needle through airway wall at target region while scope is fixed at nose or mouth, Move needle back and forth inside node while suctioning, Release suction prior to needle withdrawal from target region, Retract needle into the catheter, Observe that needle is completely retracted inside catheter, Withdraw catheter from scope</td>
<td>Yes / No</td>
<td>Score ____/10</td>
</tr>
<tr>
<td><strong>8. TBNA Technique-Hub against wall (no partial points)</strong></td>
<td>Advance catheter towards target area, Touch catheter to target area without airway trauma, Penetrate airway wall with needle while holding scope firmly, Move needle back and forth inside node while suctioning, Release suction prior to needle withdrawal from target region, Retract needle into the catheter, Observe that needle is completely retracted inside catheter, Withdraw catheter from scope</td>
<td>Yes / No</td>
<td>Score ____/10</td>
</tr>
<tr>
<td><strong>9. TBNA Technique - Piggyback: (no partial points)</strong></td>
<td>Secure catheter and scope simultaneously with one hand, Advance scope and catheter as a single unit to target region, Penetrate airway wall at target region, Move needle back and forth inside node while suctioning, Release suction prior to needle withdrawal from target region, Retract needle into the catheter, Observe that needle is completely retracted inside catheter, Withdraw catheter from scope</td>
<td>Yes / No</td>
<td>Score ____/10</td>
</tr>
<tr>
<td><strong>10. TBNA: Decision making: (5 points each, target 10 points)</strong></td>
<td>Image 4, Image 5</td>
<td>Yes / No</td>
<td>Score ____/10</td>
</tr>
</tbody>
</table>

* The combined use of the 10 items pertains to technical skills needed to climb learning curve from novice to advanced beginner to intermediate to competent bronchoscopist able to perform flexible bronchoscopy with transbronchial lung biopsy and transbronchial needle aspiration independently.

**FINAL GRADE**

PASS  FAIL

SCORE _________/100

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**Bronchoscopy Self Assessment Tool (BSAT)**

Please answer each question by writing the number that most closely represents your experience with the Bronchoscopy Education Program using the following scale.

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Not comfortable</td>
<td>Comfortable</td>
<td>Very comfortable</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

1. I am able to identify airway anatomy
2. I am able to identify airway mucosal abnormalities
3. I am able to describe secretions and other airway abnormalities
4. I am able to maneuver the flexible bronchoscope
5. I am able to do a BAL through the flexible bronchoscope
6. I am able to use a brush through the flexible bronchoscope
7. I am able to use a forceps to perform an endobronchial biopsy
8. I am able to use a forceps to perform a transbronchial biopsy
9. I am able to perform a conventional transbronchial needle aspiration
10. I would now feel comfortable performing this case in a patient

**Anatomy** | **Abnormalities** | **Technique** | **Equipment** | **Interpretation of findings**
---|---|---|---|---
I would like to learn more about (circle all that apply above)

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Poor</td>
<td>Below average</td>
<td>Average</td>
<td>Good</td>
<td>Excellent</td>
</tr>
</tbody>
</table>

Using the above scale please rate this training program as

I have the following comments

________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
Section 8

Checklists

A collection of checklists, with user instructions:

- Moderate sedation
- Fluoroscopy
- Informed consent
- Procedural pause
- Practical Approach
Scoring Recommendations for CHECKLISTS
(Informed Consent, Procedural Pause, Fluoroscopy, Moderate Sedation, Patient Safety, Proctored Bronchoscopy,)

The goal of these checklists is to be able to monitor a student’s progress along the learning curve from novice (Score < 60) to advanced beginner (Score 60-79), intermediate (score 80-99), and competent (score 100). The instructor should be able to ascertain, by observing the student’s performance that each of the TEN elements in each tool are covered satisfactorily. The frequency with which these tools should be used remains to be studied and is currently at the discretion of program directors.

Repeated testing will demonstrate knowledge and skill acquisition as the student climbs the learning curve from novice to advanced beginner, intermediate and competent bronchoscopist for the procedure being assessed.

To maximize objective scoring, each task in the checklists has been defined explicitly in this user manual. Participation in specially-designed Train-the-Trainers courses being currently organized is encouraged to assist with standardization, and to help instructors use this program to its fullest potential.

Scores can be plotted on a graph, and each institution/program can obviously choose its own cut-offs for a PASS grade, although we recommend that a final PASS grade be achieved with a score of 100, in order for the student to be judged competent to perform bronchoscopy independently.

In the absence of a large pilot study demonstrating standard normograms as is done for high-stakes testing, consensus of world renowned experts was obtained to delineate cut-off scores for the following four categories.

<table>
<thead>
<tr>
<th>Category</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Novice</td>
<td>&lt; 60</td>
</tr>
<tr>
<td>Advanced Beginner</td>
<td>60-79</td>
</tr>
<tr>
<td>Intermediate</td>
<td>80-99</td>
</tr>
<tr>
<td>Competent</td>
<td>100</td>
</tr>
</tbody>
</table>

Specific instructions marked by an asterisk (*) are provided in each of the following checklists.
MODERATE SEDATION 10-Point CHECKLIST *

Student _______________________________ Training Year _______________
Faculty _______________________________ Date _______________________

Interactive session  Patient environment

<table>
<thead>
<tr>
<th>Educational Item*</th>
<th>Satisfactory</th>
</tr>
</thead>
<tbody>
<tr>
<td>Items 1-10 are scored 10 points each (no partial points given)</td>
<td>Yes/No</td>
</tr>
</tbody>
</table>

1. Definitions
   - Moderate sedation
   - Deep sedation
   - Yes / No

2. Able to obtain moderate sedation informed consent
   - Yes / No

3. Able to describe ASA classification
   - 1
   - 2
   - 3
   - 4
   - 5
   - Yes / No

4. Able to identify high risk patients
   - Yes / No

5. Able to describe potential contraindications
   - Yes / No

6. Sedation agents: role, dosage, precautions
   - Midazolam
   - Fentanyl
   - Yes / No

7. Reversal agents: role, dosage, precautions
   - Flumazenil
   - Naloxone
   - Yes / No

8. Able to describe how to respond to complications such as
   - Vomiting
   - Seizure
   - Yes / No

9. Able to describe how to respond to over-sedation and
   - Hypotension
   - Airway obstruction
   - Yes / No

10. Able to describe how to respond to over-sedation and
    - Hypoxemia
    - Respiratory failure
    - Yes / No

* Each of the 10 items contains all of the elements required by ACGME (patient care, medical knowledge, practice-based learning and improvement, interpersonal communication skills, professionalism, and systems-based practice).

FINAL GRADE       PASS       FAIL       SCORE _______ /100
**FLUOROSCOPY 10-Point CHECKLIST**

Student _________________________________   Training Year ____________

Faculty __________________________________   Date ____________________

☐ Interactive session  ☐ Patient environment

<table>
<thead>
<tr>
<th>Educational Item*</th>
<th>Satisfactory</th>
</tr>
</thead>
<tbody>
<tr>
<td>Items 1-10 are scored 10 points each (no partial points given)</td>
<td>Yes/No</td>
</tr>
<tr>
<td>1. Able to list indications for using fluoroscopy</td>
<td>Yes/No</td>
</tr>
<tr>
<td>2. Able to describe the relevance of voltage and amperage</td>
<td>Yes/No</td>
</tr>
<tr>
<td>☐ For image quality  ☐ For patient safety</td>
<td></td>
</tr>
<tr>
<td>3. Able to describe consequences of resolution, distortion, and lag</td>
<td>Yes/No</td>
</tr>
<tr>
<td>☐ For image quality  ☐ For patient safety</td>
<td></td>
</tr>
<tr>
<td>4. Able to describe consequences of brightness and contrast</td>
<td>Yes/No</td>
</tr>
<tr>
<td>☐ For image quality  ☐ For patient safety</td>
<td></td>
</tr>
<tr>
<td>5. Able to describe dangers of scattered radiation</td>
<td>Yes/No</td>
</tr>
<tr>
<td>6. Able to describe techniques to improve visibility of fluoroscopic image</td>
<td>Yes/No</td>
</tr>
<tr>
<td>7. Able to describe techniques used to reduce patient radiation exposure</td>
<td>Yes/No</td>
</tr>
<tr>
<td>8. Able to describe techniques used to reduce operator radiation exposure</td>
<td>Yes/No</td>
</tr>
<tr>
<td>9. Able to describe special precautions in case of suspected or known pregnancy</td>
<td>Yes/No</td>
</tr>
<tr>
<td>☐ Patients  ☐ Health care providers</td>
<td></td>
</tr>
<tr>
<td>10. Able to describe basic operation procedures</td>
<td>Yes/No</td>
</tr>
</tbody>
</table>

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**FINAL GRADE**  
PASS  
FAIL  
SCORE _______/100
INFORMED CONSENT 10-Point CHECKLIST*

<table>
<thead>
<tr>
<th>Educational Item*</th>
<th>Satisfactory Yes/No</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Educational Item</strong></td>
<td>Items 1-10 are scored 10 points each (no partial points given)</td>
</tr>
<tr>
<td>1. Able to define “Informed Consent”:</td>
<td>Yes / No</td>
</tr>
<tr>
<td>□ Informed decision-making regarding indications and expected outcomes, conflict of interest</td>
<td></td>
</tr>
<tr>
<td>□ Protection from liability</td>
<td></td>
</tr>
<tr>
<td>□ Provides opportunity to assess management strategies</td>
<td></td>
</tr>
<tr>
<td>□ Provides opportunity to discuss risks, benefits, and alternatives</td>
<td></td>
</tr>
<tr>
<td>1. Able to discuss diagnosis and pertinent clinical issues</td>
<td>Yes / No</td>
</tr>
<tr>
<td>2. Able to describe the purpose of the procedure</td>
<td>Yes / No</td>
</tr>
<tr>
<td>3. Able to describe the nature of the procedure</td>
<td>Yes / No</td>
</tr>
<tr>
<td>4. Able to describe procedure-related risks</td>
<td>Yes / No</td>
</tr>
<tr>
<td>5. Able to describe procedure-related benefits</td>
<td>Yes / No</td>
</tr>
<tr>
<td>7. Able to describe alternative procedures regardless of cost or health care coverage</td>
<td>Yes / No</td>
</tr>
<tr>
<td>8. Able to describe potential risks and benefits from choosing the alternatives</td>
<td>Yes / No</td>
</tr>
<tr>
<td>9. Able to describe the risks and benefits of not performing the procedure or not choosing any of the alternatives</td>
<td>Yes / No</td>
</tr>
<tr>
<td>10. Able to demonstrate “effectiveness” of the informed consent process by asking the patient to explain in his or her own words, their understanding of the procedure</td>
<td>Yes / No</td>
</tr>
</tbody>
</table>

* Each of the 10 items contains all of the elements required by ACGME (patient care, medical knowledge, practice-based learning and improvement, interpersonal communication skills, professionalism, and systems-based practice).

FINAL GRADE  PASS  FAIL  SCORE  ____/100
### PROCEDURAL PAUSE 10-Point CHECKLIST*

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<td>Yes/No</td>
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</table>

1. Able to define “Procedural Pause” as:
   - Time-Out
   - Wrong patient, site, procedure
   - Team communication/patient understanding
   - Mandatory in USA
   - Yes/No

4. Able to describe requirements of the procedural pause:
   - Immediately before procedure
   - Correct site, position, procedure
   - Correct patient
   - Pertinent medical records and equipment
   - Verbal acknowledgements by all team members
   - Elimination of environmental distractions
   - Yes/No

5. Able to describe the team leader’s role
   - Yes/No

6. Able to describe the nursing team’s role
   - Yes/No

7. Able to describe the patient’s role
   - Yes/No

8. Able to describe other person’s roles (technicians, other physicians)
   - Yes/No

7. Able to list the elements that must be covered:
   - Patient
   - Procedure
   - Side and site
   - Informed consent
   - Medical records and equipment
   - Medications
   - Allergies/drug reactions
   - Safety concerns based on history
   - Yes/No

8. Able to address behaviors in case of distractions
   - Yes/No

9. Able to describe behaviors in case of disagreements
   - Yes/No

10. Able to describe other elements pertaining to assuring a culture of safety:
    - Communication
    - Ability to prevent and respond to complications
    - Universal, Droplet, and Airborne pathogen precautions
    - Yes/No

Each of the 10 items contains all of the elements required by ACGME (patient care, medical knowledge, practice-based learning and improvement, interpersonal communication skills, professionalism, and systems-based practice).

**FINAL GRADE**

PASS     FAIL     SCORE _____/100

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PRACTICAL APPROACH 10 Point CHECKLIST*

Student _________________________________  Training Year _______________

Faculty __________________________________   Date _______________________

☑ Instructor-learner 30 minute session   ☐ Daily rounds & bronchoscopy consultation

<table>
<thead>
<tr>
<th>Educational Item*</th>
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<td>Items 1-10 are scored 10 points each (no partial points given)</td>
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</table>

1. Initial evaluation A
   ☐ Physical examination, laboratory tests, and functional assessment
   ☐ Comorbidities

2. Initial evaluation B
   ☐ Support system   ☐ Preferences and expectations

3. Procedural strategies A
   ☐ Indications, contraindications, expected results  ☐ Operator and team experience and expertise

4. Procedural strategies B
   ☐ Risk-benefits and therapeutic alternatives   ☐ Informed consent

5. Techniques and results A
   ☐ Anesthesia and perioperative care   ☐ Techniques and instruments

6. Techniques and results B
   ☐ Anatomic dangers and other risks   ☐ Results and complications

7. Long-term management plan A
   ☐ Outcome assessment   ☐ Follow-up tests and procedures

8. Long-term management plan B
   ☐ Referrals to other specialists   ☐ Quality improvement and team evaluation

9. Able to answer case-specific questions
   ☐ Question 1   ☐ Question 2   ☐ Question 3

10. General ability to provide evidence for and rationally justify decision making
    ☐ Subjective assessment of learner ability

*These 10 items contain all of the elements required by ACGME (patient care, medical knowledge, practice-based learning and improvement, interpersonal communication skills, professionalism, and systems-based practice).

FINAL GRADE   PASS   FAIL   SCORE _______/100
CONGRATULATIONS

You have completed reading about the Bronchoscopy Education Project. Please send us your comments regarding your participation in this international endeavor by contacting your national bronchology association, emailing us at www.bronchoscopy.org or by contacting Doctor Henri Colt at hcolt@uci.edu and Doctor Eric Edell at Edell@mayo.edu