### About the Measure

<table>
<thead>
<tr>
<th>Domain:</th>
<th>Respiratory</th>
</tr>
</thead>
<tbody>
<tr>
<td>Measure:</td>
<td>Arterial Blood Gas (ABG)</td>
</tr>
<tr>
<td>Definition:</td>
<td>An arterial blood gas (ABG) test is performed using blood from an artery. The test is used to determine the pH of the blood, the partial pressure of carbon dioxide and oxygen, and the bicarbonate level. ABG testing is mainly used in critical care and pulmonary medicine, to assess oxygenation, ventilation, and acid-base status, but it can also be used in research settings.</td>
</tr>
<tr>
<td>Purpose:</td>
<td>This test is used to check how well the lungs are able to move oxygen into the blood and remove carbon dioxide from the blood. An arterial blood gas (ABG) test is conducted to evaluate for severe breathing problems and lung diseases, such as asthma, cystic fibrosis, or chronic obstructive pulmonary disease (COPD). This test is also used to determine the need for mechanical ventilation.</td>
</tr>
<tr>
<td>Essential PhenX Measures:</td>
<td>None</td>
</tr>
<tr>
<td>Related PhenX Measures:</td>
<td>Respiratory Rate, Pulse Oximetry (Rest), Pulse Oximetry (Exercise), Pulse Oximetry (Sleep)</td>
</tr>
<tr>
<td>Keywords:</td>
<td>Respiratory, American Association of Respiratory Care, AARC, partial pressure of carbon dioxide, PaCO₂, partial pressure of oxygen, PaO₂, blood gas analysis, hemoximetry</td>
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<tr>
<td>Measure Release Date:</td>
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</tbody>
</table>

### About the Protocol

| Protocol Release Date: | |
| PhenX Protocol Name: | Arterial Blood Gas (ABG) |
| Protocol Name from Source: | Blood Gas Analysis and Hemoximetry |
| Description: | This protocol describes the procedures for blood collection for arterial blood gas (ABG) analysis. It involves puncturing an artery with a thin needle and syringe and drawing a small volume of blood. The most common puncture site is the radial artery at the wrist, but sometimes the femoral artery in the groin or other sites is used. |
| Specific Instructions: | Arterial Blood gases can be collected using pre-assembled kits that contain gloves, anti-septic skin solution, pre-heparinized syringe (usually three mL) and small gauge needle (22-25 gauge) with cap, and a plastic hazard bag for iced transport. If not using a pre-assembled kit, care should be taken to minimize the heparin in the syringe, which can lower the pH and dilute the |
pCO2. At least two mL should be collected and air bubbles should not exceed 1-2 percent of the blood volume.

Protocol:

Blood is drawn anaerobically from a peripheral artery (radial, brachial, femoral, or dorsalis pedis) via a single percutaneous needle puncture, or from an indwelling arterial cannula or catheter for multiple samples.

Either method provides a blood specimen for direct measurement of partial pressures of carbon dioxide (PaCO2) and oxygen (PaO2), hydrogen ion activity (pH), total hemoglobin (Hbtotal), oxyhemoglobin saturation (HbO2), and the dyshemoglobins carboxyhemoglobin (COHb) and methemoglobin (MetHb).

Indications:

1. The need to evaluate the adequacy of ventilatory (PaCO2) acid-base (pH and PaCO2), and oxygenation (PaO2 and SaO2) status, and the oxygen-carrying capacity of blood (PaO2, HbO2, Hbtotal, and dyshemoglobins).
2. The need to quantitate the patient’s response to therapeutic intervention and/or diagnostic evaluation (e.g., oxygen therapy, exercise testing).
3. The need to monitor severity and progression of a documented disease process.

Contraindications:

Contraindications are absolute unless specified otherwise.

1. Negative results of a modified Allen test (collateral circulation test) are indicative of inadequate blood supply to the hand and suggest the need to select another extremity as the site for puncture.
2. Arterial puncture should not be performed through a lesion or through or distal to a surgical shunt (e.g., as in a dialysis patient). If there is evidence of infection or peripheral vascular disease involving the selected limb, an alternate site should be selected.
3. Agreement is lacking regarding the puncture sites associated with a lesser likelihood of complications; however, because of the need for monitoring the femoral puncture site for an extended period, femoral punctures should not be performed outside the hospital.
4. A coagulopathy or medium-to-high-dose anticoagulation therapy (e.g., heparin or coumadin, streptokinase, and tissue plasminogen activator but not necessarily aspirin) may be a relative contraindication for arterial puncture.
5. Improperly performing equipment, untrained personnel, or improper collection and/or handling of the specimen.

Limitations of Method/Validation of Results
Limitations:

- Artery may be inaccessible due to periarterial tissues (overlying muscle, connective tissue, or fat).
- Pulse may not be palpable.
- Arteriospasm may preclude collection despite successful introduction of needle into the artery.
- Arterial blood specimens withdrawn from the body only reflect the physiologic condition at the moment of sampling (e.g., pain from the puncture itself may lead to hyperventilation with consequent changes in values).
- Specimens drawn at peak exercise best reflect response to exercise; however, specimens drawn within 15 seconds or less of termination of exercise may be acceptable (otherwise results do not reflect ventilatory status during dynamic activities and may yield false-negatives for hypoxemic events).
- Specimens from mechanically ventilated patients with minimal pulmonary pathology adequately reflect the effects of oxygen concentration change 10 minutes after the change. In spontaneously breathing patients, at least 20-30 minutes should elapse following oxygen concentration change (patients with obstructive defects and increased residual volumes may require the full 30 minutes or longer).
- Specimens held at room temperature must be analyzed within 10-15 minutes of drawing; iced samples should be analyzed within 1 hour. The PaO₂ of samples drawn from subjects with elevated white cell counts may decrease very rapidly. Immediate chilling is necessary. Some dual-purpose electrolyte/blood gas analyzers stipulate immediate analysis without chilling because of possible elevations in potassium from chilling; however, the accuracy of the blood gas results should not be affected by the chilling.

Validation of results:

- Sample must be obtained anaerobically and anticoagulated, with immediate expulsion of air bubbles. Sample should be immediately chilled or analyzed within 10-15 minutes if left at room temperature.
- When a sample is obtained, date, time, patient's body temperature, position, activity level, respiratory rate, sample site, results of Allen test, inspired oxygen concentration or supplemental oxygen flow, and mode of supported ventilation should be documented in the patient's medical record with the results of blood gas analysis.
- Appropriate sample size depends on the anticoagulant used, the
requirements of the specific analyzers to be used, and the presence of a
need for other assays.

- If liquid heparin (sodium or lithium, 1,000 units/mL of blood) is used,
excess heparin (all except that filling the dead space of the syringe
and needle) should be expelled and a blood sample of 2-4 mL be drawn (liquid
heparin dilutes the specimen and changes PCO₂ and PO₂ in direct
relationship to the heparin volume).

- If lyophilized heparin is used, the minimum volume drawn depends on the
design of the analyzers and the need for other assays.

- If other assays are required (e.g., electrolyte determination), the choice of
anticoagulant and the volume of the blood sample should be guided by the
analyzer manufacturer's recommendations.

**Selection Rationale:**
This protocol, supported by the American Association of Respiratory Care,
was written by an expert panel of respiratory care professionals and has
been used for many years.

**Source:**
*Respiratory Care, 58*(10), 1694–1703.

**Life Stage:**
Any age

**Language:**
English

**Participant:**
All ages

**Personnel and Training Required:**
Arterial blood sampling should be performed under the direction of a
physician specifically trained in laboratory medicine, pulmonary medicine,
anesthesia, or critical care. Two levels of training and experience are
recognized for the actual sampling. In addition, as one aspect of a quality
assurance monitoring program, individuals performing arterial puncture
should undergo periodic reevaluation relative to universal precautions,
proper syringe preparation, site determination, puncture technique, sample
acquisition, storage and disposal of blood specimens, and postsampling
care of puncture site. Individuals who do not meet acceptable indicator
thresholds should not continue to perform punctures independently until
they have received remedial instruction and been reevaluated. (Please
note that failure to obtain a sample from a single arterial puncture does not
indicate failure as long as all other aspects of the indicator are acceptable.)

Level I: Individuals designated as Level I should have a high school
education plus specific training in sampling arterial blood, oxygen delivery
devices and related equipment, record keeping, and the associated
hazards and sources of specimen and sampler contamination. Additionally,
a strong background in mathematics, with 1 year or more of college
courses in the physical and biologic sciences is preferred. Performance of
blood sampling should be supervised by a Level II individual.

Level II: The Level II person is a health care professional trained in patient
assessment, acid-base, oxygenation disorders, and diagnostic and
therapeutic alternatives—an associate or higher degree in the sciences or
respiratory therapy or substantial experience in pulmonary function technology is preferred. Two years of college with courses in the biologic sciences and mathematics plus 2 years of training and experience may be substituted for personnel supervising arterial blood sampling. Level II personnel sample and supervise Level I personnel during sampling. A recognized credential (MD, DO, CRTT, RRT, RN, RPFT, CPFT, MT, MLT, RCVT, or equivalent) is strongly recommended.

| **Equipment Needs:** | Single puncture: Appropriate anticoagulant, sterile glass or plastic (low diffusibility) syringe with needle, patient label, 70% isopropyl alcohol or other suitable antiseptic solution, gauze squares or similar material, well-fitting latex or vinyl gloves, puncture-resistant container, syringe cap, "cork," and device to remove needle from syringe.

The term "cork" describes any device designed to allow insertion of the sample needle point after withdrawal from the artery. The purpose of the cork is to reduce exposure time of the sampler to the contaminated needle and remind the sampler not to re-sheathe the needle, thus reducing the potential for inadvertent needle stick. The cork should provide some resistance to insertion and should not allow the needle to completely traverse it. Devices that allow single-hand recapping are preferred.

Indwelling catheter: Sterile glass or plastic (low diffusibility) syringe that has been appropriately anticoagulated, "waste" syringe, syringe cap, protective eyewear and outerwear (in the anticipation of splashing), well-fitting latex or vinyl gloves, and patient labels (6–8) (local anesthetic is recommended for arterial line insertion).

Container of ice and water (to immerse syringe barrel if specimen will not be analyzed within 15 minutes). |


| **Mode of Administration:** | Bioassay |

| **Derived Variables:** | None |

<table>
<thead>
<tr>
<th><strong>Requirements:</strong></th>
<th><strong>Requirement Category</strong></th>
<th><strong>Required (Yes/No):</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Major equipment</td>
<td>Yes</td>
<td></td>
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<tr>
<td>Specialized training</td>
<td>Yes</td>
<td></td>
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<tr>
<td>Specialized requirements for biospecimen collection</td>
<td>Yes</td>
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<tr>
<td>Process and Review:</td>
<td>The <a href="#">Expert Review Panel #6</a> (ERP 6) reviewed the measures in the Respiratory domain.</td>
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<tr>
<td></td>
<td>Guidance from ERP 6 includes:</td>
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<tr>
<td></td>
<td>• An updated protocol</td>
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</tr>
<tr>
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<td>Back-compatible: no changes to Data Dictionary</td>
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<td>Previous version in Toolkit archive (<a href="#">link</a>)</td>
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<tr>
<td>Annotations for Specific Conditions:</td>
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