

## APPENDICES

### Units of Measurement in the Systeme International (SI) (Continued)

Basic 51			
Parameter	Dimensions	Unit (Symbol)	Equivalences
Force	M x (L/T <sup>2</sup> )	Newton (N) = kg x (m/sec <sup>2</sup> )	1 dyne = 10 <sup>-5</sup> N
Pressure	M x (L/T <sup>2</sup> ) L <sup>2</sup>	Pascal (Pa) = N/m <sup>2</sup>	1 kPa = 7.5 mm Hg = 10.2 cm HP 1 mm Hg = 1.00000014 torr (See conversion table for kPa and mmHg)
Heat	M x (L/T <sup>2</sup> ) x L	Joule (J) = N x m	1 kilocalorie (kcal) = 4184 J
Temperature	None	Kelvin (K)	0° C = -273 K (See conversion table for °C and OF)
Viscosity	M, 1/L, 1/T	Newton x second per square meter (N . sec/m <sup>2</sup> )	Centipoise (cP) = 10 <sup>-3</sup> N . sec/m <sup>2</sup>
Amount of a substance	N	Mole (mol) = molecular weight in grams	Equivalent (Eq) = mol x valence
Concentration	N/L <sup>3</sup> N/M	mol/m <sup>3</sup> = Molarity mol/kg = Molality	Ionic strength = mol/kg

### Temperature Conversions

(degree C)	(Fahrenheit)
100	212
41	105.8
40	104
39	102.2
38	100.4
37	98.6
36	96.8
35	95
34	93.2
33	91.4
32	89.6
31	87.8
30	86
0	32

$$\text{Fahrenheit} = (9/5 \text{ } ^\circ\text{C}) + 32$$

$$^\circ\text{C} = 5/9 (\text{F} - 32)$$

### Apothecary and Household Conversions

Apothecary	Household
1 grain = 60 mg	1 teaspoonful = 5 mL
1 ounce = 30 g	1 dessertspoonful = 10 mL
1 fluid ounce = 30 mL	1 tablespoonful = 15 mL
1 pint = 500 mL	1 wineglassful = 60 mL
1 quart = 947 mL	1 teacupful = 120 mL
	1 tumblerful = 240 mL
	1 petroleum barrel = 42 gal

### Pressure Conversions

mmHg	kPa	mmHg	kPa	mmHg	kPa
41	5.45	61	8.11	81	10.7
42	5.59	62	8.25	82	10.9
43	5.72	63	8.38	83	11.0
44	5.85	64	8.51	84	11.1
45	5.99	65	8.65	85	11.3
46	6.12	66	8.78	86	11.4
47	6.25	67	8.91	87	11.5
48	6.38	68	9.04	88	11.7
49	6.52	69	9.18	89	11.8
50	6.65	70	9.31	90	11.9
51	6.78	71	9.44	91	12.1
52	6.92	72	9.58	92	12.2
53	7.05	73	9.71	93	12.3
54	7.18	74	9.84	94	12.5
55	7.32	75	9.98	95	12.6
56	7.45	76	10.11	96	12.7
57	7.58	77	10.24	97	12.9
58	7.71	78	10.37	98	13.0
59	7.85	79	10.51	99	13.1
60	7.98	80	10.64	100	13.9

Kilopascal (kPa) = 0.133 x mmHg

mm Hg = 7.50 x kPa

### pH and Hydrogen Ion Concentration

pH	[H <sup>+</sup> ] (nEq/L)
6.8	160
6.9	125
7.0	100
7.1	80
7.2	63
7.3	50
7.4	40
7.5	32
7.6	26
7.7	20
7.8	16

### Sizes of Plastic Tube Devices

French Size	Outside Diameter*		Device
	Inches	mm	
1	0.01	0.3	Vascular catheters
4	0.05	1.3	
8	0.10	2.6	Small-bore feeding tubes
10	0.13	3.3	
12	0.16	4.0	
14	0.18	4.6	Nasogastric tubes
16	0.21	5.3	
18	0.23	6.0	
20	0.26	6.6	Chest tubes
22	0.28	7.3	
24	0.31	8.0	
26	0.34	8.6	
28	0.36	9.3	
30	0.39	10.0	
32	0.41	10.6	
34	0.44	11.3	
36	0.47	12.0	
38	0.50	12.6	

\*Diameters can vary with manufactures. However, a useful rule of thumb is OD French size

### Sizes of Intravascular Catheters

Gauge	Outside Diameter*		Type of Catheter
	Inches	mm	
26	0.018	0.45	Butterfly devices
25	0.020	0.50	
24	0.022	0.56	
23	0.024	0.61	
22	0.028	0.71	Peripheral vascular catheters
21	0.032	0.81	
20	0.036	0.91	
19	0.040	1.02	
18	0.048	1.22	Central venous catheters
16	0.064	1.62	
14	0.080	2.03	Introducer catheters
12	0.104	2.64	
10	0.128	3.25	

\*Diameters can vary with manufacturers.

## SELECTED REFERENCE RANGES

### Reference Ranges for Selected Clinical Laboratory Tests

Substance	Fluid*	Traditional			SI Units
		Units	x	k =	
Acetoacetate	P, S	0.3-3.0 mg/dL	97.95	3-30 $\mu\text{mol/L}$	
Alanine aminotransferase (SGPT)	S	0-35 U/L	0.016	0-0.58 $\mu\text{kat/L}$	
Albumin	S	4-6 g/dL	10	40-60 <i>giL</i>	
	CSF	11-48 mg/dL	0.01	0.11-0.48 <i>giL</i>	
Aldolase	S	0-6 U/L	16.6	0-100 nkat/L	
Alkaline phosphatase	S	(F)30-100 U/L (M)45-115 U/L	0.016	0.5-1.67 $\mu\text{kat/L}$ 0.75-1.92 $\mu\text{kat/L}$	
Ammonia	P	10-80 $\mu\text{g/dL}$	0.587	5-50 $\mu\text{mol/L}$	
Amylase	S	0-130 U/L	0.016	0-2.17 $\mu\text{kat/L}$	
Aspartate aminotransferase (SGOT)	S	0-35 U/L	0.016	0-0.58 $\mu\text{kat/L}$	
P-Hydroxybutyrate	S	<1.0 mg/dL	96.05	<100 $\mu\text{mol/L}$	
Bicarbonate	S	22-26 mEq/L	1	22-26 mmol/L	
Bilirubin: Total	S	0.1-1.0 mg/dL	17.1	2-18 $\mu\text{mol/L}$	
Conjugated	S	<=0.2 mg/dL		<=4 $\mu\text{mol/L}$	
Blood urea nitrogen (BUN)	P, S	8--18 mg/dL	0.367	3.0-6.5 mmol/L	

**Reference Ranges for Selected Clinical Laboratory Tests (Continued)**

Substance	Fluid*	Traditional		
		Units	x k	= 51 Units
Calcium: Total	S	8.5-10.5 mg/dL	0.26	2.2-2.6 mmol/L
Ionized	P	2.2-2.3 mEq/L	0.49	1.10-1.15 mmol/L
Chlorid	P, S	95-105 mEq/L	1	95-105 mmol/L
	CSF	120-130 mEq/L		120-130 mmol/L
	U	10-200 mEq/L		10-200 mmol/L
Creatinine	S	0.6-1.5 mg/dL	0.09	0.05-0.13 mmol/L
	U	15-25 mg/kg/24 hr	0.009	0.13-0.22 mmol/kg/24 h
Cyanide: Nontoxic	WB	<5 µg/dL	3.8	<19 µmol/L
Lethal		>30 µg/dL		>114 µmol/L
Fibrinogen	P	150-350 mg/dL	0.01	1.5-3.5 g/L
Fibrin split product	S	<10 µg/mL	1	<10 mg/L
Glucose (fasting)	P	70-100 mg/dL	0.06	3.9-6.1 mmol/L
	CSF	50-80 mg/dL		2.8-4.4 mmol/L
Lactate: Resting	P	<2.0 mEq/L	1	<2 mmol/L
Exercise		<4.0 mEq/L		<4 mmol/L
Lactate dehydrogenase (LDH)	S	50-150 U/L	0.017	0.82-2.66 µkat/L
Lipase	S	0-160 U/L	0.017	0-2.66 µkat/L
Magnesium	P, S	1.8-3.0 mg/dL	0.41	0.8-1.2 mmol/L
		1.5-2.4 mEq/L	0.5	0.8-1.2 mmol/L
Osmolality	S	280-296 mOsm/kg	1	280-96 mmol/kg
Phosphate	S	2.5-5.0 mg/dL	0.32	0.80-1.60 mmol/L
Potassium	P, S	3.5-5.0 mEq/L	1	3.5-5.0 mmol/L
Total protein	P, S	6.0-8.0 g/dL	10	60-80 g/L
	CSF	<40 mg/dL	0.01	<0.40 g/L
	U	<150 mg/24 hr	0.01	<1.5 g/24 hr
Sodium	P, S	135-147 mEq/L	1	135-147 mmol/L
Thyroxine: Total	S	4-11 µg/dL	12.9	51-142 nmol/L
Free		0.8-2.8 ng/dL		10-36 pmol/L
Triiodothyronine (T <sub>3</sub> )	S	75-220 ng/dL	0.015	12-3.4 nmol/L

\* P = Plasma, S = serum, U = urine, WB = whole blood, CSF = cerebrospinal

RBG = red blood

Adapted from the New England Journal of Medicine SI Unit Conversion Guide.

MA: Massachusetts Medical Society. 1992.

### Reference Ranges for Vitamins and Trace Elements

Substance	Fluid*	Traditional unit x	k	= 51 Units
Chromium	S	0.14-0.15 ng/mL	17.85	2.5-2.7 nmol/L
Copper	S	70-140 µg/dL	0.16	11-22 µmol/L
Folate	RBC	140-960 ng/mL	2.26	317-2169 nmol/L
Iron	S	(M)80-180 µg/dL (F)60-160 µg/dL	0.18	(M)14-32 µmol/L (F)11-29 µmol/L
Ferritin	P, S	(M)20-250 ng/mL (F)10-120 ng/mL	1	(M)20-250 µg/L (F)10-120 µg/L
Manganese	WB	0.4-2.0 µg/dL	0.018	0.7-3.6 µmol/L
Pyridoxine	P	20-90 ng/mL	5.98	120-540 nmol/L
Riboflavin	S	2.6-3.7 µg/dL	26.57	70-100 nmol/L
Selenium	WB	58-234 µg/dL	0.012	0.7-2.5 µmol/L
Thiamine (total)	P	3.4-4.8 µg/dL	0.003	98.6-139 µmol/L
Vitamin A	P, S	10-50 µg/dL	0.349	0.35-1.75 µmol/L
Vitamin B <sub>12</sub>	S	200-1000 pg/mL	0.737	150-750 pmol/L
Vitamin C	S	0.6-2 mg/dL	56.78	30-100 µmol/L
Vitamin D	S	24-40 ng/mL	2.599	60-105 nmol/L
Vitamin E	P, S	0.78-1.25 mg/dL	23.22	18-29 µmol/L
Zinc	S	70-120 µg/dL	0.153	11.5-18.5 µmol/L

\*P = plasma, S = serum, WB = whole blood, RBC = red

Adapted from the New England Journal of Medicine SI Unit Conversion Guide, MA: Massachusetts Medical Society, 1992.

### Laboratory Measurements Influenced by Body Position

Measurement	% Decrease When Upright	
	Average	Range
Hemoglobin	5	3-7
Hematocrit	6	4-9
Serum calcium	4	2-6
Total protein	9	7-10
Serum albumin	9	6-14
Cholesterol	9	5-15
Alkaline phosphatase	9	5-11
Alanine aminotransferase	7	4-14

From Ravel R. Clinical laboratory medicine, Chicago: Yearbook Medical 1989:4.

**Volume Used by Automated Analyzers in the Clinical Laboratory**

Laboratory Test	Instrument Volume (mL)
Arterial blood gases	1.0
Electrolyte panel	0.15
Complete blood cell count	0.125
Glucose	0.04

For serum assays, the volume of whole blood to be withdrawn is:

$$\text{Whole blood volume} = \frac{\text{Serum volume}}{1 - \text{Hematocrit}}$$

From Mayo Clin Proc 1993;68:255.

**Desirable Weights for Adults\***

Height		Males		
Feet	Inches	Small Frame	Medium Frame	Large Frame
5	2	128-134	131-141	138-150
5	3	130-136	133-143	140-153
5	4	132-138	135-145	142-156
5	5	134-140	137-148	144-160
5	6	136-142	139-151	146-164
5	7	138-145	142-154	149-168
5	8	140-148	145-157	152-172
5	9	142-151	148-160	155-176
5	10	144-154	151-163	158-180
5	11	146-157	154-166	161-184
6	0	149-160	157-170	164-188
6	1	152-164	160-174	168-192
6	2	155-168	164-178	172-197
6	3	158-172	167-182	172-202
6	4	162-176	171-187	181-207
		Females		
4	10	102-111	109-121	112-131
4	11	103-113	111-123	120-134
5	0	104-115	113-126	122-137
5	1	106-118	115-129	125-140
5	2	108-121	118-132	128-143



Desirable Weights for Adults\* (Continued)

Height		Males		
Feet	Inches	Small Frame	Medium Frame	Large Frame
5	3	111-124	121-135	131-147
5	4	114-127	124-138	134-151
5	5	117-130	127-141	137-155
5	6	120-133	130-144	140-159
5	7	123-136	133-147	143-163
5	8	126-139	136-150	146-167
5	9	129-142	139-153	149-170
5	10	132-145	142-156	152-173
5	11	135-148	145-159	155-176
6	0	138-151	148-162	158-179

\*Unclothed weights associated with the longest life expectancies. From the statistics bureau of the Metropolitan Life Insurance Company, 1983.

Basal Metabolic Rates

Body Weight (kg)	kcal/24 hours	
	Male	Female
40	1340	1241
50	1485	1399
52	1505	1429
54	1555	1458
56	1580	1487
58	1600	1516
60	1630	1544
62	1660	1572
64	1690	1599
66	1725	1626
68	1765	1653
70	1785	1679
72	1815	1705
74	1845	1731
76	1870	1756
78	1900	1781
80	—	1805

From Talbot FB. Am J Dis Child 1938;5:455-459.

### Determinations of Body Size

#### Ideal Body Weight\*

Males: IBW (kg) = 50 + 2.3 (Ht in inches - 60)

Females: IBW (kg) = 45.5 + 2.3 (Ht in inches - 60)

#### Body Mass Index†

$$\text{BMI} = \text{Wt (in lbs)} / \text{Ht (in inches)}^2 \times 703$$

#### Body Surface Area

Dubois Formula:‡

$$\text{BSA (m}^2\text{)} = \text{Ht (in cm)}^{0.725} \times \text{Wt (in kg)}^{0.425} \times 0.007184$$

Jacobson Formula§

$$\text{Ht (in cm)} + \text{Wt (in kg)} - 60$$

BSA (m<sup>2</sup>) =

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100

\*Devine BJ. Drug Intell Clin Pharm 1974;8:650.

†Matz R. Ann Intern Med 1993;

‡Dubois EF. Basal metabolism in health and disease. Philadelphia: Lea &

§Jacobson B. Medicine and clinical engineering. Englewood Cliffs, NJ:

### Body Build and Blood Volume in Adults

Body Build	Average Blood Volume (mL/kg)	
	Males	Female
Thin	65	60
Normal	70	65
Muscular	75	70
Obese	60	55

From Documenta Geigy Scientific Tables. 7th ed. Basel, Switzerland: JR Geigy, 1970:528.

### Blood Volumes in the Elderly

Volume(mL)	Elderly Men	Elderly Women
Whole blood	(3809 x BSA) - 2362	(1591 x BSA) + 889
Plasma	(1,995 x BSA) - 667	(925 x BSA) + 802
Erythrocytes	(1761 x BSA) - 1609	(716 x BSA) + 14

From Cordtes PR et al. Surg Gynecol Obstet 1992;

Body Fluid Distribution in Healthy Adults

Parameter	Derivation	Males	Female
Total body water	0.55 x body wt (kg)	600 mL/kg	500 mL/kg
Interstitial fluid	0.16 x body wt (kg)	160 mL/kg	160 mL/kg
Blood volume (BV)	0.065 x body wt (kg)	70 mL/kg	65 mL/kg
Erythrocyte volume (EV)	EV = BV x Hct	33 mL/kg	27 mL/kg
Plasma volume (PV)	PV = BV - EV	37 mL/kg	38 mL/kg
Hematocrit (Hct)	EV/BV x 100	47% (mean) 40-54% (range)	42% (mean) 37-47% (range)

From Documenta Geigy Scientific Tables. 7th ed. Basel, Switzerland: JR Geigy

Peak Expiratory Flow Rates for Healthy Males

Age (yr)	Ht:	Average Peak Flow (L/min)			
		60"	65"	70"	75"
20		602	649	693	740
25		590	636	679	725
30		577	622	664	710
35		565	609	651	695
40		552	596	636	680
45		540	583	622	665
50		527	569	607	649
55		515	556	593	634
60		502	542	578	618
65		490	529	564	603
70		477	515	550	587

Peak Flow (Umin) =  $[3.95 - (0.0151 \times \text{Age})] \times \text{Ht (cm)}$

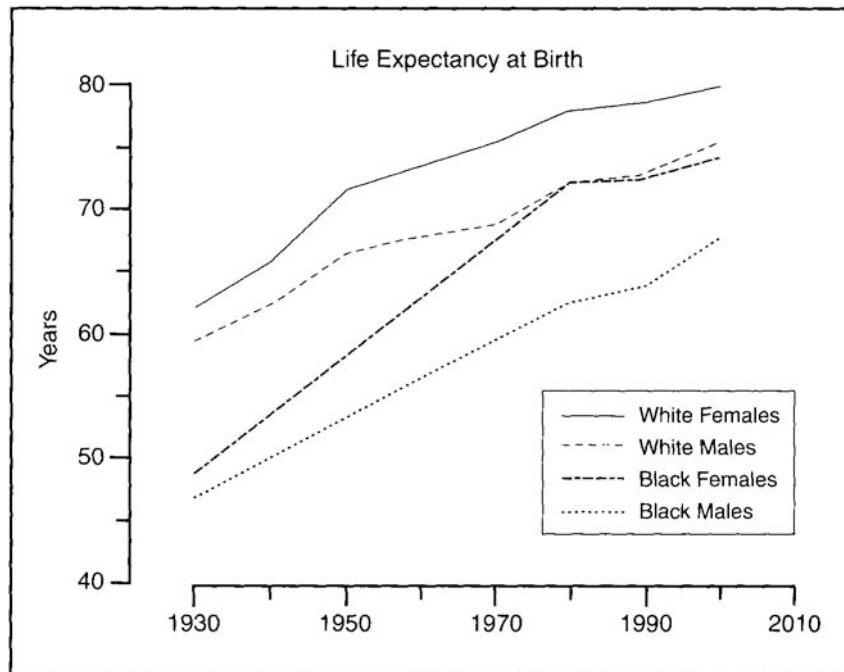
Regression equation from Leiner GC et al. Am Rev Respir Dis

**Peak Expiratory Flow Rates for Healthy Females**

Age (yr)	Average Peak Flow (Umin)				
	Ht:	55"	60"	65"	70"
20		309	423	460	496
25		385	418	454	490
30		380	413	448	483
35		375	408	442	476
40		370	402	436	470
45		365	397	430	464
50		360	391	424	457
55		355	386	418	451
60		350	380	412	445
65		345	375	406	439
70		340	369	400	432

Peak Flow (Umin) =  $[2.93 - (0.0072 \times \text{Age})] \times \text{Ht (cm)}$

Regression equation from Leiner GC et al. Am Rev Respir Dis 1963;88:647.



National Vital Statistics Reports, Sept. 18, 2003; 53(3).

## **CLINICAL SCORING SYSTEMS**

### **APACHE II SCORING SYSTEM**

The APACHE (Acute Physiology and Chronic Health Evaluation) scoring system was developed to provide an objective assessment of severity of illness in patients in the ICU. The scoring system is not meant for burn patients or post-cardiopulmonary bypass patients. Although there are limitations in predicting mortality in individual patients in the ICU, the APACHE scoring system is widely used in clinical studies to provide some measure of disease severity in the study patients. The following pages demonstrate how to generate an APACHE II score (1). Although there is an APACHE III scoring system (2), the APACHE II score is more widely used.

The APACHE II score is made up of three components:

**Acute Physiology Score (APS).** The largest component of the APACHE II score is derived from 12 clinical measurements that are obtained within 24 hours after admission to the ICU. The *most abnormal measurement* is selected to generate the APS component of the APACHE II score. If a variable has not been measured, it is assigned zero points.

**Age Adjustment.** From one to six points is added for patients older than 44 years of age.

**Chronic Health Evaluation.** An additional adjustment is made for patients with severe and chronic organ failure involving the heart, lungs, kidneys, liver, and immune system.

## Acute Physiology Score

	Points:								
	+4	+3	+2	+1	0	+1	+2	+3	+4
Temperature (°C)	≥41	39-40.9		38.5-38.9	36-38.4	34-35.9	32-33.9	30-31.9	≤29.9
Mean arterial pressure	≥160	130-159	110-129		70-109		50-69		≤49
Heart rate	≥180	140-179	110-139		70-109		55-69	40-54	≤39
Respiratory rate	≥50	35-49		25-34	12-24	10-11	6-9		≤5
<sup>1</sup> A-aPO <sub>2</sub>	≥500	350-499	200-349		<200				
<sup>2</sup> PAO <sub>2</sub>					>70	61-70		55-60	<55
Arterial pH	≥7.7	7.6-7.69		7.5-7.59	7.33-7.49		7.25-7.32	7.15-7.24	<7.15
<sup>3</sup> Serum bicarbonate (mEq/L)	≥52	41-51.9		32-40.9	23-31.9		18-21.9	15-17.9	<15
Serum sodium (mEq/L)	≥180		160-179	155-159	150-154	130-149	120-129	111-119	≤110
Serum potassium (mEq/L)	≥7	6-6.9		5.5-5.9	3.5-5.4	3-3.4	2.5-2.9		<2.5
Serum creatinine (mg/dL)	≥3.5	2-3.4	1.5-1.9		0.6-1.4		<0.6		
Hematocrit	≥60		50-59.9	46-49.9	30-45.9		20-29.9		<20
WBC count	≥40		20-39.9	15-19.9	3-14.9		1-2.9		<1
<sup>4</sup> 15 - (Glasgow Coma Score) =									

1. If  $FiO_2 > 50\%$ . 2. If  $FiO_2 < 50\%$ . 3. Use only if no ABGs.

### Scoring Method

1. Select the *most abnormal measurement* for each parameter in the first 24 hours after ICU admission.
2. If a parameter has not been measured, assign it zero points.
3. Add the corresponding points for all 12 parameters to obtain the Acute Physiology Score.
4. Glasgow Coma Scale follows.

### The Glasgow Coma Scale\*

Eye Opening:	Points	
Spontaneous .....	4	
To Speech .....	3	
To Pain .....	2	
None .....	1	<input type="checkbox"/> Points
<b>Verbal Communication†:</b>		
Oriented .....	5	
Confused conversation .....	4	
Inappropriate words .....	3	
Incomprehensible sounds .....	2	
None .....	1	<input type="checkbox"/> Points
<b>Motor Response:</b>		
Obeys commands .....	6	
Localizes to pain .....	5	
Withdraws to pain .....	4	
Abnormal flexion .....	3	
Abnormal extension .....	2	
None .....	1	<input type="checkbox"/> Points
Total Points‡		<input type="checkbox"/>

\*Adapted from Teasdale G, Jennet B. Assessment of coma and impaired consciousness. A practical approach. *Lancet* 1974;2:81–86.

†For intubated patients, assign a score of 1 for verbal communication.

‡Best score is 15 points; worst score is 3 points.

### Age Adjustment

Age (yr)	Points
<44	0
45–54	2
55–64	3
65–74	5
>75	6

### **Chronic Health Adjustment**

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For any of the following:

1. Biopsy proven cirrhosis.
2. Heart failure: NYHA Class IV
3. Severe COPD (hypercapnia, home oxygen)
4. Chronic dialysis
5. Immunocompromised

Add 2 points for elective surgery or neurosurgery, 5 points for emergency surgery.

**Total APACHE II Score** APS score

Age adjustment

Chronic health adjustment Total APACHE II score

### **APACHE II Score and Mortality in 5,185 ICU Patients**

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<b>APACHE II Score</b>	<b>Hospital Mortality (%)</b>	
	<b>Nonoperative</b>	<b>Postoperative</b>
0-4	4	1
5-9	6	3
10-14	12	6
15-19	22	11
20-24	40	29
25-29	51	37
30-34	71	71
≥35	82	87

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Data from Knaus WA et al. Crit Care Med 1985;13:818-829.



**Limitations**

The following limitations of the APACHE II score deserve mention.

The APS score has no adjustments for measurements obtained in the presence of interventions such as hemodynamic support drugs, mechanical ventilation, or antipyretic therapy.

There is an exaggerated penalty for old age. For example, age greater than 65 years adds more points than an A-a PO<sub>2</sub> gradient above 500 mm Hg (6 points versus 4 points, respectively).

There is no consideration for malnutrition or cachexia in the chronic health evaluation.

**SEQUENTIAL ORGAN FAILURE ASSESSMENT (SOFA) SCORE**

The Sequential Organ Failure Assessment (SOFA) score is designed to evaluate the function of six major organ systems (i.e., cardiovascular, respiratory, renal, hepatic, central nervous system, and coagulation) over time. The score is obtained on the day of admission and each of the following days in the ICU. Because the SOFA score monitors daily changes in organ function, it can evaluate the patient's response to treatment, and sequential changes in the SOFA score (e.g., increasing or decreasing) can predict the eventual outcome of the ICU stay.

The SOFA score differs from the APACHE II score in the following ways: (1) The APACHE II score is performed only on the day of admission, and does not monitor the clinical course of the patient, and (2) The APACHE II score has no adjustment for the use of hemodynamic support drugs, and the SOFA score does.

The Sequential Organ Failure Assessment (SOFA) Score

Variables	Points				
	0	1	2	3	4
PaO <sub>2</sub> /FIO <sub>2</sub> (mmHg)	>400	≤400	≤300	≤200	≤100 <sup>†</sup>
Platelets (10 <sup>3</sup> /μL)	>150	≤150	≤100	≤50	≤20
Bilirubin (mg/dL)	<1.2	1.2-1.9	2.0-5.9	6.0-11.9	≥12
Creatinine (mg/dL) or Urine Output (mL/day)	<1.2	1.2-1.9	2.0-3.4	3.5-4.9 or <500	>5.0 or <200
Glasgow Coma Score <sup>‡</sup>	15	13-14	10-12	6-9	<6
Hypotension	None	Mean BP <70 mmHg	Dopa ≤5 or Dobu (any dose) <sup>†</sup>	Dopa >5 or Epi ≤0.1 or Norepi ≤0.1	Dop >15 or Epi >0.1 or Norepi >0.1 <sup>†</sup>

<sup>†</sup>Values obtained during respiratory support.

<sup>‡</sup>In patients who are sedated, use the best estimate of what the GCS would be sedation.

<sup>†</sup>Adrenergic agents administered for at least one hour. Doses expressed in Dopa = Dopamine, Dobu = dobutamine, Epi = epinephrine, Norepi =

Scoring Method:

1. Use the *most abnormal value* for each variable in a 24-hour
2. If a single value is missing, use the mean value of the sum of the results preceding and following the missing value.
3. Add the corresponding points for all 6 parameters to obtain the final score (range = 0-24).

From Ferreira FL, et al. Serial evaluation of the SOFA score to predict outcome ill patients. JAMA 2001; 286:1754-1758.

SOFA Score and Mortality\*

Initial Score	Mortality Rate	Highest Score	Mortality Rate
0-1	0	0-1	0
2-3	7%	2-3	2%
4-5	20%	4-5	7%
6-7	22%	6-7	18%
8-9	33%	8-9	26%
10-11	50%	10-11	46%
>11	95%	>11	86%

<sup>†</sup>SOFA scores obtained on admission and every 48 hrs until discharge in 352 patients admitted to a medicosurgical ICU. Data from Ferreira et al. JAMA 2001;

### The Richmond Agitation Sedation Scale (RASS)

Score	Term	Description
+4	Combative	Overly combative or violent; immediate danger to staff.
+3	Very agitated	Pulls on or removes tube(s)/catheter(s), or aggressive behavior.
+2	Agitated	Frequent non-purposeful movement or patient-ventilator asynchrony.
+1	Restless	Anxious or apprehensive but movements not aggressive or vigorous.
0	Alert & calm	
-1	Drowsy	Not fully alert, but awakens for >10 sec, with eye contact, to voice.
-2	Light sedation	Briefly awakens (<10 sec), with eye contact, to voice.
-3	Moderate sedation	Any movement (but no eye contact) to voice.
-4	Deep sedation	No response to voice, but movement to physical stimulation.
-5	Unarousable	No response to voice or physical stimulation.

To determine the RASS, proceed as follows:

- Step 1. **Observation:** Observe the patient without interaction. If patient is alert, assign the appropriate score (0 to +4). If patient is not alert, go to Step 2.
- Step 2. **Verbal Stimulation:** Address patient by name in a loud voice and ask the patient to look at you. Can repeat once if necessary. If patient responds to voice, assign the appropriate score (-1 to -3). If there is no response, go to Step 3.
- Step 3. **Physical Stimulation:** Shake the patient's shoulder. If there is no response, rub the sternum vigorously. Assign the appropriate score (-4 to -5).

From Sessler CN, Gosnell MS, Grap MJ, et al. The Richmond Agitation-Sedation Scale: validity and reliability in adult intensive care unit patients. *Am J Respir Crit Care Med* 2002; 166:1338-1344.

**THE CONFUSION ASSESSMENT METHOD FOR THE ICU** The Confusion Assessment Method for the ICU (CAM-ICU) was developed by Dr. Wes Ely at Vanderbilt University (and is reproduced here with his kind permission). The CAM-ICU is a validated scale that can be used to evaluate and serially monitor delirium (both hyperactive and hypoactive forms) in critically ill patients, including nonverbal patients and patients with coexisting dementia. Performing the test requires under 2 minutes.

**The Confusion Assessment Method for the Intensive Care Unit  
(CAM-ICU)**

<b>Feature 1: Acute Onset or Fluctuating Course</b>	<b>Positive</b>	<b>Negative</b>
Positive if you answer "yes" to either 1A or 1B.		

1A: Is the pt different than his/her baseline mental status?	<b>Yes</b>	<b>No</b>
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Or

1B: Has the patient had any fluctuation in mental status in the past 24 hours as evidenced by fluctuation on a sedation scale (e.g., RASS), GCS, or previous delirium assessment?

<b>Feature 2: Inattention</b>	<b>Positive</b>	<b>Negative</b>
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Positive if either score for 2A or 2B is less than 8. Attempt the ASE letters first. If pt is able to perform this test and the score is clear, record this score and move to Feature 3. If pt is unable to perform this test or the score is unclear, then perform the ASE Pictures. If you perform both tests, use the ASE Pictures' results to score the Feature.

2A: ASE Letters: record score (enter NT for not tested)	<b>Score (out of 10):</b> ____
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Directions: Say to the patient, "I am going to read you a series of 10 letters. Whenever you hear the letter 'A,' indicate by squeezing my hand." Read letters from the following letter list in a normal tone.

**S A V E A H A A R T**

Scoring: Errors are counted when patient fails to squeeze on the letter "A" and when the patient squeezes on any letter other than "A."

2B: ASE Pictures: record score (enter NT for not tested)	<b>Score (out of 10):</b> ____
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Directions are included on the picture packets.

**The Confusion Assessment Method for the Intensive Care Unit  
(CAM-ICU)**

<b>Feature 3: Disorganized Thinking</b>	<b>Positive</b>	<b>Negative</b>
Positive if the combined score is less than 4		

<b>3A: Yes/No Questions</b>	<b>Combined Score</b>
(Use either Set A or Set B, alternate on consecutive days if necessary):	<b>(3A+3B): ____ (out of 5)</b>

- | <b>Set A</b>                                  | <b>Set B</b>                                |
|---|---|
| 1. Will a stone float on water?               | 1. Will a leaf float on water?              |
| 2. Are there fish in the sea?                 | 2. Are there elephants in the sea?          |
| 3. Does one pound weigh more than two pounds? | 3. Do two pounds weigh more than one pound? |
| 4. Can you use a hammer to pound a nail?      | 4. Can you use a hammer to cut wood?        |

**Score** \_\_\_\_ (Patient earns 1 point for each correct answer out of 4)

**3B: Command**

Say to patient: *"Hold up this many fingers"* (Examiner holds two fingers in front of patient) *"Now do the same thing with the other hand"* (Not repeating the number of fingers).

\*If pt is unable to move both arms, for the second part of the command ask patient *"Add one more finger."*

**Score** \_\_\_\_ (Patient earns 1 point if able to successfully complete the entire command)

<b>Feature 4: Altered Level of Consciousness</b>	<b>Positive</b>	<b>Negative</b>
Positive if the RASS score is anything other than "0" (zero)		

<b>Overall CAM-ICU</b> (Features 1 and 2 and either Feature 3 or 4)	<b>Positive</b>	<b>Negative</b>
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Copyright © 2002, E. Wesley Ely, MD, MPH and Vanderbilt University, all rights reserved. From Ely EW, Margolin R, Francis J, et al. Evaluation of delirium in critically ill patients: validation of the Confusion Assessment Method for the Intensive Care Unit (CAM-ICU). Crit Care Med 2001; 29:1370–1379. Further details available @ [www.icudelirium.org/delirium](http://www.icudelirium.org/delirium).