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APACHE® Foundations User Guide

Methodology & Data Collection

APACHE Foundations Overview

APACHE Foundations is a free, web-based offering from Cerner Corporation that provides users the ability to calculate and report on outcomes data based upon the APACHE IV predictions available in the public domain. With APACHE Foundations, the following scores, predictions and reports are provided (based upon the patient’s first day in the ICU):

- APS (Acute Physiology Score)
- APACHE III score
- APACHE IV hospital mortality risk prediction
- APACHE IV expected ICU LOS prediction
- APACHE II score (for patients with a diagnosis of sepsis)
- Risk-Adjusted Patient List Report
- Aggregated Risk Adjustment Outcomes Report

The system may be used in a number of ways to best suit your needs and goals:

1. As an on-line calculator to quickly obtain scores and predictions for individual patients or subsets of patients on an as needed basis
2. As a severity-adjusted outcomes measurement system for an individual ICU (or group of ICUs) to assess quality of care and identify opportunities for improvement
The accuracy of APACHE predictions is dependent upon the quality of data upon which predictions are made. Deviations from the precise data collection methodology may result in errors in prediction for which Cerner Corporation cannot be responsible. Please review this user guide carefully for an understanding of the methodology and operational definitions for data collection. For in depth information on the APACHE methodology, please refer to research article links on the APACHE Foundations home page.

## History of APACHE

In 1978, the developers of APACHE recognized the need to collect quality information on patients in the ICU and to use that information to improve outcomes. This led to the development of the Acute Physiology, Age and Chronic Health Evaluation system, known by its acronym, APACHE. Further work by APACHE’s developers led to the introduction of APACHE II in 1985. Hospital mortality predictions in APACHE II were based on the prognostic impact of the deviation from normality for 12 physiologic values (consolidated into a measure of physiologic derangement known as the Acute Physiology Score or APS), age, chronic health status and one of 56 disease groups. APACHE II continues to be used as a valid severity-of-illness measurement, but its mortality predictions are no longer valid because the case-mix adjustment is inadequate, and mortality is severely over-estimated because outcome prediction is based on 1979-1981 data.

In 1991, APACHE III was introduced, changing the number and weightings of APS variables and revising the measurement of chronic health status using seven co-morbidities. Other changes included expanding the number of disease groups to 78 from 56, adding terms for admission source and including a variable indicating if the patient was a post-operative admission.

This version of APACHE consisted of a set of equations for predicting ICU and hospital mortality, ICU and hospital length of stay, risk of active treatment, duration of mechanical ventilation and the Therapeutic Intervention Scoring System (TISS) score. APACHE researchers expanded predictions of mortality, risk of active treatment and TISS score by developing daily equations that predicted the pertinent outcome on the next day. Additional equations were constructed for use with patients undergoing coronary artery bypass grafting (CABG) surgery. Periodically, these outcome predictions were re-evaluated and updated. New developments in protocols and practices within ICUs since the advent of APACHE III prompted a full review and updating of all of the APACHE III equations in 2004. The result was a new set of equations called APACHE IV.

There were several changes made in this new version of APACHE. The first excluded patients transferred from another ICU from receiving predictions. The second change involved measuring previous length of stay as a continuous rather than an integer
variable. And the third change included a variable for designating whether a patient’s Glasgow Coma Score could not be assessed due to sedation. The most important change involved the new categorization of disease groups. Based on the frequency of selected diagnoses and their mortality rate, the existing 94 groups were expanded to 116.

Today, the APACHE System is recognized worldwide as the premier decision support methodology for adult critical care populations. The APACHE II manuscript is now a Citation Classic, cited by more than 5,500 articles. Articles describing APACHE III and APACHE IV also have been widely acclaimed. In total, APACHE is backed by more than 30 years of research, hundreds of publications and more than one million ICU admissions.

The APACHE III Score

APACHE is a severity-adjusted methodology that predicts outcomes for critically ill adult patients. In order to predict these outcomes, the APACHE methodology looks at 27 variables for each patient. These variables include the patient's diagnosis, age, vital signs, and laboratory values. This data, in conjunction with a few other pieces of information about the patient's history, is combined and used to mathematically formulate predictions for each individual patient. These predictions are made for mortality (both ICU and hospital), length of stay (both ICU and hospital), the need for active treatment and predicted ventilator days. The APACHE Foundations solution includes the APACHE IV hospital mortality risk prediction and the APACHE IV expected ICU LOS prediction.

The APACHE III score consists of a cardinal index risk number varying from 0-299 points. Points are tabulated from weights assigned to the following:

- **Physiology:** Physiology is the largest component of the APACHE III score. The Acute Physiology Score (APS) is the total number of points that the patient is assigned due to acute physiologic derangements alone. The total score can range from 0 to 252.

- **Chronic Health:** Chronic Health includes only significant co-morbidities influencing a patient's immunologic status. More than 30 chronic health items were collected in the APACHE III study, but only those that were found to impact outcomes are included in the methodology. The total score derived from chronic health information can range from 0 to 23.

- **Age:** The patient’s chronological age can contribute 0-24 points.
Chronic Health and Age points combined equal the physiological reserve points - an indicator of the patient's ability to recover from illness. The patient’s $\text{APS + Chronic Health + Age} = \text{APACHE III Score}$. The score is calculated using the value furthest from a predetermined midpoint, over the course of the patient’s first ICU day. In APACHE Foundations, the evaluation period for the first ICU day is the first 24 hours in the ICU following admission. The APACHE III score provides relative risk stratification for acutely ill hospitalized adults only when used within a single medical or surgical diagnostic category.

**The APACHE IV Predictive Equations**

The APACHE III score is a component in the APACHE IV predictive equations that include the score, the patient's length of stay in the hospital prior to ICU admission, the patient's exact ICU admission disease classification (there are 116 specific diagnostic category classifications), the patient's chronic health conditions, the patient's origin immediately prior to ICU admission and a measure of practice patterns to provide probability estimates for various outcomes on a daily basis. The APACHE IV predictive equations reference the current 131,988 ICU patient database and the risk predictions are calculated for patients selected by similar criteria.

In order to produce accurate risk estimates of hospital mortality or probabilities of length of stay (LOS) the APACHE III score must be combined with the other patient risk factors noted above in the APACHE IV predictive equations developed using the nationally representative database.
Even though the APACHE III score is the most critical component of the predictive equations, you cannot assume a linear relationship between APACHE III scores and predicted mortality or LOS in a multi-diagnostic database. Consequently, hospitals cannot use their mean APACHE III scores to make assumptions or predictions regarding mortality or length of stay.

We have designed the APACHE to be useful as a general risk stratification tool (APACHE III score) or as a predictive instrument relative to a specific database (APACHE IV predictive equation).

**Data Collection Methods and Operational Definitions**

**Eligible Patients**

When using APACHE Foundations to assess an ICU’s overall performance, data should be collected on all consecutive ICU admissions. The exceptions are categories of patients the system does not yet fully accommodate or patients whose brief stay did not provide enough physiology data for adequate risk assessment.

The following patient types will be classified as **non-predictive**:

- Burn patients
- Patients less than sixteen years of age
• Most transplant diagnoses (“kidney transplant” alone and “liver transplant” alone will receive predictions)

*Note: Patients with an ICU stay of less than four hours will receive “preliminary predictions” provided all data necessary to generate a prediction is entered. However, it is recommended that these patients are NOT entered in APACHE Foundations as they should not be included in data used to generate aggregate reports.

**Additional Exclusions for Certain Predictions**

There are some scenarios where patients will be excluded from receiving certain predictions. The chart below details when you can expect that certain predictions will not be generated.

*Note: APS, APACHE III score & APACHE II score (for sepsis patients) will still be calculated for these patients.
**Required Data**

All data elements that are required by the system in order to generate predictions are noted by a red asterisk on the Data Entry page. You will receive predictions for any patient that is considered “predictive” and, at a minimum, has all the required data points provided.

It is very important, however, to enter worst values for every data element for which data is available during the patient’s first day in the ICU. Since the patient’s physiologic derangements are the primary factors in determining APACHE scores and predictions, it is crucial to capture all possible contributors to ensure the most accurate severity-adjusted information.

**Admission/Demographics Information**

![Screen capture of Admission/Demographics](image)

**APACHE Control Number**

This is a system assigned patient identifier. When you are brought to the Data Entry page, the APACHE Control Number field will be disabled and display “NEXT”. When data has been entered for a patient and the “Submit” button selected, scores and predictions are presented and the data entry form will display a system generated APACHE Control Number.

![Screen capture of APACHE control Number](image)

The APACHE Control Number is the sole patient identifier within APACHE Foundations. You may use this number to search for existing records in the system and to identify patients on the Risk-Adjusted Patient List report.
*Note: If you intend you use the system to track performance across an entire ICU, group of ICUs or a specific group of patients (not simply a calculator), we recommend users keep a separate patient list that contains pertinent patient identifiers at your facility along with the APACHE Control Number.

Age on Hospital Admission (Required)
Enter the patient’s age in years at the time of admission to the hospital.

*Note: APACHE was developed for use with adult, critically ill populations. Patients < 16 years of age will not receive any scores or predictions and, therefore, should not be entered in APACHE Foundations.

Gender (Required)
From the menu provided, select the appropriate gender of the patient.

Hospital Admission Date/Time (Required)
Use the calendar control provided to record the patient's hospital admission date and time.

The system defaults to the current date and time. You may navigate the calendar control as follows:

Click the double “back” arrows to select a previous year.
Click the single “back” arrow :leftarrow: to select a previous month.
Click the double “forward” arrows :rightarrow: to select the next year.
Click the single “forward” arrow :rightarrow: to select the next month.
Select the desired date. The time may be adjusted by clicking or dragging on the hour and minute displays when highlighted.

ICU Admission Date/Time (Required)
Use the calendar control provided to record the date and time the patient was admitted to the ICU. If there are discrepancies in ICU admission time, refer first to the admission vital signs, nursing documentation, or progress notes.

APACHE Readmit? (Required)
From the menu provided, select “Yes” or “No” to indicate the whether the patient is an APACHE readmit. A patient is considered an APACHE re-admission if he or she was transferred from any ICU at your hospital to an area of lesser acuity then subsequently admitted to an ICU collecting APACHE Outcomes during the same hospital stay.

*Note: The Operating Room/ Recovery Room (PACU) is NOT considered an area of lesser acuity.

ICU Admission Source (Required)
From the menu provided, select the location from which the patient was directly admitted to the ICU.
1. Another Hospital- Admission from any area within another hospital
2. Direct Physician Admit- Admission from any of the following areas is included in this category:
   a. Home
   b. Physician Office
   c. Urgent Care Facility
   d. Ambulatory Surgery/Outpatient Procedure Area
   e. Skilled Nursing Facility
   f. Rehabilitation Center
   g. Nursing Home
   h. Extended Care Facility
   i. Another Hospital’s ER
3. Emergency Room
4. Hospital Floor/ward- Admission from any of the following areas is included in this category:
   a. General Care Floor
b. General Care Floor with Telemetry  
c. Telemetry Floor  
d. Labor and Delivery  
e. Step Down/Intermediate Care Unit  

5. **ICU Transfer**- Admission directly from another ICU at your institution where APACHE Foundations data is not also collected.  
   *Note: In cases where the user is collecting APACHE Foundations data in more than one ICU, movement directly from one APACHE Foundations ICU to another is considered a continuous stay per APACHE methodology and should NOT result in the creation of a new patient record.

6. **ICU to OR Transfer**- Admission directly from the OR/Recovery Room who was admitted to another ICU within your institution immediately prior to surgery  
   *Note: In cases where the user is collecting APACHE Foundations data in more than one ICU, movement directly from one APACHE Foundations ICU to the OR/PACU and then to another ICU collecting APACHE Foundations data is considered a continuous stay per APACHE methodology and should NOT result in the creation of a new patient record.

7. **Operating room**

8. **Other**- Admissions that do not fall into one of the specific menu options are included in this category

9. **Recovery room**

Patients admitted from procedural areas such as cardiac cath lab, GI lab, interventional radiology, pulmonary suite, cardiology suite, and special procedure areas should be classified according to their location prior to that procedural area. For example, a patient who was hospitalized on a medical-surgical floor who went to the GI lab for an endoscopic procedure and was admitted to the ICU is assigned an ICU admission source of General Care Floor. Likewise, a patient who presented to the ER with chest pain, then proceeds to the cardiac cath lab prior to ICU admission is assigned an ICU admission source of Emergency Department.

**ICU Visit Number for Current Hospitalization (Required)**

Enter a whole number that reflects the ICU visit number for this ICU admission. A patient’s initial admission to the ICU during the current hospitalization is ICU Visit 1. A subsequent “ICU Visit” occurs each time a patient returns to the ICU during the current hospitalization following a transfer to an area of lesser acuity.

**Notes:**

1. The Operating Room/ Recovery Room (PACU) is NOT considered an area of lesser acuity.
2. A transfer directly from one APACHE Foundations ICU to another is not considered a new visit.
3. Hospital mortality risk predictions are generated once per hospitalization during ICU Visit 1 for all predictive patients. ICU Visits > 1 will not have an associated hospital mortality risk displayed.

**Diagnosis/Chronic Health Condition Information**

![Diagnosis/Chronic Health Conditions](image)

**APACHE Diagnosis (Required)**

Accurate classification of a patient's primary diagnosis is essential to generating reliable predictions of patient outcome. The admission diagnosis is the diagnosis precipitating ICU admission for each patient entered into APACHE Foundations.

Selections for the APACHE Diagnosis are dependent upon whether the patient's ICU Admission Source is categorized as “Operative” or “Non-Operative” and displayed in alphabetical order. Patients with an ICU admission source of Operating Room, Recovery Room or ICU to OR Transfer are considered operative and must have a diagnosis corresponding to the surgical procedure that was performed.

*Note: If a patient was admitted to the ICU from the Operating Room, Recovery Room, or ICU to OR Transfer but no surgical procedure was performed (for example, the case was cancelled or the procedure was not completed), then the patient is considered a Non-Operative patient. In such cases, the ICU Admission Source should be the patient's location prior to the OR/Recovery Room.

Patients from ALL OTHER admission sources must have a diagnosis corresponding to the medical condition that necessitated ICU admission.

The admitting diagnostic information for non-operative patients should answer one of two important questions:

1. What is the precipitating event that caused admission to the ICU?
2. What is happening or could potentially happen to the patient that cannot be managed on the regular hospital floor and requires the special services of the ICU?
Try to determine the cause of an event. For example, when a patient is admitted with a diagnosis of acute respiratory failure you should make every effort to determine the cause. When the respiratory failure was due to CHF, pneumonia, exacerbation of COPD, ARDS or some known condition, that condition should be selected as the Primary APACHE Diagnosis rather than Respiratory, Medical Other.

Utilize the first 24 hours after ICU admission to select a diagnosis. Consider these scenarios:

A patient is admitted with chest pain and shortness of breath and rules in for acute myocardial infarction. In this case, the user should select Body System = Cardiovascular and Diagnosis = Infarction, Acute Myocardial (MI).

A patient is admitted with chest pain and shortness of breath and rules out for acute myocardial infarction. In this case, the diagnosis selected would be dependent upon the determined cause of chest pain (i.e., stable/unstable angina, chest pain epigastric, chest pain musculoskeletal, chest pain respiratory, chest pain unknown origin).

Additional considerations in determining the APACHE diagnosis:

1. **Cardiac Arrest** - Non-operative patients admitted to the ICU post-cardiac arrest should always have cardiac arrest selected as the APACHE diagnosis.
2. **Sepsis Diagnosis** - When sepsis is a part of the working diagnosis for a non-operative patient, it must be selected as the APACHE diagnosis, unless definitively ruled out within 24 hrs.
3. **Trauma Diagnosis** - Any patient whose injury or illness is a result of trauma should have a Trauma diagnosis selected. The method for classifying trauma patients is the same as for other patients. First, classify a trauma patient as operative or non-operative, then identify all major sites of injury. The selection of a diagnosis should be that which includes as many sites of trauma as possible. ALWAYS select head trauma when the head has been involved.

When considering the APACHE diagnosis for patients where more than one of the above diagnoses applies the following hierarchy should be followed:

1. Cardiac arrest takes priority over all other diagnosis codes.
2. Sepsis is the next consideration.
3. When trauma is present, choose it as the diagnosis, unless cardiac arrest or sepsis also is present.

*Refer to the Use APACHE Foundations section of the home page to link to a complete listing of APACHE IV diagnoses categorized by operative status and body system.*
**Diagnosis Variables**
When Acute MI or any CABG surgery is selected as the APACHE Diagnosis additional fields are displayed to capture information related to that diagnosis.

**AMI Diagnosis Variables**
If Acute Myocardial Infarction is selected as the APACHE Diagnosis, the following additional fields must be completed.

**AMI Location (Required)**
Provide the AMI location from the list below. If the AMI location is unknown, non-Q wave should be selected.

- Anterior
- Anterior/lateral
- Anterior/septal
- Inferior
- Lateral
- Non-Q Wave
- Posterior

**Did the patient receive Thrombolytic Therapy within 24 hours of ICU admission? (Required)**
Select YES if the patient received thrombolytic therapy during either the 24 hours prior to or the 24 hours following the ICU admission date/time. If there is no documentation that the patient received Thrombolytic Therapy during that time frame choose No.

**CABG Diagnosis Variables**
The table below references all APACHE diagnoses falling into the CABG diagnosis category.

<table>
<thead>
<tr>
<th>Diagnosis</th>
<th>Diagnosis Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>S-CABG</td>
<td>CABG alone, coronary artery bypass grafting</td>
</tr>
<tr>
<td>S-CABGAOV</td>
<td>CABG with aortic valve replacement</td>
</tr>
<tr>
<td>S-CABGDVAL</td>
<td>CABG with double valve repair/replacement</td>
</tr>
<tr>
<td>S-CABGMINI</td>
<td>CABG, Minimally invasive; Mid-CABG</td>
</tr>
</tbody>
</table>
If a diagnosis from the table above is selected as the APACHE Diagnosis, the following additional fields must be completed.

**Pre-operative left ventricular ejection fraction**

In the text box provided, record a number > 0 and <100 to indicate the pre-operative left ventricular ejection fraction (LVEF) percentage as documented in the patient's medical record. If no LVEF documentation is available in the patient record, leave this field blank. If descriptive terms such as mild, moderate, or severe are used instead of a number, the following table can be used to find the corresponding value to be entered:

<table>
<thead>
<tr>
<th>Description</th>
<th>Range of EF Value</th>
<th>Value to Enter</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal</td>
<td>EF 60%</td>
<td>60%</td>
</tr>
<tr>
<td>Mild</td>
<td>EF 50-59%</td>
<td>55%</td>
</tr>
<tr>
<td>Mildly Moderate</td>
<td>EF 46-49%</td>
<td>47%</td>
</tr>
<tr>
<td>Moderate</td>
<td>EF 41-45%</td>
<td>43%</td>
</tr>
<tr>
<td>Moderately Severe</td>
<td>EF 36-40%</td>
<td>38%</td>
</tr>
<tr>
<td>Severe</td>
<td>EF 35%</td>
<td>35%</td>
</tr>
</tbody>
</table>

**Number of Grafts Performed**

In the text box provided, record a whole number between 1 and 10 to
indicate number of grafts performed as documented in the patient's medical record.

**Was an Internal Mammary Artery (IMA) graft performed? (Required)**
Select YES if an internal mammary artery graft procedure was performed. If there is no documentation indicating that an IMA graft was performed, select NO.

**Did the patient have an MI during current hospitalization?**
Select YES if the patient had a myocardial infarction during this hospitalization. If there is no documentation indicating that the patient had an MI during the current hospitalization, select NO.

**Was this an Emergency Surgery? (Required for Operative Admissions)**
Select Yes if the patient required emergency surgery. Emergency surgery is any surgery that is immediately required to prevent death, loss of limb, or loss of major organ system function. If a serious condition exists but surgery can be delayed for hours or days without loss of life, limb, or major organ system function, select No as this is considered Elective surgery.

*Note*: This field is enabled only when the patient's ICU admission source is the Operating Room, Recovery Room, or ICU to OR Transfer.

**Vented on APACHE Day 1? (Required)**
Select Yes if the patient was ventilated for any portion of their first day in the ICU. In **APACHE Foundations, the evaluation period for the first ICU day is the first 24 hours in the ICU following admission (APACHE Day 1)**. Any modes of ventilation that mechanically assist or replace spontaneous breathing to decrease the work of breathing should be considered a “Yes” for ventilation. This would include the following ventilation modes from the Active Treatment list:

- BiPAP (nocturnal)
- BiPAP mask
- BiPAP per mask/ventilator (NIPPV)
- Controlled ventilation
- Controlled ventilation with relaxant
- IMV or assisted respirations
- Spontaneous ventilation with PEEP/CPAP/Pressure Support in any combination (includes PEEP alone, Pressure Support alone and CPAP with Pressure Support)

*Note*: CPAP alone is not considered "ventilated ".

Actively Treated on Day 1? (Required)

Select Yes if the patient received one or more of the active treatment items from the list below during their first day in the ICU. In APACHE Foundations, the evaluation period for the first ICU day is the first 24 hours in the ICU following admission (APACHE Day 1).

The level at which interventions are delivered may vary throughout the data collection time frame. If an intervention occurred at any point in time during the data collection period, regardless of the duration for which it was delivered, a Yes should be recorded. If the patient did not receive any active treatment during the first APACHE day, indicate No on the data collection form.

List of Active Treatment Items

1. Controlled ventilation with or without positive end expiratory pressure (PEEP) - Patient requires controlled ventilation for breathing assistance (any type of ventilator). PEEP is Positive End Expiratory Pressure.
2. Controlled ventilation with intermittent or continuous muscle relaxant/sedation - Patient requires a muscle relaxant or sedative such as curare or pavulon, or sedation such as diazepam, fentanyl, or morphine, to be maintained on the ventilator.
3. Intermittent mandatory ventilation (IMV) or Assisted Respirations - May or may not include positive end expiratory pressure therapy. May receive sedation.
4. Spontaneous ventilation with positive end expiratory pressure (PEEP) or continuous positive airway pressure (CPAP), includes Pressure Support and CPAP with Pressure Support
5. BiPAP - Bi-level positive airway pressure. Note that patients receiving this mode of ventilation are not intubated.
6. Nasotracheal or Orotracheal intubation (in intensive care) - Intubation performed while patient in intensive care.
7. Reintubation within 24 hours - Reintubation in the intensive care unit within 24 hours of previous extubation was necessary for any reason.
8. Fresh tracheostomy - The procedure was performed less than 48 hours before.
9. Bronchoscopy (ies) - The procedure was performed in the intensive care unit.
10. Atrial or ventricular pacing (actively) - There are temporary pacemaker wires located in the patient's atria and/or ventricle that are actively pacing the heart or set to capture below a specified rate. External pacer pads also apply. If the pacer is applied to the patient, regardless of if it fires, this item applies. It does not apply to a temporary pacer unit located outside of the patient room.
or not attached to the patient. Permanent pacemakers are not considered active treatment.

11. **Intra-aortic balloon pump (IABP) active** - The patient is connected to a functioning IABP machine. Left ventricular assist devices (LVAD) and right ventricular assist devices (RVAD) are included in this category.

12. **Single Vasoactive drug infusion (intravenous)** - Drugs in this category would include, but are not limited to: dopamine, dobutamine, NTG, prostaglandin, nitroprusside, norepinephrine, epinephrine, phenylephrine, labetalol, and others. Do not include heparin or aminophylline as vasoactive drugs. Renal dose dopamine is not considered vasoactive.

13. **Multiple Vasoactive drug infusions** - The patient is receiving two or more vasoactive infusions.

14. **Continuous antiarrhythmic infusion(s)** - Continuous intravenous infusion of one or more antiarrhythmic medications (amiodorone, lidocaine, procainamide, bretyllium, esmolol, verapamil, diltiazem, isoproterenol, and others).

15. **Intravenous replacement of excess fluid loss (greater than 6 liters per 24 hrs)** - This is the aggressive intravenous administration of replacement fluid therapy. The minimum amount of fluids a patient must receive to qualify for this item is 2 liters in 8 hours. Blood products should be considered in totals for replacement of excess fluid loss (provided colloidal equivalent of 3L/square meter/day is received). Maintenance or supplemental IV intake (for example TPN, IVPBs) should not be considered as part of the 6L/24 hrs total.

16. **Rapid blood transfusion(s)** - This includes any number of units of blood or blood products given "rapidly" (one unit given over 10-20 minutes or less). It is intended to reflect blood products (any type) given for resuscitative reasons.

17. **Post-arrest (within 48 hours)** - The patient is within 48 hours of cardiac arrest and/or respiratory arrest. The patient would have this indicated for 2 days (two 24-hour periods) while in intensive care if daily physiology data is collected.

18. **Cardioversion(s) for any arrhythmia** - Elective or non elective electrical cardioversion. Defibrillation is included.

19. **Pericardiocentesis(es)** - The procedure was performed in the intensive care unit. This includes active percardial drains.

20. **Stable hemodialysis** - including CAVH, CVVH, Ultrafiltration, or SCUF. "Stable" indicates that no serious complications developed while the patient was on dialysis. Plasmaphoresis performed in the ICU is also considered a type of plasmaphoresis.

21. **Unstable hemodialysis** - including CVH, CVVH, Ultrafiltration, SCUF, or Plasmaphoresis. "Unstable" indicates that serious complications developed while the patient was on dialysis, such as a significant drop in blood pressure requiring rapid volume infusion or the administration of vasoactive drugs.
22. **Intravenous Vasopressin infusion** - Intravenous infusion of vasopressin or octreotide to control bleeding.

23. **Continuous arterial drug infusion** - There was continuous administration of medication via an arterial catheter such as Vasopressin via superior mesenteric artery (SMA) catheter.

24. **Balloon tamponade of varices** - There was control of bleeding varices via pressurized balloon such as a Sengstaken/Blakemore tube or Minnesota tube.

25. **Nasogastric lavage for active bleeding (continuous)**

26. **Endoscopy(ies)** - The procedure was performed in the intensive care unit.

27. **Continuous mannitol infusion (cerebral edema)** - Continuous or intermittent IV infusion of mannitol or comparable drug used to treat cerebral edema. This does not include the use of Mannitol for diuresis.

28. **Ventriculostomy** - There is a drainage tube or catheter in patient's ventricle, venous sinus, etc. This does not include ICP monitor that used to measure pressure only. An ICP monitor functioning as a ventriculostomy (actively draining) would qualify.

29. **Treatment of seizures/metabolic encephalopathy (acute) [first 48 hours]** - Active treatment of the initial onset of seizures via administration of intravenous medication given routinely and PRN (lorazepam, diazepam, phenytoin and others). It includes treatment for metabolic encephalopathy due to metabolic abnormalities (hepatic coma). This applies to the treatment of status epileptics regardless of prior seizure history as well.

30. **Induced hypothermia (body temperature reduced to 32 degrees Centigrade or less)** - There was controlled reduction in the patient's central body temperature to between 30 - 32 degrees Centigrade.

31. **Barbiturate anesthesia (continuous)** - A continuous level of barbiturate anesthesia was established in the patient.

32. **Active treatment of complex metabolic balance, alkalosis/acidosis** - There was active treatment for a significantly abnormal acid-base balance such as continuous intravenous administration of ammonium chloride or bicarbonate. The patient requires intensive treatment for significantly complex fluid and electrolyte balance and/or acid-base disturbances. Insulin drips alone (even if actively titrating) do not qualify. IV fluids with potassium (K+) concentrations of 60 Meq per liter or less also do not qualify. Titrating insulin drips in conjunction with concentrated potassium infusions would qualify. Frequent intermittent administration of multiple electrolytes in response to frequently drawn labs generally qualifies for this.

33. **Emergency operative procedures inside the Intensive Care Unit** - This category includes emergency operations (post-intensive care unit admission) that were performed in the ICU.

34. **Emergency operative procedure outside the Intensive Care Unit** - Do not indicate if the patient was admitted directly to intensive care post-emergency
surgery. This category includes emergency operations (post-intensive care unit admission) that were performed in OR or dedicated procedure suite.

**Chronic Dialysis Patient? (Required)**
Select Yes if the patient was receiving chronic hemodialysis or peritoneal dialysis prior to the current hospitalization.

**Any Chronic Health Conditions? (Required)**
APACHE utilizes information from each patient regarding his or her chronic health history. This information provides an indicator of the patient's "physiologic reserve", or the patient's underlying ability to recover from an acute illness. Review each patient's medical record for documentation of any conditions on the List of Essential Chronic Health Items that follows. This information is found in various parts of the chart including, but not limited to, the physician's history and physical, physician's admission notes, nurse's admission data, and nurse's notes.

Select each applicable chronic health item if the patient has a history of the condition prior to the onset of the present acute illness. Chronic health conditions diagnosed during the current hospitalization also should be recorded in this section when determination of the condition is made, provided the criteria listed for the condition(s) are met. If health history is available, but no chronic health items are identified, select “None.” Use the Control key to select multiple chronic health items from the list.

**List of Essential Chronic Health Items**

1. **Acquired Immunodeficiency Syndrome** - The patient has a definitive diagnosis of AIDS (not HIV positive alone). The diagnosis of AIDS includes a CD4 count < 200, or the presence of an opportunistic infection/clinical complications such as pneumocystis carinii, Kaposi's sarcoma, lymphoma, tuberculosis or toxoplasma infection.
2. **Cirrhosis** - History of heavy alcohol use with portal hypertension and varices, other causes of cirrhosis with evidence of portal hypertension and varices, or biopsy confirmation of cirrhosis. If the patient has a functioning liver transplant, this chronic health item does not apply.
3. **Diabetes Mellitus** - The patient has been diagnosed with diabetes, juvenile or adult onset, requiring medication.
4. **Hepatic Failure** - Cirrhosis with one or more episodes of jaundice and ascites, upper GI bleeding, or hepatic encephalopathy or coma.
5. **Immune Suppression** - Immunosuppression within six months prior to ICU admission from any of the following:
   - Radiation therapy
   - Chemotherapy
• The daily use of non-cytotoxic immunosuppressive drugs (i.e., anti-rejection drugs)
• The patient has been receiving high dose steroids for at least six months. High dose steroids is defined as \( \geq 0.3 \text{mg/kg/day} \) of methylprednisolone or its equivalent. Use the following chart to determine whether the patient meets criteria for high dose steroid use based on weight.

<table>
<thead>
<tr>
<th>KG</th>
<th>Lbs</th>
<th>Methylprednisolone Mg/Day</th>
<th>Prednisone Mg/Day</th>
<th>Cortisone Mg/Day</th>
<th>Decadron Mg/Day</th>
</tr>
</thead>
<tbody>
<tr>
<td>45</td>
<td>100</td>
<td>14</td>
<td>17</td>
<td>87</td>
<td>3</td>
</tr>
<tr>
<td>68</td>
<td>150</td>
<td>20</td>
<td>25</td>
<td>125</td>
<td>4</td>
</tr>
<tr>
<td>90</td>
<td>200</td>
<td>27</td>
<td>34</td>
<td>168</td>
<td>5</td>
</tr>
<tr>
<td>114</td>
<td>250</td>
<td>34</td>
<td>42</td>
<td>213</td>
<td>6</td>
</tr>
</tbody>
</table>

6. **Leukemia/Myeloma** - The patient has been diagnosed with acute or chronic myelogenous or lymphocytic leukemia; or multiple myeloma.

7. **Non-Hodgkin's Lymphoma** - The patient has been diagnosed with Non-Hodgkin's lymphoma.

8. **Solid Tumor with Metastasis** - The patient has a diagnosis of any solid tumor carcinoma with metastasis (this includes malignant melanoma with metastasis).

**Physiology Information**

- **Physiology**:
  - Core Temperature: [36°C]
  - Heart Rate: [75 (beats/min)]
  - MAP: [90 (mm Hg)]
  - Respiratory Rate: [19 (breaths/min)]
  - Ventilator: [Select One…]
  - Total Urate Output: [Select One…]

- **Labs**:
  - Hct: [45.50 (%)]
  - Serum Sodium: [145 (mEq/L)]
  - Serum Creatinine: [1.0 (mg/dL)]
  - Serum Albumin: [3.5 (g/dL)]
  - Serum Glucose: [130 (mg/dL)]
  - Serum Bilirubin: [50 (mg/dL)]
  - Serum Potassium: [4.50 (mEq/L)]
  - Serum Bicarbonate: [27.0 (mEq/L)]

- **GCS**:
  - GCS Motor: [Select One…]
  - GCS Verbal: [Select One…]
  - GCS Eye: [Select One…]

- **ABGs**:
  - ABG pH: [Select One…]
  - ABG PaO2 (%): [Select One…]
  - ABG PaCO2: [Select One…]
APACHE methodology relies upon a standard set of physiologic measures to produce an acute physiology score (APS) which is used to generate both patient predictions. Data collection for all physiology measures must be confined to values obtained during the designated timeframe. In APACHE Foundations, the evaluation period for the first ICU day is the first 24 hours in the ICU following admission (APACHE Day 1).

APS points are assigned based upon the degree of physiologic derangement a patient exhibits during the APACHE Day. The "Worst" values, in most cases, are those that are furthest away from the APACHE-defined mid-point. For two of the physiology variables, Total Bilirubin and BUN, the worst value is the highest result obtained during the APACHE day.

For example, given two heart rate values of 60 and 120, the heart rate of 120 is furthest away from the APACHE midpoint of 75. In situations where two values for a given physiology variable are equidistant from the midpoint, select the value that occurred closest to the end of the APACHE day.

All data elements that are required by the system in order to generate predictions are noted by a red asterisk on the Data Entry page. You will receive predictions for any patient that is considered “predictive” and, at a minimum, has all the required data points provided.

It is very important, however, to enter worst values for every data element for which data is available during the patient’s first day in the ICU. Since the patient’s physiologic derangements are the primary factors in determining APACHE scores and predictions, it is crucial to capture all possible contributors to ensure the most accurate severity-adjusted information.

APACHE Foundations employs absolute ranges for the physiology measures to help reduce the potential for typographical/data entry errors. In order to receive predictions, physiology values entered must fall within the ranges defined by the system (refer to the Physiology Data Midpoints and Ranges Table at the end of this section for details).

*Note: In situations where the patient’s actual “worst” value falls outside the ranges allowed by the system, you should enter the highest or lowest value allowed by the system that is closest to the patient’s actual value.

Vital Signs
Record the “worst” value for each vital sign measure obtained during the patient’s first APACHE day. Any values obtained in the operating room should not be considered in determining the worst value for a given measure. Also exclude any cardiopulmonary arrest values resulting from direct intervention. For example, if the patient is receiving CPR, a blood pressure is generated, but this value should be excluded. The same is true...
for heart rate that is the direct result of CPR. Should the patient have a cardiac arrest or expire during the first APACHE day, “0” should be considered as a potential worst value for HR, MAP and RR though there may be cases where the highest value for a given measure is furthest from the midpoint.

**Temperature (midpoint = 38° C)**
Select the temperature furthest from the midpoint. Temperatures may be obtained by a variety of routes (oral, rectal, tympanic, core, axillary, etc.) For axillary temperature readings, add one degree Celsius to arrive at the core temperature.

\[(Formula\ for\ Fahrenheit\ to\ Centigrade):\ C = \left(\frac{F-32}{9}\right)\times 5\]

**Heart Rate (midpoint = 75) (Required)**
Select the HR furthest from the midpoint based upon ventricular response/minute.

**MAP (midpoint = 90 mmHg) (Required)**
Select Mean Arterial Pressure (MAP) value furthest from 90. In instances where a blood pressure cannot be obtained by other means, a palpated blood pressure or one obtained by Doppler can be used. These values should have a diastolic value of 1 when calculating MAP (for example, 40/palp or 40/doppled = 40/1).

**Respiratory Rate (midpoint = 19 breaths/minute) (Required)**
Select the respiratory rate furthest from the midpoint and record whether the patient was ventilated at the time of the worst respiratory rate.

- When determining the answer for “Ventilated for this RR?” a Yes should be recorded for any modes of ventilation that mechanically assist or replace spontaneous breathing to decrease the work of breathing. This would include the following ventilation modes from the Active Treatment list:
  - BiPAP (nocturnal)
  - BiPAP mask
  - BiPAP per mask/ventilator (NIPPV)
  - Controlled ventilation
  - Controlled ventilation with relaxant
  - IMV or assisted respirations
  - Spontaneous ventilation with PEEP/CPAP/Pressure Support in any combination (includes PEEP alone, Pressure Support alone and CPAP with Pressure Support)

*Note: CPAP alone is not considered "ventilated ".*
• The patient does not have to be intubated in order to be ventilated.
• For patients who are being ventilated, the respiratory rate recorded should reflect the total breaths/minute (rate set per ventilator + additional spontaneous respirations = RR).
• If the worst value is reflected in two respiratory rates, which are the either the same or the same distance from the midpoint, but one was recorded while the patient was being ventilated, and the other was not, record the worst respiratory rate as the one while the patient is not ventilated.
• If the worst value is reflected in two respiratory rates that are the same distance from the midpoint with the same ventilated status, choose the one occurring closest to the end of the APACHE® day.

**Total Urine Output (mL/day)**
Enter the total urine output during the first APACHE day (the first 24 hours in the ICU following admission). If the patient’s length of stay in the ICU is < 24 hours, the user should extrapolate a 24 hour equivalent based on the urine produced during the ICU stay as follows:

- Determine the total urine produced during the ICU stay.
- Determine the patient’s ICU length of stay in hours.
- Divide the total urine produced by the length of stay in hours to determine the volume of urine/hr (in mL).
- Multiply the mL/hr by 24 to determine the 24 hour equivalent for the patient.
- Example: The patient is admitted to the ICU from the PACU at 1800 and transferred to the General Care Floor at 1000 the following day. During that time the patient’s total urine output is 1200 mL or 75 mL/hr. The 24 hour equivalent for this patient is 1800 mL (75 x 24).

**Additional guidelines for recording Total Urine Output:**

- If a large volume of urine was inadvertently spilled, the patient was incontinent or the urine was not measured, leave the field blank.
- Do not use "zero" unless the patient is truly anuric.
- Do not include urine obtained outside of the ICU (for example, ER, OR, PACU, and so on).

**Glasgow Coma Score (GCS)**

**GCS – Meds?**
The presence or absence of medications (given by a medical caregiver) altering the patient's neurological function must be determined before recording the Glasgow Coma Score (GCS) values. GCS is not required on patients who have a decreased level of consciousness during the entire APACHE day secondary to
drugs or medication that they are receiving (such as paralytics, anesthesia, or therapeutic coma).

The neurologic function must be altered during the entire APACHE day (regardless of whether the medication continued for entire day) in order to select Yes.

- It is acceptable to use GCS obtained during a "Daily Wake-up Assessment"s for a patient who is being continuously sedated in the ICU. If this is the case, answer NO to the GCS Meds question and record the GCS obtained during the wake-up assessment.
- If the patient's neurologic function is altered due to meds the entire first APACHE day, but there is a reliable GCS while not affected by meds that was obtained within 12 hours of admission to the ICU, answer NO to the GCS Meds question and record the GCS obtained prior to ICU admission.

**Determining the “Worst” Glasgow Coma Score (GCS)**

The GCS is the sum of the following:

- Best eye opening response [Eyes 1-4]
- Best verbal response [Verbal 1-5]
- Best motor response [Motor 1-6]

The GCS is determined based upon the patient's best response in each category during a single examination (highest level of integrated physiologic response). When the three component scores are added, the total Glasgow Coma Score ranges from 3 (worst) to 15 (best). The “worst” GCS in APACHE is the GCS assessment resulting in the lowest total score.

**GCS Components:**

**Eyes**

Enter the value for Eye Opening associated with the lowest GCS measurement obtained during the first APACHE day. If the patient's eyes are swollen shut, use clinical judgment to assign an eye-opening score that would best describe the patient's capability if his/her eyes were not swollen. Enter a value from 1 to 4.

- 4 - Spontaneously
- 3 - To verbal command
- 2 - To pain
- 1 - No response
**Verbal**

Enter the value for Verbal Response associated with the lowest GCS measurement obtained during the first APACHE day. Enter a value from 1 to 5.

- 5 - Oriented and converses
- 4 - Disoriented and converses
- 3 - Inappropriate words
- 2 - Incomprehensible sounds - not words
- 1 - No response

**Modified Verbal Score:**

If the patient is intubated or otherwise unable to speak, use your clinical judgment to score verbal response as follows:

- 5 - Patient is clearly oriented and able to converse or indicate needs
- 3 - Patient is responsive but orientation/ability to communicate reasonably is in question
- 1 - Patient is clearly unresponsive

Because 5 and 1 are readily discernible, it is often easiest to score verbal response by first assessing if patient's verbal response is a 5. If it is not a 5, determine if it is a 1. If not, the patient's verbal response defaults to 3.

**Motor**

Enter the value for Motor Response associated with the lowest GCS measurement obtained during the first APACHE day. Enter a value from 1 to 6.

- 6 - Obeys (moves according to) verbal commands
- 5 - Localizes pain
- 4 - Flexion-withdrawal
- 3 - Flexion-abnormal/decorticate rigidity
- 2 - Extension/decerebrate rigidity
- 1 - No response

**Important Considerations when determining the worst GCS:**

- All three elements of the Glasgow Coma Score (Eyes, Motor, Verbal) must reflect values assessed at the same time.
- Determine the Glasgow Coma Score on all patients, except those with an altered neurologic status for the entire first APACHE® day due to medication given by a medical caregiver.
- GCS may be assessed multiple times during the course of the first APACHE® day. At the end of data collection time frame, select the lowest total score during the timeframe the patient was not sedated.
due to medication given by a medical caregiver. Then record the three individual component scores from that “worst” total.

- If the patient is unable to speak for any chronic reason, such as aphasia or Parkinsonism, or because of intubation or foreign language barrier, use clinical judgment to assess the patient’s actual ability to communicate and assign verbal scores according to the Modified Verbal Score guidelines that follow.
- Patients with an ICU admitting diagnosis of self-overdose should have a GCS determined.
- Certain GCS combinations are considered highly unlikely clinical combinations. APACHE Foundations will not generate predictions if one of the following GCS combinations is entered into the system:

<table>
<thead>
<tr>
<th>Eyes</th>
<th>Verbal</th>
<th>Motor</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>5</td>
<td>6</td>
</tr>
<tr>
<td>1</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>1</td>
<td>5</td>
<td>4</td>
</tr>
<tr>
<td>1</td>
<td>5</td>
<td>3</td>
</tr>
<tr>
<td>1</td>
<td>5</td>
<td>1</td>
</tr>
<tr>
<td>1</td>
<td>4</td>
<td>6</td>
</tr>
<tr>
<td>1</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>1</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>1</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>1</td>
<td>4</td>
<td>1</td>
</tr>
<tr>
<td>1</td>
<td>3</td>
<td>6</td>
</tr>
<tr>
<td>1</td>
<td>3</td>
<td>5</td>
</tr>
<tr>
<td>1</td>
<td>2</td>
<td>6</td>
</tr>
<tr>
<td>1</td>
<td>2</td>
<td>5</td>
</tr>
</tbody>
</table>

Laboratory Values

**Guidelines for Determining "Worst" Laboratory Values:**

- Select the value furthest from the noted midpoint values.
- Exclude any values obtained in the OR.
- In situations where laboratory values are not obtained in the ICU during the data collection period, you may use admission source values (except for OR) if drawn
no more than 1 hour prior to ICU admission. This rule only applies if ALL lab values are missing during the 1st APACHE® day

- Laboratory values that are drawn during a cardiopulmonary arrest can be included in the data collection. Labs obtained during a code generally are not altered by CPR; in fact, they may be the cause of the arrest. For example, a patient with an elevated CO2 arrests secondary to the severe acidosis, but this is not realized until the initial ABG’s are drawn at the beginning of the code. These values represent the patient's true physiology and should improve with intervention; therefore, these lab values are included.

- It is appropriate to consider lab values obtained outside the ICU during the APACHE day provided they are drawn by an ICU nurse who is accompanying the patient to an area outside the ICU for a procedure or test (i.e., radiology, nuclear medicine) and the patient returns to the ICU.

### Physiology Data Midpoints and Ranges Table

<table>
<thead>
<tr>
<th>Variable</th>
<th>Apache Midpoint</th>
<th>Absolute Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Temperature</td>
<td>38°C</td>
<td>25.0 - 44.0</td>
</tr>
<tr>
<td>MAP</td>
<td>90 mm Hg</td>
<td>0 - 334</td>
</tr>
<tr>
<td>Respiratory Rate</td>
<td>19 Breaths/min</td>
<td>0 - 300</td>
</tr>
<tr>
<td>Heart Rate</td>
<td>75 Beats/min</td>
<td>0 - 400</td>
</tr>
<tr>
<td>GCS Eyes</td>
<td>4</td>
<td>1 - 4</td>
</tr>
<tr>
<td>GCS Verbal</td>
<td>5</td>
<td>1 - 5</td>
</tr>
<tr>
<td>GCS Motor</td>
<td>6</td>
<td>1 - 6</td>
</tr>
<tr>
<td>Urine Output</td>
<td>3000 (mL/day)</td>
<td>0 – 30,000</td>
</tr>
<tr>
<td>WBC</td>
<td>11.5 1000/uL</td>
<td>0.1 - 100</td>
</tr>
<tr>
<td>Hematocrit</td>
<td>45.5%</td>
<td>11 - 54</td>
</tr>
<tr>
<td>Serum Na+</td>
<td>145 mEq/L</td>
<td>90 - 160</td>
</tr>
<tr>
<td>Potassium</td>
<td>4.5 mEq/L</td>
<td>1.5 – 8.0</td>
</tr>
<tr>
<td>Serum BUN</td>
<td>Highest (mg/dL)</td>
<td>1 - 160</td>
</tr>
<tr>
<td>Serum Creatinine</td>
<td>1.0 mg/dL</td>
<td>0.1 - 20</td>
</tr>
<tr>
<td>Serum Glucose</td>
<td>130 mg/dL</td>
<td>20 -1500</td>
</tr>
<tr>
<td>Serum Bicarbonate</td>
<td>27.0 mEq/L</td>
<td>4 - 40</td>
</tr>
<tr>
<td>Serum Albumin</td>
<td>3.5 g/dL</td>
<td>1.5 - 4.5</td>
</tr>
<tr>
<td>Serum Bilirubin</td>
<td>Highest (mg/dL)</td>
<td>0.2 - 25</td>
</tr>
<tr>
<td>ABG-Fio2</td>
<td>21%</td>
<td>21-100</td>
</tr>
<tr>
<td>ABG-PaO2</td>
<td>80 mm Hg</td>
<td>30 - 450</td>
</tr>
<tr>
<td>ABG-PaCO2</td>
<td>40 mm Hg</td>
<td>10 - 150</td>
</tr>
<tr>
<td>ABG-pH</td>
<td>7.4</td>
<td>6.8 – 7.7</td>
</tr>
</tbody>
</table>
Arterial Blood Gas Data

Record the following components of the worst ABG:

**ABG Intubated?** – Select Yes or No to indicate whether this ABG was obtained while the patient was intubated.

**ABG FiO2 (21-100)** - Indicate the percentage of oxygen delivered when the worst arterial blood gas was obtained.

**ABG PaO2** - Indicate the PaO2 reflected in the worst arterial blood gas results.

**ABG PaCO2** - Indicate the PaCO2 reflected in the worst arterial blood gas results.

**ABG pH** - Indicate the pH reflected in the worst arterial blood gas result.

*Note:* Values for FiO2, PaO2, PaCO2, and arterial pH are obtained from the same arterial blood gas. All of the ABG components listed above must be recorded in order to the ABG data to be considered complete. Incomplete or “partial” ABGs sets should not be recorded in the system.

In order to determine the worst ABG according to the APACHE methodology, use the following formula found on pages 1.19 & 1.20. The diagram below is a decision tree to help you determine the worst ABG:

```
Is the patient intubated?

no  yes

select the lowest PaO2  Is the FiO2 ≥ 50%?

no  yes

select the lowest PaO2  select the highest AaDO2

Compare using the two weighting scales, and select the ABG that receives the higher weight.
```
**Weighting Scale #1: Lowest PaO₂**

If the patient is not intubated or the patient is intubated and FiO₂ < 50%, use the ABG with the lowest actual PaO₂ value.

<table>
<thead>
<tr>
<th>PaO₂</th>
<th>&lt;50</th>
<th>≥50 &amp; &lt;70</th>
<th>≥70 &amp; &lt;80</th>
<th>≥80</th>
</tr>
</thead>
<tbody>
<tr>
<td>weight</td>
<td>15</td>
<td>5</td>
<td>2</td>
<td>0</td>
</tr>
</tbody>
</table>

**Weighting Scale #2: Highest AaDO₂**

If the patient is intubated and the FiO₂ ≥ 50%, use the formula below for AaDO₂:

\[ AaDO₂ = (FiO₂ \times 713) - PaCO₂ - PaO₂ \]

Select the highest AaDO₂ as worst ABG.

<table>
<thead>
<tr>
<th>AaDO₂</th>
<th>0 - &lt;100</th>
<th>≥100 &amp; &lt;250</th>
<th>≥250 &amp; &lt;350</th>
<th>≥350 &amp; &lt;500</th>
<th>≥500</th>
</tr>
</thead>
<tbody>
<tr>
<td>weight</td>
<td>0</td>
<td>7</td>
<td>9</td>
<td>11</td>
<td>14</td>
</tr>
</tbody>
</table>

*Note: If the patient has ABGs during the first APACHE day that fall into each of the weighting scales noted above, the ABG with the highest weight should be recorded.*

**Additional ABG Information:**

If supplemental oxygen is given via cannula or mask, please approximate the FiO₂ as follows:

- Room Air = 21%  
- 1 liter of oxygen = 23%  
- 2 liters of oxygen = 25%  
- 3 liters of oxygen = 27%  
- 4 liters of oxygen = 30%  
- 5 liters of oxygen = 35%  
- 6 and 7 liters of oxygen = 40%  
- 8, 9, and 10 liters of oxygen = 49%
AaDO₂ = (FiO₂ x 713) - PaO₂ - PaCO₂

<table>
<thead>
<tr>
<th>FiO₂</th>
<th>Answer</th>
</tr>
</thead>
<tbody>
<tr>
<td>50%</td>
<td>356.5</td>
</tr>
<tr>
<td>55%</td>
<td>392.15</td>
</tr>
<tr>
<td>60%</td>
<td>427.8</td>
</tr>
<tr>
<td>65%</td>
<td>463.45</td>
</tr>
<tr>
<td>70%</td>
<td>499.1</td>
</tr>
<tr>
<td>75%</td>
<td>534.75</td>
</tr>
<tr>
<td>80%</td>
<td>570.4</td>
</tr>
<tr>
<td>85%</td>
<td>606.05</td>
</tr>
<tr>
<td>90%</td>
<td>641.7</td>
</tr>
<tr>
<td>95%</td>
<td>677.35</td>
</tr>
<tr>
<td>100%</td>
<td>713</td>
</tr>
</tbody>
</table>

Discharge/Outcome Information

ICU Discharge Date/Time

Use the calendar control provided to record the date and time when the patient:

- Was discharged from the ICU to go a lower level of care
- Moved to another ICU in your hospital where APACHE Foundations data is not being collected
- Died in the ICU

For ICU transfers/discharges, the date and time entered should reflect when the patient physically left the ICU. If the patient leaves the ICU to go to the Operating Room or any type of procedure suite and either dies before returning to the ICU or leaves the OR/procedure suite to go to a lower level of care or non-CO ICU, record the date and
time the patient left the ICU to go to the OR or procedure suite as the time of transfer or death.

*Note: This value is not required in order to generate scores and predictions for a patient. However, in order to compare actual to expected outcomes this information should be recorded.

**Hospital Discharge Date/Time**
Use the calendar control provided to record the calendar date and time on which the patient was discharged from or died in the current hospital.

**Vital Status at Hospital Discharge**
Indicate whether the patient was alive or dead at the time of discharge from the hospital.

*Note: This value is not required in order to generate scores and predictions for a patient. However, in order to compare actual to expected outcomes this information should be recorded.

**Post-ICU Discharge Destination**

From the menu provided, select the location that best describes the patient's ICU discharge destination.

1. Another Hospital- The patient has been discharged from the current hospital and transferred to any area within another hospital.
2. Home- The patient has been discharged from the current hospital to a home setting.
3. Hospital Floor/ward- The patient has been transferred out of the ICU to any of the following areas in the current hospitalization:
   a. General Care Floor
   b. General Care Floor with Telemetry
   c. Telemetry Floor
   d. Labor and Delivery
   e. Step Down/Intermediate Care Unit
4. ICU Transfer- The patient has been transferred from the current ICU to another ICU within your institution
5. Other- The patient has been transferred or discharged to a location that does not fall into one of the specific menu options.

When the patient is transferred to a lower level of care unit, that patient care unit should be entered as the discharge destination. If the patient is transferred to an ICU where APACHE Foundations data is not being collected, the destination should be entered as "ICU Transfer". If the patient stops on the way to the receiving unit for a therapy such as
dialysis, PT, or hyperbaric oxygen the receiving patient care unit still should be considered the discharge destination. When the patient goes to the Operating Room or to an inpatient procedure suite (cath lab, invasive radiology, GI lab, bronchoscopy, etc.) where an invasive procedure is to be done and is subsequently admitted to another patient care unit in the hospital the discharge destination should be the receiving patient care unit.
APACHE® Foundations provides two reports based on the data entered into APACHE Foundations' data entry section:

- The Risk-Adjusted Patient list report contains a list of scores, predictions and outcomes for all predictive patients entered into APACHE Foundations.

- The Aggregated Risk-Adjusted Outcomes report compares actual versus expected hospital mortality and ICU length of stay for all predictive patients with sufficient data to compute each prediction.

**APACHE Risk-Adjusted Patient List**

The APACHE Risk-Adjusted Patient List is a comprehensive patient listing of risk-adjusted information on patients eligible for APACHE predictions (i.e. predictive patients). Non-predictive patients are not included in this report.

**Predictive** patients are those patients who do not meet any of the following criteria:

- Younger than 16 years of age.
- Burn diagnoses.
- Transplant diagnoses except liver transplant alone and kidney transplant alone.
- ICU admission source is ICU Transfer or ICU to OR.

---

1 APACHE Foundations associates all patients captured in the data entry section with the email used to access the solution (and as shown on the Profile screen). The phrase “all predictive patients” refers to all patients entered while accessing the system with the current email and password who are eligible for predictions.
Information included in this report:

**APACHE Control #** - this unique, system-generated number identifies a patient's ICU admission. The APACHE Control # is created when the patient's information is entered into the Data Entry screen and saved. The APACHE Control # link provided on this report can be used to subsequently retrieve patient data, as needed.

**Patient/ICU Admission Identifiers** - specifically Age, Gender and ICU Admission date and time. The ICU Admission Date Time column header includes a link indicating whether the list is sorted by ICU admit date time in ascending (up arrow) or descending (down arrow) order. Clicking on this arrow link will change the sort order from ascending to descending and back again, as needed. Note: patient's whose age is less than 16 years will not be included on this report.

**Acute Physiology Score (APS)** – patient's APACHE APS (see Report Interpretation section for more information).

**APACHE III Score** - patient's APACHE III score (see Report Interpretation section for more information).

**APACHE IV National Hospital Mortality prediction** – the probability that a patient will die in the hospital as determined by the APACHE IV National Day 1 Hospital Mortality equation. Note: APACHE IV hospital mortality predictions
will only be generated for patients during their first visit to the ICU (as noted in the Visit # field on the Data Entry screen).

**Hospital Discharge Status** – the patient's vital status at hospital discharge.

*Note:* If a patient's hospital discharge status was not entered, this field will be blank. You can access the patient's record to provide this information by using the patient's APACHE Control # link in the Risk-Adjusted Patient List. Note: patients who do not have a specified hospital discharge status will not be included in the Hospital Mortality report on the Aggregated Risk-Adjusted Outcomes page.

**APACHE IV National ICU LOS prediction** – the patient's expected or predicted ICU Length of Stay as determined by the APACHE IV National Day 1 ICU LOS equation. Note: APACHE IV ICU LOS predictions are not generated for patients with Post-ICU Discharge Destination of ICU Transfer.

**Actual ICU LOS (Truncated)** - the patient's actual truncated ICU length of stay, where actual ICU lengths of stay greater than 30 days are truncated at 30 days. During methodology development, ICU days for patients who are considered outliers are truncated so that their data does not overly influence the resulting prediction. ICU days are truncated at 30 days before being used to develop the APACHE ICU length of stay prediction. The same rule is applied to the actual ICU days shown as Actual ICU LOS (Truncated). Always use this truncated value when comparing actual to expected (or predicted) ICU days.

*Note:* If a patient's ICU discharge date and time was not entered, this field will be blank. You can access the patient's record to provide this information by using the patient's APACHE Control # link on the Risk-Adjusted Patient list report. Note: patients who do not have a valid ICU discharge date and time will not be included in the ICU Length of Stay report on the Aggregated Risk-Adjusted Outcomes page.

**APACHE II Score** – APACHE II Score is provided for patients whose Primary Admission Diagnosis is Sepsis (listed below) for which all data required to compute the score has been provided:

- Sepsis, cutaneous/soft tissue
- Sepsis, GI
- Sepsis, gynecologic
- Sepsis, other
• Sepsis, pulmonary
• Sepsis, renal/UTI (including bladder)
• Sepsis, unknown

Aggregated APACHE Risk-Adjusted Outcomes

The Aggregated Risk-Adjusted Outcomes report contains three main sections:

- The Hospital Mortality Results compare the percentage of actual hospital deaths to the number of predicted hospital deaths for all patients receiving hospital mortality predictions. Results are aggregated by ICU admission quarter and shown for the last four quarters and overall in table and chart format. Detailed information on this report section is included below.

- The ICU Length of Stay Results compares your patients' actual ICU length of stay to their predicted ICU length of stay for all patients receiving ICU length of stay
predictions. Results are aggregated by ICU admission quarter and shown for the last four quarters and overall in table and chart format. Detailed information on this report section is included below.

- The Results for All Patients section shows the average APS and APACHE III scores for all eligible patients (patients whose age >= 16) with sufficient data to compute APS and APACHE III scores. The total numbers of ICU and hospital admissions contributing these scores are provided as well. Non-predictive patients (e.g. those excluded from all predictions due to age less than 16, non-predictive diagnoses or admission from another ICU) are tallied in the last row of this table.

**Hospital Mortality Results**

Only patients with hospital mortality predictions are considered in determination of national standard mortality ratios (SMRs) and significance for the Hospital Mortality report. Hospital mortality is predicted based on the patient's first ICU visit during a hospitalization; hospital mortality predictions are not made for subsequent ICU visits during the same hospitalization.

The total number of non-predictive patients is included at the bottom of this report though these patients are not included in the ratios and p-values shown in the report. Non-predictive patients are those patients meeting at least one of the following criteria:

- Younger than 16 years of age.
- Burn diagnoses.
- Transplant diagnoses except liver transplant alone and kidney transplant alone.
- ICU admission source is ICU Transfer or ICU to OR.
The following information is provided, by ICU Admission Quarter and Overall, for patients who have both Ntl Hospital Mortality predictions and specified hospital discharge statuses.

- **Ntl Pred Hosp Mort** - the percentage of patients predicted to die in the hospital based on APACHE IV's National Hospital Mortality predicted risk of death. Only patients with hospital mortality predictions are included in this percentage.

- **Act Hosp Mort** – the percentage of patients with hospital mortality predictions who died in the hospital.

- **Hosp Mort Ntl ratio** – the ratio of Ntl Pred Hosp Mort/Act Hosp Mort, often referred to as a standardized mortality ratio or SMR. Ratios less than 1.0 will appear in green while those greater than 1.0 will appear in red. Refer to the Report Interpretation section below for information on comparing ratios and statistical significance.

- **Hosp Mort Ntl p-value** - a measure of statistical significance associated with the standardized mortality ratio (SMR).
• **Act # Hosp Deaths** - the actual number of hospital deaths for patients with hospital mortality predictions

• **Pred Hosp Deaths** – the sum of APACHE IV National Hospital Mortality predictions for all patients with hospital mortality predictions

• **Total # ICU Pt Encounters** - the total number of ICU patient encounters for patients with APACHE IV National Hospital Mortality predictions

**Note:** Patients who do not receive hospital mortality predictions or do not have a hospital discharge status will not be included in the Hospital Mortality report. Review the Risk-Adjusted Patient list to identify patients who have a hospital mortality prediction but no hospital discharge status. If a patient's hospital discharge status was not entered, this field will be blank in the table. You can access the patient's record to provide this information by using the patient's APACHE Control # link on the Risk-Adjusted Patient list report. The results given in the Hospital Mortality report will be suspect if the number of patients with missing hospital discharge status is high.

**ICU Length of Stay Results**

Only patients with ICU LOS predictions are considered in determination of national ratios and significance for the ICU Length of Stay report. Patients with a post-ICU destination of “ICU transfer: Transferred from this ICU to another ICU within your institution” do not receive ICU Length of Stay predictions.

The total number of non-predictive patients is included at the bottom of this report though these patients are not included in the ratios and p-values shown in the report. Non-predictive patients are those patients meeting at least one of the following criteria:

- Younger than 16 years of age.
- Burn diagnoses.
- Transplant diagnoses except liver transplant alone and kidney transplant alone.
- ICU admission source is ICU Transfer or ICU to OR.
The following information is provided, by ICU Admission Quarter and Overall, for patients who have both Ntl ICU LOS predictions and actual ICU lengths of stay:

- **Ntl Pred ICU LOS** – the average APACHE IV National ICU length of Stay prediction for patients with national ICU LOS predictions.

- **Act Trunc ICU LOS** – the average actual ICU length of stay (truncated) for patients with APACHE IV National ICU LOS predictions. ICU lengths of stay greater than 30 days are truncated at 30 days before inclusion in this average.

**Note:**
During methodology development, ICU days for patients who are considered outliers are truncated so that their data does not overly influence the resulting prediction. ICU days are truncated at 30 days before being used to develop the APACHE ICU length of stay prediction. The same rule is applied to the actual ICU days shown as Act Trunc ICU LOS. Always use this truncated value when comparing actual to expected (or predicted) ICU days.
• **Act (non-trunc) ICU LOS** - the average actual ICU length of stay for patients with APACHE IV National ICU LOS predictions. All ICU lengths of stay, even those greater than 30 days, are included in average.

• **ICU LOS Ntl Ratio** - the average, truncated ICU LOS divided by the average APACHE predicted ICU LOS for patients with APACHE IV National ICU LOS predictions. Ratios less than 1.0 will appear in green while those greater than 1.0 will appear in red. Refer to the Report Interpretation section below for information on comparing ratios and statistical significance.

• **ICU LOS Ntl p-value** - the measure of statistical significance associated with the ICU LOS Ntl Ratio.

• **Total # ICU Pt Encounters** - the total number of ICU patient encounters for patients with APACHE IV National ICU Length of Stay predictions.

Note: Patients who do not receive ICU length of stay predictions or do not have a valid actual ICU length of stay will not be included in the ICU Length of Stay report. Actual ICU length of stay will not be available if the patient's ICU discharge date and time have not been entered into the patient's APACHE Foundations' record. Review the Risk-Adjusted Patient list to identify patients who have an ICU LOS prediction but no actual ICU LOS. If a patient's ICU discharge date and time was not entered, this field will be blank. You can access the patient's record to provide this information by using the patient's APACHE Control # link on the Risk-Adjusted Patient list report. The results given in this report will be suspect if the number of patients missing an actual ICU LOS is high.

**Report Interpretation**

**APACHE III Scoring System**

The following items are evaluated and scored in APACHE:

**Physiology.** Physiology is the largest component of the APACHE III score. The Acute Physiology score (APS) is the total number of points that the patient gets from deranged physiology alone. The total score can range from 0 to 252.

**Chronic Health.** Chronic Health includes only those items that affect the immune system. More than 30 chronic health items were collected in the APACHE III study, but only those that were found to impact outcomes are included in the methodology. The total score derived from chronic health information can range from 0 to 23.
Age. Note that age is not as significant as physiology in terms of length of stay (LOS) and mortality. The Chronic Health and Age equal the physiological reserve points (this is an indicator of the patient's ability to recover from illness). When determining the APACHE III score, the following equation is used: APS + Chronic Health + Age = APACHE III Score

**APACHE IV Predictions**

Points from age, chronic health, and physiology form the APACHE III score, which is a basic severity indicator. This score can be used only to compare patients in the same disease category. When lead-time bias and disease are added to the APACHE III score, a precise risk indicator is generated in the form of predictive equations. Predictive equations allow comparisons across different disease categories.

The APACHE III score is in the public domain and is useful as long as comparisons are made within the same diagnosis, but a precise risk indicator is required to compare different diagnoses. The coefficients used in the predictive equations are proprietary.

The APACHE methodology provides a way for you to compare your outcomes to national norms. The APACHE national predictions make adjustments on the following patient risk factors:

- Acute Physiology Score (APS)
- Age
- Chronic Health
- Disease (APACHE Primary Diagnosis)
- Surgical Status (Emergency versus Elective)
- ICU Admission Source
- Pre-ICU LOS (how long the patient was treated in the hospital before coming to the ICU)

**Comparing Actual Outcomes to Expected Outcomes**

Outcomes are reported as ratios of actual outcomes versus expected outcomes in APACHE Foundations' Aggregated Risk-Adjusted Reports. For example, the Standardized Mortality Ratio (also known as an SMR) is equal to the Percent (or Number) of Actual Deaths divided by Percent (or Number) of Predicted Deaths.

To put mortality ratios in perspective, compare the actual and predicted percentages (or the actual and predicted number of deaths) to determine the statistical significance, clinical relevance, or both.
ICU LOS Ratio

ICU Length of Stay (LOS) ratios represent actual versus predicted LOS and are a common basis for measuring a facility's performance in comparison with the national norm.

A ratio of 1.0 indicates a precise match between actual and predicted values. Ratios above 1.0 represent actual ICU LOS above predicted, and ratios below 1.0 represent ICU LOS below predicted.

Example ICU LOS Ratio

<table>
<thead>
<tr>
<th>Sample Size</th>
<th>Average ICU LOS</th>
<th>Predicted ICU LOS</th>
<th>ICU LOS Ratio</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>450</td>
<td>5.12</td>
<td>4.04</td>
<td>1.25</td>
<td>p &lt; .01</td>
</tr>
</tbody>
</table>

The ICU LOS of 1.25 represents an average ICU LOS longer than predicted, which indicates potential inefficiencies.

Standardized Mortality Ratios

Standardized mortality ratios (SMRs) represent the percentage of actual mortalities at a facility in comparison with the predicted mortalities from the national norm. An SMR ratio of 1.0 indicates a precise match between actual and predicted values. Ratios above 1.0 represent actual mortality rates above predicted, and ratios below 1.0 represent rates below predicted.

Example Standardized Mortality Ratio

<table>
<thead>
<tr>
<th>Sample Size</th>
<th>Actual Mortality (N)</th>
<th>Predicted Mortality (N)</th>
<th>SMR</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>990</td>
<td>11.4% (113)</td>
<td>10.2% (101)</td>
<td>1.11</td>
<td>NS</td>
</tr>
</tbody>
</table>

The SMR of 1.11 indicates and actual mortality rate higher than predicted. The difference is not statistically significant; however, the difference in the number of deaths is 12 patients (113 actual deaths compared to 101 predicted deaths). This difference could be of clinical importance.
Example Standardized Mortality Ratio

<table>
<thead>
<tr>
<th>Sample Size</th>
<th>Actual Mortality (N)</th>
<th>Predicted Mortality (N)</th>
<th>SMR</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>683</td>
<td>11.3% (77)</td>
<td>15.0% (102)</td>
<td>.75</td>
<td>p &lt; 0.01</td>
</tr>
</tbody>
</table>

The SMR of 1.11 indicates and actual mortality rate higher than predicted. The difference is not statistically significant; however, the difference in the number of deaths is 12 patients (113 actual deaths compared to 101 predicted deaths). This difference could be of clinical importance.

Example Standardized Mortality Ratio

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<td>.75</td>
<td>p &lt; 0.01</td>
</tr>
</tbody>
</table>

The SMR of .75 probably represents above average quality of care with 25 fewer actual deaths than predicted. Large differences in the number of deaths are generally both clinically and statistically important.

**Time Frames**

When you review your reports, remember that some quarters might not include enough information for a statistically valid sample. In recent quarters, this may be because patients who are still in the hospital will not be included in the Hospital Mortality report while those who died in the hospital during that recent quarter will be included in mortality ratios and p-values. This could result in unreliable mortality ratios.

Example Time Frame

<table>
<thead>
<tr>
<th>Sample Size</th>
<th>Patient Sample</th>
<th>Actual Mortality (N)</th>
<th>Predicted Mortality (N)</th>
<th>SMR</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Qtr 2</td>
<td>168</td>
<td>7.1% (12)</td>
<td>8.9% (15)</td>
<td>0.80</td>
<td>NS</td>
</tr>
<tr>
<td>Qtr 3</td>
<td>189</td>
<td>9.5% (18)</td>
<td>7.1% (13.5)</td>
<td>1.36</td>
<td>NS</td>
</tr>
</tbody>
</table>

If you looked at the SMR alone, it might seem that a quality of care problem exists. The SMR increased from .80 (actual death rate below predicted) to 1.36 (actual death rate above predicted); however, you must consider the following items:
In both Qtr 2 and Qtr 3, the difference between predicted and actual mortality is relatively low (less than two deaths). Therefore, the differences between actual and predicted values are not likely to be clinically or statistically meaningful.

The sample size in both time frames is too small to give truly meaningful results. The SMR change from 0.80 to 1.36 was the result of a 21 patient increase in patients and 6 patient increase in death (the predicted death rate was constant). We cannot draw any definitive conclusions from these samples.

**Statistical Significance (use of p-values)**

**Example Comparing Actual to Expected Mortality**

In this scenario, assume the following information:

- The actual number of deaths equals 142
- The predicted number of deaths equals 119
- N = 1200

The SMR is equal to 11.83\% (% Actual Deaths) divided by 9.92\% (% Expected Deaths) = 1.193.

<table>
<thead>
<tr>
<th>SMR</th>
<th>Indicates</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.00</td>
<td>Actual matches expected.</td>
</tr>
<tr>
<td>&gt; 1.00</td>
<td>Actual is worse than expected.</td>
</tr>
<tr>
<td>&lt; 1.00</td>
<td>Actual is better than expected.</td>
</tr>
</tbody>
</table>

To determine the statistical significance or clinical relevance, you must consider the associated p-value. The p-value tells you the probability of observing an outcome by random chance alone.

- A p-value of less than 0.05 means there is less than a five percent chance that our results were an artifact of chance.
- A p-value of less than 0.01 means there is less than a one percent chance that our results were an artifact of chance.
- A p-value of n.s. means there is a greater than five percent chance that our results could occur if the true SMR equals 1.00. In other words, there is no significant difference between the actual and expected outcomes.

With our current example in mind (SMR = 1.193), consider the statistical relevance implied by each of the p-values given below:
The table below illustrates the difference between statistical and clinical significance in our example.

<table>
<thead>
<tr>
<th>Value</th>
<th>P-Value</th>
<th>Interpretation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.15</td>
<td>0.001</td>
<td>Clinically and statistically significant.</td>
</tr>
<tr>
<td>1.01</td>
<td>0.001</td>
<td>Statistically significant, but not of any meaningful clinical consequence.</td>
</tr>
<tr>
<td>1.15</td>
<td>0.40</td>
<td>Not statistically significant. Most likely there is a small sample size.</td>
</tr>
<tr>
<td>1.13</td>
<td>0.06</td>
<td>Not quite statistically significant, but close enough so that the SMR of 1.193 is worrisome.</td>
</tr>
</tbody>
</table>

The APACHE risk-adjusted outcomes reports will show if a ratio is statistically significant to the 99th or 95th percentile (<0.01 or <0.05) or display n.s. if the ratio is not statistically significant. Since the actual p-values are not shown on these reports, both the 0.40 and 0.06 p-values shown above will be indistinguishable on reports. Because of that, you should consider the sample size in interpretation of n.s. ratios. Also, if N > 200 and the SMR is worse or better than expected, additional investigation and monitoring is recommended.

**Summary**

Risk-adjusted APACHE outcomes tell you what should happen (known as expected outcomes), and then these predictions are used to compare to what actually happens (known as actual outcomes). You should remember the following guidelines when comparing actual outcomes to expected outcomes:

- The actual vs. expected outcomes ratio alone has no useful meaning.
- Consider the actual vs. expected outcomes ratio only in combination with the estimate of significance of the difference between actual and predicted values.
• Ratios based on samples of less than 200 patients are not reliable.

• Ratios based on samples between 200 and 400 patients are potentially unreliable (samples above 400 patients are preferred).

• Excess number of deaths as well as ratios can be important.

• A sample containing less than five deaths is not useful for mortality ratios.

• Both clinical and statistical differences can be relevant.

• Monitor trends and changes in performance over time. Avoid focusing solely on a single value in isolation.