

Cardiac Output Formulas Cheat Sheet

Essential Formulas for Cardiovascular Assessment

1. The Fundamental Cardiac Output Formula

Formula: $CO = HR \times SV$

Variables:

CO: Cardiac Output (L/min or mL/min)

HR: Heart Rate (beats/min)

SV: Stroke Volume (L/beat or mL/beat)

Application: Basic conceptual understanding. Used when HR and SV are known.

2. The Fick Principle Formula

Formula: $CO = VO_2 / (CaO_2 - CvO_2)$

Variables:

CO: Cardiac Output (L/min)

VO₂: Oxygen consumption (mL O₂/min)

CaO₂: Arterial oxygen content (mL O₂/dL or mL O₂/L blood)

CvO₂: Mixed venous oxygen content (mL O₂/dL or mL O₂/L blood)

Unit Note: If CaO₂ and CvO₂ are in mL/dL, multiply the denominator difference by 10 to convert to mL/L.

Application: Gold standard in cardiac catheterization and research. Requires invasive sampling.

3. Doppler Echocardiography Formula (LVOT Method)

Step 1: $SV = CSA_{LVOT} \times VTI_{LVOT}$

$CSA_{LVOT} = \pi \times (D_{LVOT} / 2)^2$ OR $CSA_{LVOT} = 0.785 \times D_{LVOT}^2$

Step 2: $CO = SV \times HR$

Variables:

CSA_{LVOT}: Cross-sectional area of LVOT (cm²)

D_{LVOT}: Diameter of LVOT (cm)

VTI_{LVOT}: Velocity Time Integral across LVOT (cm)

SV: Stroke Volume (mL)

HR: Heart Rate (bpm)

CO: Cardiac Output (mL/min, convert to L/min)

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Application: Widely used non-invasive clinical method. Relies on accurate ultrasound measurements.

4. Thermodilution Formula (Stewart-Hamilton Equation)

Formula: $CO = [V_i \times (T_b - T_i) \times K_1 \times K_2] / \text{IntegralDeltaTb}(t)dt$

Variables:

CO: Cardiac Output (L/min)

V_i : Volume of injectate (mL)

T_b : Blood temperature (degreesC)

T_i : Injectate temperature (degreesC)

K_1 : Density factor (specific gravity x specific heat)

K_2 : Computation constant (includes catheter and unit adjustments)

$\text{IntegralDeltaTb}(t)dt$: Area under the temp change curve (degreesCxsec)

Application: Common invasive method in ICUs using pulmonary artery catheters. Considered a clinical gold standard.



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