INSTRUCTIONS
Selected Best Practices and Suggestions for Improvement

What is this tool? The purpose of this tool is to provide:

- Detailed description of best practices, including supporting evidence, suggestions for improvement, prescribed process steps, and additional resources.
- Sufficient information to complete a Gap Analysis (Tool D.5), make a decision to implement (or not to implement) a process, and develop an Implementation Plan (Tool D.6).

These tools provide information on evidence-based best practices when available, as well as information gathered from real-world experience in working with hospitals. These tools are not meant to replace validated guidelines. Rather, these documents are meant to supplement various improvement process projects related to the AHRQ Quality Indicators.

The information used to populate these documents is derived from professional association guidelines, the research literature, and experience and lessons learned from hospitals' work on previous AHRQ Quality Indicator implementation efforts. The references cited were not derived from a full systematic evidence-based literature review. Rather, the list includes more well-known research and publications on the subject, where available.

The information contained in these documents should be used to review and compare against your organization's current processes to determine where gaps may exist. As always, the final decision regarding whether to implement the guidance provided in this document should be made by a multidisciplinary quality improvement team in your hospital and should be based on information specific to your organization.

Who are the target audiences? The primary audiences include quality improvement leaders, clinical leaders, and multidisciplinary frontline staff members.

How can the tool help you? The Best Practices and Suggestions for Improvement Tool details each of the following components of a best practice and its implementation:

- Indicator Specifications
- Literature Support
- Best Processes/Systems of Care
- Additional Resources

How does this tool relate to others? The Best Practices and Suggestions for Improvement Tools are used to prepare the Gap Analysis (Tool D.5) and the Implementation Plan (Tool D.6).

Instruction Steps

1. See instructions for Gap Analysis (Tool D.5).

2. Use the appropriate Selected Best Practices and Suggestions for Improvement Tool to populate the Gap Analysis (Tool D.5).

Selected Best Practices and Suggestions for Improvement

Patient Safety Indicator Specifications

PSI 6: Iatrogenic Pneumothorax

Numerator: Discharges with International Classification of Diseases (ICD)-9 code for iatrogenic pneumothorax in any secondary diagnosis field among cases meeting the inclusion and exclusion rules for the denominator.

Denominator: All surgical and medical discharges age 18 years and older defined by specific diagnosis-related groups (DRGs) or Medicare Severity (MS)-DRGs.

Exclude:

- Principal diagnosis of iatrogenic pneumothorax or secondary diagnosis present on admission.
- Major diagnostic category 14 (Pregnancy, Childbirth, and Puerperium).
- Any diagnosis code of chest trauma or pleural effusion.
- A code of diaphragmatic surgery repair in any procedure field.
- Any code indicating thoracic surgery, lung or pleural biopsy, or cardiac surgery procedure.
- Missing gender (SEX=missing), age (AGE=missing), quarter (DQTR=missing), year (YEAR=missing), or principal diagnosis (DX1=missing).

Reference: AHRQ Patient Safety Indicators Technical Specifications, Version 4.3, August 2011.

Recommended Practice	Details of Recommended Practice
Identification of Patients at Risk	Develop a process to address common iatrogenic pneumothorax risk factors identified in the literature.[5]
Safe Insertion Techniques During Pleural Procedures	Standardize procedures and position techniques during pleural procedures, such as thoracentesis and chest tube insertion.[1,4,12,13]
Physician Training	Develop specified training components and criteria and establish a plan for continued competency[1,4]
Standardized Practices	Develop and standardize practices for site identification, marking, and procedural practice.[1,4,10, 11, 15, 16]

Literature Support

<u>Identification of Patients at Risk</u>

"Iatrogenic pneumothorax (IP) is a life-threatening complication seen in 3% of ICU patients. Incorporating risk factors for IP into preventive strategies should reduce the occurrence of IP."

De Lassence A, Timsit JF, Tafflet M, et al. Pneumothorax in the intensive care unit. Anesthesiology 2006;104(1):5–13.

"There were 90 cases of spontaneous pneumothorax at this institution during the same time period. The most common cause of iatrogenic pneumothorax was transthoracic needle aspiration, followed by thoracentesis, subclavian venipuncture, and positive pressure ventilation]."

Despars J, Sassoon C, Light R. Significance of iatrogenic pneumothoraces. Chest 1994;105:1147–-50.

Safe Insertion Techniques During Pleural Procedures

"The UK National Patient Safety Agency recently highlighted 12 deaths and 15 cases of serious harm related to chest drain insertion between 2005 and 2008. Lack of physician experience, supervision, adequate imaging and knowledge of published insertion guidelines, as well as inappropriate choice of insertion sites, contributors contributed to adverse events."

Wrightson J, Fysh E, Maskell N, et al. Risk reduction in pleural procedures: sonography, simulation and supervision. Curr Opin Pulm Med 2010;16:340–50.

Physician Training

"An improvement program that included simulation, ultrasound guidance, competency testing, and performance feedback reduced iatrogenic risk to patients. We recommend application of this process to procedural practices."

Duncan DR, Morgenthaler TI, Ryu JH, et al. Reducing iatrogenic risk in thoracentesis: establishing best practice via experiential training in a zero-risk environment. Chest 2009;135:1315–20.

"At training hospitals the incidence of [iatrogenic pneumothorax] will increase in parallel to the increase in invasive procedures. Invasive procedures should be performed by experienced personnel or under their supervision when risk factors are involved."

Celik B, Sahin E, Nadir A, et al. Iatrogenic pneumothorax: etiology, incidence, and risk factors. Thorac Cardiovasc Surg 2009;57:286–90.

Standardized Practices

"Significant harm could be prevented by careful consideration of the site chosen for a proposed procedure. Poor site selection risks visceral injury; lung, heart, liver, spleen, esophagus, diaphragm, kidney and stomach penetration have been reported with chest drain insertion and pleural aspiration."

"Simpler to learn and perform, 'site marking' determines an optimal location prior to a procedure, but not during, drain insertion."

Wrightson J, Fysh E, Maskell N, et al. Risk reduction in pleural procedures: sonography, simulation and supervision. Curr Opin Pulm Med 2010;16:340–50.

"The basis of our methodology to train physicians with the use of ultrasound and to assure procedural competency included the creation of a zero-risk experiential training environment.…This resulted in a marked reduction in the number of iatrogenic pneumothoraces…"

Duncan DR, Morgenthaler TI,Ryu JH, et al. Reducing iatrogenic risk in thoracentesis: establishing best practice via experiential training in a zero-risk environment. Chest 2009;135:1315–20.

Best Processes/Systems of Care

Introduction: Essential First Steps

- Engage key procedural personnel, including nurses, physicians, technicians, and representatives from the quality improvement department, to develop evidence-based protocols for care of the patient preprocedure, intraprocedure, and postprocedure to prevent iatrogenic pneumothorax.
- The above team:
  - Identifies the purpose, goals, and scope and defines the target population for this guideline.
  - Analyzes problems with guidelines compliance, identifies opportunities for improvement, and communicates best practices to frontline teams.
  - Establishes measures to indicate if changes are leading to improvement; identifies process and outcome metrics, and tracks performance using these metrics based on a standard performance improvement methodology (e.g., FOCUS-PDSA).
  - Determines appropriate facility resources for effective and permanent adoption of practices.

Recommended Practice: Identification of Patients at Risk

- Determine risk for iatrogenic pneumothorax during the history and physical.
- Consider the many factors identified in the literature that are associated with a higher risk of iatrogenic pneumothorax. These can be categorized as either patient related or procedure related.

  Patient-related factors include:
  - History of AIDS.
  - Body habitus.
  - Effusion size.
  - Localized fluid.
  - Chronic obstructive pulmonary disease.
  - Depth of the lesion.
  - Diagnosis of cardiogenic pulmonary edema at admission.
  - Diagnosis of acute respiratory distress syndrome at admission.
  - Insertion during the first 24 hours of a central venous catheter or pulmonary artery catheter.
  - Use of vasoactive agents within 24 hours postprocedure.[5]
  - Cancer of kidney and renal pelvis (risk is likely due to the need for transthoracic needle aspiration, which is used for diagnostic purposes).

  Procedure-related factors include:
  - Transthoracic needle aspiration.

- Thoracentesis.
- Subclavian venipuncture.
- Positive pressure ventilation.
- Bronchoscopy.
- Respiratory and mechanical ventilation.
- Abdominal cavity operations.
- Pleural biopsy.
- Coughing during the procedure (patient).

Recommended Practice: Safe Insertion Techniques During Pleural Procedures

- Standardize procedures and equipment.[4]
  - Use of real-time ultrasound to identify and mark site and/or guidance for thoracentesis.
  - Requirement of preprocedural verification of the correct patient using two identifiers.
  - Requirement of preprocedural verification of the intended procedure and the correct site selection.
- Use a lateral approach; avoid posterior approach if possible. A lateral approach minimizes risks of vessel laceration.[1,12]
- Use blunt dissection vs. trocar use for chest tube insertion.[1,13]

Recommended Practice: Physician Training

- Provide specified training, including three components:
  - Theoretical didactic training,
  - Simulated practice, and
  - Formal, supervised practice with minimum observation criteria.[1,4]
- Consider identifying a subset of practitioners (e.g., focus group) who receive specific training to perform the procedure (thoracentesis, chest tube insertion) regularly. Establish criteria for continued competency with minimum procedural number.[1,4]

Recommended Practice: Standardized Practices

- Appropriate site selection, including use of the ”safe triangle” (defined by the anterior border of the latissimus dorsi, the lateral border of the pectoralis major, and a horizontal line through the anatomical position of the ipsilateral nipple) as a default to reduce chances of visceral perforation. Consider using pleural ultrasound to provide real-time localization of pleural fluid.[1,10]
- Site marking performed immediately prior to the procedure to reduce the likelihood of fluid redistribution or tissue/organ movement secondary to patient repositioning.[1,11]
- Implementation of procedural guidelines (e.g., American College of Chest Physicians).

Educational Recommendation

- Plan and provide education on protocols to physician, nursing, and all other staff involved in procedural cases. Education should occur upon hire, annually, and when this protocol is added to job responsibilities.

Effectiveness of Action Items

- Track compliance with elements of established protocol by using checklists, appropriate documentation, etc.

- Evaluate effectiveness of new processes, determine gaps, modify processes as needed, and reimplement practices.
- Mandate that all personnel follow the safety protocols developed by the team to prevent iatrogenic pneumothorax and develop a plan of action for staff in noncompliance.
- Provide feedback to all stakeholders (physician, nursing, and ancillary staff; senior medical staff; and executive leadership) on the level of compliance with process.
- Conduct surveillance and determine prevalence to evaluate outcomes of new process.
- Monitor and evaluate performance regularly to sustain improvements achieved.

Additional Resources

√ *Systems/Processes*

- WHO Surgical Care at the District Hospital 2003, World Health Organization

√ *Staff Required*

- Physicians
- Registered nurses
- Respiratory therapists

√ *Equipment*

- Computerized tomography (CT)
- Ultrasound

√ *Communication*

- Education on policy/protocol of monitoring and treatment of pneumothorax
- Communication system to escalate up the chain of command when physician not responding to diagnosis of pneumothorax or signs and symptoms of pneumothorax

√ *Authority/Accountability*

- Senior leaders such as chief/chairs of surgery and medicine, nursing leadership, and unit managers

Supporting Literature

1. Wrightson J, Fysh E, Maskell N, et al. Risk reduction in pleural procedures: sonography, simulation and supervision. Curr Opin Pulm Med 2010;16:340–50.
2. Sadeghi B, Baron R, Zrelak P, et al. Cases of iatrogenic pneumothorax can be identified from ICD-9-CM coded data. Am J Med Qual 2010;25(3):218–24.

3. Celik B, Sahin E, Nadir A, et al. Iatrogenic pneumothorax: etiology, incidence, and risk factors. Thorac Cardiovasc Surg 2009;57:286–90.

4. Duncan DR, Morgenthaler TI, Ryu JH, et al. Reducing iatrogenic risk in thoracentesis: establishing best practice via experiential training in a zero-risk environment. Chest 2009;135:1315–20.

5. de Lassence A, Timsit JF, Tafflet M, et al. Pneumothorax in the intensive care unit. Anesthesiology 2006;104(1):5–13.

6. Zhan C, Smith M, Stryer D. Accidental iatrogenic pneumothorax in hospitalized patients. Med Care 2006;44(2):182–86.

7. Despars J, Sassoon C, Light R. Significance of iatrogenic pneumothoraces. Chest 1994;105:1147–50.

8. Ponde VC. Continuous infraclavicular brachial plexus block: a modified technique to better secure catheter position in infants and children. Anesth Analg 2008;106(1):94–96.

9. Renes SH, Bruhn J, Gielen Mj, et al. In-plane ultrasound-guided thoracic paravertebral block. Reg Anesth Pain Med 2010;35(2):212–6.

10. Havelock T, Teoh R, Laws D, et al. Pleural procedures and thoracic ultrasound: British Thoracic Society Pleural Disease Guideline 2010. Thorax 2010 Aug;65 Suppl 2:ii61–76.

11. Raptopoulos V, Davis LM, Lee G. Factors affecting the development of pneumothorax associated with thoracentesis. Am J Roentgeneol 1991;156:917–20.

12. Wraight W, Tweedie D, Parkin I. Neurovascualar anatomy and variation in the fourth, fifth, and sixth intercostal spaces in the midaxillary line: a cadaveric study in respect to chest drain insertion. Clin Anat 2005;18:346–49.

13. Deneuville M. Morbidity of percutaneous tube thoracostomy in trauma patients. Eur J Cardiothorac Surg 2002;22:673–8.

14. Mayo P, Beaulieu Y, Doelken P. American College of Chest Physicians: competence in critical care ultrasonography. Chest 2009;125:1050–60.

15. Chalice R, Chalice R. Improving health care using Toyota Lean production methods: 46 steps for improvement. Milwaukee: ASQ Quality Press.

16. Improvement tip: find and root it out. Cambridge, MA: Institute for Healthcare Improvement; 2008. Available at: http://www.ihi.org.

17. Barnes TW, Morgenthaler TI, Olson EJ, et al. Sonographically guided thoracentesis and rate of pneumothorax. J Clin Ultrasound 2005;33:442–6.

18. Jones P, Moyers J, Rogers J. Ultrasound-guided thoracentesis: is it a safer method? Chest 2003;123:418–23.

19. Grogan D, Irwin R, Channick R. Complications associated with thoracentesis. A prospective, randomized study comparing three different methods. Arch Intern Med 1990;150:873–7.